These Ordinances, Regulations, Rules and Senate instructions come into force on 1st July, 1967.
## CONTENTS

### PART—I

**ORDINANCES**

<table>
<thead>
<tr>
<th>Ordinance</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Courses of Studies</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>Admission</td>
<td>1—2</td>
</tr>
<tr>
<td>III</td>
<td>Requirements for Examination and Graduation</td>
<td>2—3</td>
</tr>
<tr>
<td>IV</td>
<td>Fellowships, Exhibitions, Scholarships, Medals and Prizes</td>
<td>3</td>
</tr>
<tr>
<td>V</td>
<td>Boards of Examiners and the Examination Committee</td>
<td>3</td>
</tr>
<tr>
<td>VI</td>
<td>Standard of Examination</td>
<td>3</td>
</tr>
<tr>
<td>VII</td>
<td>Conduct and Discipline</td>
<td>3—4</td>
</tr>
<tr>
<td>VIII</td>
<td>Payment of Fees and other dues</td>
<td>4—5</td>
</tr>
<tr>
<td>IX</td>
<td>Medium of Instruction</td>
<td>5</td>
</tr>
<tr>
<td>X</td>
<td>Residence</td>
<td>5</td>
</tr>
<tr>
<td>XI</td>
<td>Committees</td>
<td>5—6</td>
</tr>
</tbody>
</table>

### PART—II

**REGULATIONS, CURRICULA AND SUBJECTS OF INSTRUCTION FOR B. Tech. AND B. Arch. DEGREE COURSES**

#### SCHEDULE I

**Regulation No. 1**

Admission to the First Year Class of the Five-Year Five-and-a-half Year and Six-Year courses (B. Tech. and B. Arch. Degree) 9—10

**Regulation No. 2**

Admission to the First Year Class of the Special Three-Year courses for the B. Tech. Degree 10
Regulation No. 3
Entrance Examination for admission to the First Year Classes of the five-year, five-and-a-half year and six-year (B. Tech. and B. Arch.) courses...

Regulation No. 4
Entrance Test for admission to the First Year Class of the Special Three-Year courses for the B. Tech. degree...

Regulation No. 5
Undergraduate courses of study and duration of the degrees of Bachelor of Technology (Five-Year course)...

Regulation No. 6
Degree of Bachelor of Technology (B. Tech.) in Naval Architecture (Five-and-a-half year course)...

Regulation No. 7
Degree of Bachelor of Technology in Naval Architecture (Naval Construction) (Six-Year course)...

Regulation No. 8
Degree of Bachelor of Technology (Three-Year course)...

Regulation No. 9
Degree of Bachelor of Architecture (B. Arch.) (Five-and-a-half Year course)...

Regulation No. 10
Graduation Requirement—Bachelor's Degrees (B. Tech. and B. Arch.)

(A) General Regulations...

(B) The degree of Bachelor of Technology:—
(a) Five-year and Five-and-a-half year courses...
(b) Six-year course...
(c) Special Three-Year B. Tech. degree course...

(C) The degree of Bachelor of Architecture (Five-and-a-half year course)...

Regulation No. 11
Syllabi for the subjects of the Joint Entrance Examination...

Regulation No. 12
Schedule of courses and Distribution of marks for 5-year, 5½-year and 6-year Bachelor of Technology and 5½-year Bachelor of Architecture courses...

Distribution of Marks
CONTENTS—contd.

PART—II—contd.

Regulation No. 13

SCHEDULE VII

Subjects of Instruction for 5, 5½-year and 6-year B. Tech. and B. Arch. degree courses...

75—135

Regulation No. 14

SCHEDULE VIII

Schedule of courses and distribution of marks for Special Three-Year courses for the B. Tech. degree...

136—154

Regulation No. 15

SCHEDULE IX

Subjects of Instruction for Special 3-Year courses for the B. Tech. degree...

155—176

Regulation No. 16

SCHEDULE X

Optional Subjects...

176—182

PART—III

REGULATIONS, COURSE SCHEDULES AND SUBJECTS OF INSTRUCTION FOR 3-YEAR B.Sc. (Hons.) DEGREE COURSES AND 2-YEAR M.Sc. DEGREE COURSES IN CHEMISTRY, MATHEMATICS AND PHYSICS, AND 5-YEAR INTEGRATED B.Sc./M.Sc. DEGREE COURSES IN APPLIED GEOLOGY AND EXPLORATION GEOPHYSICS

Regulation No. 17

SCHEDULE XI

Admission to the First Year class of the Three-Year B.Sc. (Hons.) Degree courses...

185—186

Regulation No. 18

SCHEDULE XII

Method of admission to the First Year Class of the Three-Year B.Sc. (Hons.) degree courses...

186

Regulation No. 19

SCHEDULE XIII

Three-Year B.Sc. (Hons.) degree course and its duration...

187

Regulation No. 20

SCHEDULE XIV

Graduation requirements for three-year B.Sc. (Hons.) degree courses...

188—189

Regulation No. 21

SCHEDULE XV

Course Schedule and Distribution of Marks for three-year B.Sc. (Hons.) degree courses...

190—194

Regulation No. 22

SCHEDULE XVI

Subjects of Instruction for three-year B.Sc. (Hons.) degree courses...

195—212
CONTENTS—contd.

PART—III—contd.

Regulation No. 23
SCHEDULE XVII
Admission to the First Year class of 2-Year M.Sc. degree courses 212—213

Regulation No. 24
SCHEDULE XVIII
Entrance Test for admission to the First Year Class of 2-Year M.Sc. Degree courses 213

Regulation No. 25
SCHEDULE XIX
Course and Duration—2-Year M.Sc. degree courses 213

Regulation No. 26
SCHEDULE XX
Graduation Requirements 214—215

Regulation No. 27
SCHEDULE XXI
Course Schedule and Distribution of Marks for 2-Year M.Sc. degree courses 216—224

Regulation No. 28
SCHEDULE XXII
Subjects of Instruction for 2-Year M.Sc. degree courses 225—241

Regulation No. 29
SCHEDULE XXIII
Admission to the first year class of the 5-year integrated B.Sc./M.Sc. degree courses 241—242

Regulation No. 30
SCHEDULE XXIV
Method of admission to the first year class of 5-year integrated B.Sc./M.Sc. degree courses and also to the Fourth Year class 242—243

Regulation No. 31
SCHEDULE XXV
Duration of 5-year integrated B.Sc./M.Sc. degree courses 243

Regulation No. 32
SCHEDULE XXVI
Graduation Requirement for 5-year integrated B.Sc./M.Sc. degree courses 243—247

Regulation No. 33
SCHEDULE XXVII
Course Schedule and distribution of marks for 5-year integrated M.Sc. degree courses 248—260

Regulation No. 34
SCHEDULE XXVIII
Subjects of Instruction for 5-year B.Sc./M.Sc. degree courses 261—273
REGULATIONS, SCHEDULE OF COURSES AND SUBJECTS OF INSTRUCTION
FOR 2-YEAR M.Tech., M.C.P., M.R.P., DEGREE COURSES AND
1-YEAR D.I.I.T. COURSES

Regulation No. 35

Admission to the Postgraduate courses

Page 277—278

Regulation No. 36

Entrance Test for admission to the Postgraduate courses

Page 279

Regulation No. 37

Courses and Duration

Page 280—281

(A) Degree of Master of Technology (M.Tech.)

(B) Postgraduate Diploma (D.I.I.T.)

(C) Degree of Master of City Planning (M.C.P.) and Degree of Master of Planning (M.R.P.)

Regulation No. 38

Graduation Requirements

Page 281—284

(A) General Regulations

(B) Degree of Master of Technology (M.Tech.)

(C) Postgraduate Diploma (D.I.I.T.)

(D) Degree of Master of City Planning (M.C.P.) and Degree of Regional Regional Planning (M.R.P.)

Regulation No. 39

Course Schedule and units for the Postgraduate courses

Page 285—318

Regulation No. 40

Subjects of Instruction for the Postgraduate courses

Page 319—381

REGULATIONS, RESEARCH FACILITIES, RESEARCH TRAINING, DEGREE OF
DOCTOR OF PHILOSOPHY (Ph.D.) AND DEGREE OF
DOCTOR OF SCIENCE (D.Sc.)

Regulation No. 41

Research Facilities and Training (Doctorate Degrees)

Page 385

Regulation No. 42

Admission to Research Training

Page 385—386
### CONTENTS—contd.

**PART—V—contd.**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Graduation Requirement (Degree of Doctor of Philosophy)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td></td>
<td>386-388</td>
</tr>
</tbody>
</table>

**SCHEDULE XXXVII**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Graduation Requirement (Degree of Doctor of Science)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td></td>
<td>389</td>
</tr>
</tbody>
</table>

**PART—VI**

**GENERAL REGULATIONS**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Intake, Eligibility, Reservation of Seats</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td></td>
<td>393</td>
</tr>
</tbody>
</table>

**SCHEDULE XXXIX**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>National Cadet Corps, Physical Education and Social Service</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td></td>
<td>394</td>
</tr>
</tbody>
</table>

**SCHEDULE XL**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Examination Results, Grade Card and Cross List</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td></td>
<td>394</td>
</tr>
</tbody>
</table>

**SCHEDULE XLI**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Scholarships, Fellowships, Free Studentships and Practical Training Stipends</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td></td>
<td>394-397</td>
</tr>
</tbody>
</table>

**SCHEDULE XLII**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Medals and Prizes</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td></td>
<td>397-398</td>
</tr>
</tbody>
</table>

**SCHEDULE XLIII**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Senate Committees</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
<td>398-400</td>
</tr>
</tbody>
</table>

**SCHEDULE XLIV**

<table>
<thead>
<tr>
<th>Regulation No.</th>
<th>Educational Tours</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td></td>
<td>401</td>
</tr>
</tbody>
</table>

**RULES**

<table>
<thead>
<tr>
<th>Rule No.</th>
<th>Advertisement</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>405</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rule No.</th>
<th>Admission</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>405</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rule No.</th>
<th>Application Fees</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td>405</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rule No.</th>
<th>Travelling Allowance for appearing at interview</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td>405</td>
</tr>
</tbody>
</table>
## CONTENTS—contd.

**RULES—contd.**

<table>
<thead>
<tr>
<th>Rule No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Exemption from payment of Seat rent in the Hall of Residence including charges for Water and Electric Supply</td>
<td>405-406</td>
</tr>
<tr>
<td>6</td>
<td>Withdrawal from the Institute</td>
<td>406</td>
</tr>
<tr>
<td>7</td>
<td>Issue of Migration Certificate</td>
<td>406</td>
</tr>
<tr>
<td>8</td>
<td>Issue of Grade Card</td>
<td>406</td>
</tr>
<tr>
<td>9</td>
<td>Issue of Diploma</td>
<td>406</td>
</tr>
<tr>
<td>10</td>
<td>Issue of Cross List</td>
<td>406</td>
</tr>
<tr>
<td>11</td>
<td>Re-checking of Answer-scripts</td>
<td>406</td>
</tr>
<tr>
<td>12</td>
<td>Disposal of old answer-scripts, rejected applications and sundry papers</td>
<td>407</td>
</tr>
<tr>
<td>13</td>
<td>Fees payable to Additional Examiners</td>
<td>407</td>
</tr>
<tr>
<td>14</td>
<td>Library Rules</td>
<td>407-408</td>
</tr>
<tr>
<td>15</td>
<td>Rules for the Regulation of the Halls of Residence</td>
<td>408-411</td>
</tr>
</tbody>
</table>

## PArt III

**SENATE INSTRUCTIONS**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Additional Examiners</td>
<td>415</td>
</tr>
<tr>
<td>2.</td>
<td>Membership of the Doctoral Scrutiny Committee (Ph.D. degree)</td>
<td>415</td>
</tr>
<tr>
<td>3.</td>
<td>Maximum period for submission of thesis</td>
<td>415</td>
</tr>
<tr>
<td>4.</td>
<td>Requirement for submission of thesis</td>
<td>415-416</td>
</tr>
<tr>
<td>5.</td>
<td>Submission of thesis</td>
<td>416</td>
</tr>
<tr>
<td>6.</td>
<td>Period for submission of report on adjudication of thesis</td>
<td>416</td>
</tr>
<tr>
<td>7.</td>
<td>Notice for Viva-Voce Examination</td>
<td>416</td>
</tr>
<tr>
<td>8.</td>
<td>Academic session</td>
<td>416</td>
</tr>
<tr>
<td>9.</td>
<td>Length &amp; Duration of Term</td>
<td>416</td>
</tr>
<tr>
<td>10.</td>
<td>Last date for joining the course</td>
<td>416</td>
</tr>
<tr>
<td>11.</td>
<td>Institute Examinations</td>
<td>416-417</td>
</tr>
<tr>
<td>12.</td>
<td>Instructions for the guidance of the Officer-in-Charge of Examinations</td>
<td>418-419</td>
</tr>
<tr>
<td>13.</td>
<td>Instructions for the guidance of the Invigilators</td>
<td>419</td>
</tr>
<tr>
<td>14.</td>
<td>Instructions for the guidance of the students appearing at the Examination</td>
<td>419-420</td>
</tr>
<tr>
<td>15.</td>
<td>Procedure for Admission</td>
<td>420-422</td>
</tr>
</tbody>
</table>
In this volume the word “he” shall mean a student, either male or female

PART I

ORDINANCES
ORDINANCE I

COURSES OF STUDIES

1. The Institute shall provide:

(a) Courses leading to the Bachelor's Degree in different branches of Engineering, Technology, Science, and in Architecture, and in such other branches of study as may be instituted by the Board either on its own initiative or on the recommendation of the Senate; (Schedule I, XI, XXIII).

(b) Courses leading to the Master's Degree in different branches of Engineering, Technology and Science, and in Architecture and Planning, and in such other branches of study as may be instituted by the Board either on its own initiative or on the recommendation of the Senate; (Schedule XVII, XXIII, XXIX).

(c) Courses leading to the Postgraduate Diploma in different branches of Engineering, Technology, Science, and in Architecture and Planning, and in such other branches of study as may be instituted by the Board either on its own initiative or on the recommendation of the Senate; (Schedule XXIX).

(d) Facilities for, and courses and training in, Research in the various branches of study. (Schedule XXXV).

2. The Institute may, also, from time to time, provide short-term and part-time courses in subjects of scientific, technological and professional interest.

ORDINANCE II

ADMISSION

1. Admission to the Institute shall be open to students, irrespective of sex, race, creed, caste or class provided they satisfy the minimum educational and other requirements as prescribed in the regulations (Schedule I, XI, XVII, XXIII, XXIX and XXXVI).

2. Admission to the different stages of the degree and diploma courses shall be granted in order of merit to be judged on the results of such test or tests as may be prescribed by the Senate from time to time provided that the Board of Governors may, for sufficient reasons, on the recommendations of the Senate, grant relaxation in favour of applicants coming from the educationally backward sections of the people and foreign students or Indian students residing outside India.

3. The Senate shall appoint each year Admission Committee or Committees for the conduct of examination or test or tests for admission of students to the undergraduate and postgraduate courses.

4. Admission to the undergraduate and postgraduate courses shall ordinarily be made at the beginning of the academic session.
5. The Chairman of the Senate may admit a student for research training with or without scholarship at any time during the academic year on the recommendation of Admission Committee or Committees as may be set up by the Senate.

6. The Senate shall constitute from time to time one or more Doctoral Scrutiny Committee to consider applications from research workers, and staff of the Institute for registration for the Doctorate Degrees of the Institute.

7. The Chairman of the Senate may admit students for short-term and part-time courses as may be offered from time to time on the recommendation of Committee or Committees set up to organise such courses.

**ORDINANCE III**

**REQUIREMENTS FOR EXAMINATION AND GRADUATION**

1. For admission to the prescribed examinations of the Institute for the purpose of graduation, a student shall be regular in attendance and studies, and shall conform to the standard of conduct to the satisfaction of the teachers and the Senate.

2. *Bachelor's Degree.*—A student of the Institute who fulfils the requirements for graduation as laid down in the Regulations shall, on the recommendation of the Senate, be awarded the Degree of Bachelor of Science (B.Sc.), or Bachelor of Technology (B. Tech.), or Bachelor of Architecture (B. Arch.) as the case may be. (Schedule IV, XIV and XXVI).

3. *Master’s Degree.*—On satisfactory completion of a prescribed course of study and on passing the prescribed examinations which may include a thesis or dissertation, as laid down in the Regulations, a student or a member of staff of the Institute shall, on the recommendation of the Senate, be awarded the Degree of Master of Science (M.Sc.), or Master of Technology (M. Tech.), or Master of City Planning (MCP), or Master of Regional Planning (MRP) as the case may be. (Schedule—XX, XXVI, XXXII).

4. *Postgraduate Diploma.*—On satisfactory completion of a prescribed course of study and on passing the prescribed examinations which may include a dissertation, as laid down in the Regulations, a student or a member of the staff of the Institute shall, on the recommendation of the Senate, be awarded the postgraduate Diploma (D.I.I.T.) of the Institute (Schedule XXII).

5. *Doctorate Degree.*—A registered Research student or a member of staff of the Institute, on the results of his study and Research and on his satisfying the requirements as prescribed in the respective Regulations, shall, on the recommendation of the Senate, be awarded the Degree of Doctor of Philosophy (Ph.D) or the Degree of Doctor of Science (D.Sc.). (Schedule XXXVII, XXXVIII).

6. The Degrees and Diplomas to be awarded by the Institute shall be signed by the Chairman of the Board of Governors, the Director and the Registrar.

7. The Senate shall have the right to withhold recommendation to the Board for any of these awards, or to withdraw it with the approval of the Board.
at any time on the ground that the student has been found to have contravened
the provisions under Ordinance VII. (Conduct and Discipline).

8. A suitable certificate may be issued to a person who satisfactorily
completes a short-term or a part-time course.

ORDINANCE IV
FELLOWSHIPS, EXHIBITIONS, SCHOLARSHIPS, MEDALS
AND PRIZES

1. Fellowships, Exhibitions, Scholarships, Medals and Prizes shall be
awarded by the Senate to the students on the recommendation of a Committee
or Committees as may be constituted by the Senate for the purpose.

2. The Senate shall have the right to withhold or cancel any of these
awards at any time on grounds of irregular attendance, or unsatisfactory
progress or unbecoming conduct.

ORDINANCE V
BOARDS OF EXAMINERS AND THE EXAMINATION COMMITTEE

1. The Senate shall appoint each year Boards of Examiners for the different
examinations of the Institute with duties as may be laid down from time to time.

2. The Senate shall appoint each year an Examination Committee for the
contact of examinations of the Institute.

ORDINANCE VI
STANDARD OF EXAMINATION

The standard of examinations shall be as determined by the Senate from
time to time, and the standard so determined shall be accessible only to the
Senate and the Boards of Examiners appointed by it.

ORDINANCE VII
CONDUCT AND DISCIPLINE

1. Students shall conduct themselves within and outside the precincts of
the Institute in a manner befitting the students of an institution of national
importance. They shall show due respect to the teachers of the Institute,
the Wardens of the Halls of Residence, the officers of the National Cadet Corps,
courtesy and consideration to the employees of the Institute and of the Halls
of Residence; and good neighbourliness to fellow students. They shall also
pay due attention and courtesy to visitors.

2. Lack of courtesy and decorum; ungentlemanly conduct, both in and
outside the Institute and the Halls of Residence; willful damage or removal,
without permission, of Institute or Hall properties, or belongings of a fellow student; interfering with his studies or disturbing him; adoption of unfair means in the examination; noisy and unseemly behaviour in the Halls of Residence, Library, Laboratories, Field, examination halls and elsewhere, all these shall constitute violation of the code of conduct and breach of Regulations and Rules of the Institute, and shall invite disciplinary measures and may merit punishment, such as, reprimand, fines, debarring from examination, and even dismissal from the Institute.

3. For committing any of the offences, mentioned in the preceding paragraph, either inside the Hall of Residence or outside, the Warden of the Hall of Residence shall have the power to reprimand or impose fine or take any other suitable measure. For committing such offences or misbehaving in the class taken by a teacher of a Department, the Head of that Department shall have the power to reprimand or fine a student or take any other suitable step. For breach of rules in an examination hall, an offender may be debarred from proceeding with the examination by the teacher in charge of the hall. All such cases of orders imposing punishment shall be reported to the Senate at its next meeting.

4. In all cases, other than reprimand and fines, Director shall pass orders, under report to the Senate, after considering the recommendations of the standing Discipline Committee or Committees appointed by the Senate for the purpose and giving the student or students a hearing.

5. A student who has been found guilty of any of these offences may not be recommended by the Senate to the Board of Governors for the award of Degree or Diploma or Certificate.

ORDINANCE VIII

PAYMENT OF FEES AND OTHER DUES

1. All students, Research Scholars and Fellows, and other trainees shall pay the Institute and Hall dues as prescribed in the Statutes on dates to be specified by the Registry.

2. The first instalment of fees which a student, a Research Scholar/Fellow shall be required to pay at the time of admission will cover:

   (i) Admission Fee (for Undergraduate and Postgraduate students only).
   (ii) Registration fee.
   (iii) First instalment of Tuition fee—(except for Post-Doctoral Research fellows).
   (iv) First instalment of seat rent including water and electricity charges in the Hall of Residence.
   (v) Fees for Students' Gymkhana, Medical examination and medical aid.
   (vi) Institute Caution money.
   (vii) Hall Caution money.
   (viii) Mess advance.
   (ix) Any other fees.
In addition, students, Research Scholars/Fellows and trainees resident in a Hall of Residence shall be required to pay messing charges and other dues as may be specified by the Warden of the Hall every month and in accordance with the rules framed.

3. Fees mentioned in (i) to (v) of paragraph 2 above shall not be refunded. All caution money is refundable in accordance with the provisions of the Statutes. Mess advance shall be refunded only after adjustment of mess dues.

4. A student or a Research scholar or a Fellow or a trainee who does not pay the requisite fees including the Hall dues within the specified dates shall not be permitted to stay in the Hall of Residence and shall be debarred from sitting at examinations. His name shall be struck off the rolls in accordance with the provisions of the Statute 24(2).

ORDINANCE IX

MEDIUM OF INSTRUCTION

The medium of instruction shall, at all levels, be English.

ORDINANCE X

RESIDENCE

1. The Institute is residential and all students shall be required to reside in the Halls of Residence.

2. Under special circumstances, the Director may permit a student to reside with his father or guardian on the Institute campus or within a reasonable distance from the Institute. Such a student shall, however, be attached to a Hall of Residence and pay seat rent, and Hall establishment charges as may be fixed by the Warden. He shall, however, be required to come into residence in the event of unsatisfactory progress.

3. No married accommodation shall be provided to any student.

ORDINANCE XI

COMMITTEES

1. The Senate shall constitute each year the following Committees at appropriate time as mentioned in Schedule XLIII.

(1) Advisory Committees:
    The Senate shall constitute an Advisory Committee for each of the teaching Departments comprising leading educationists and experts from Research and Industrial organisations.

(2) Admission Committee (Undergraduate courses).

(3) Admission Committees (Postgraduate courses).
(4) Admission Committees (Research).
(5) Post-Doctoral Fellowship Committee.
(6) Scholarships Committees.
(7) Examination Committee.
(8) Board of Examiners (Bachelor’s Degree course examination).
(9) Examination Results Review Committee.
(10) Board of Examiners (Postgraduate Degree and Diploma examinations).
(11) Doctoral Scrutiny Committees.
(12) Training and Placement Committee.
(13) Medals and Prizes Committee.
(14) Convocation Committee.
(15) Conduct and Discipline Committee.
(16) Social and Welfare Committee.
(17) Library Committee.
(18) Workshops Committee.
(19) Central Instruments Services Section Committee.
(20) Journal and Publications Committee.
(21) Ordinance Review Committee.

2. The Senate shall have the power to constituent any other Committee or committees as it may deem necessary.
PART II

REGULATIONS

CURRICULA AND SUBJECTS OF INSTRUCTION FOR B. TECH. AND B. ARCH. DEGREE COURSES
SCHEDULE I
REGULATION NO. 1

Admission to the First Year Class of the Five-Year, Five-and-a-Half Year and Six-Year Courses (B. Tech. and B. Arch. Degrees)

(a) Minimum educational qualifications:

Admission to the First Year Class of the five-year, five-and-a-half year and six year courses leading to the Degrees of Bachelor of Technology (B. Tech.) and Bachelor of Architecture (B. Arch.) shall be made on the results of an Entrance Examination (Schedule II) which shall be open to any person who has passed or is expected to pass before 1st July of the year of admission in any one of the following examinations:

(i) Higher Secondary Examination of recognised Boards of Secondary Education or Universities either in the Science stream with Chemistry, Mathematics and Physics or in the Technical Stream;

(ii) Pre-University or Pre-Degree or University Entrance Examination of a recognised University or Board with Chemistry, Mathematics and Physics after passing the Matriculation or School Final or S.S.L.C. or High School or equivalent examination conducted by a recognised University or Board;

(iii) Indian School Certificate or Senior Cambridge Examination with Elementary Mathematics and Additional Mathematics, Physics and Chemistry as separate subjects;

(iv) First Year Examination of the Two-Year Inter-Science or F.Sc. course of a recognised University or Board or Institute affiliated to a recognised University or Board with Chemistry, Mathematics and Physics as separate subjects;

(v) Jamia Higher Secondary (Three-Year course after eighth standard) with Chemistry, Mathematics and Physics as separate subjects;

(vi) First Year Examination of the Two-Year course of the Joint Services Wing of the National Defence Academy with Chemistry, Mathematics and Physics as separate subjects;

(vii) Army Higher Secondary Certificate Examination with Chemistry, Mathematics and Physics and

(viii) General Certificate Examination ("O" level) with Chemistry, Mathematics and Physics as separate subjects.

(Candidates who have passed the Intermediate Science or any higher examination of a recognised University or Board with Chemistry, Mathematics and Physics are also eligible provided they fulfil other requirements, viz., age and standard of physical fitness).

(b) Age Limit:

To be eligible for admission to the First Year class a candidate must have, on the 1st of October of the year of admission, completed 16 years of age.

(c) Standard of Physical Fitness:

Candidates seeking admission to the First Year class should fulfil the prescribed standard of physical fitness as given below:

(i) Height ... 1.5 metre
(ii) Weight ... 41 Kilogram
(iii) Chest Measurement ... 69 Centimetre (with satisfactory limits of expansion and contraction)
(iv) Heart and Lungs ... There should be no abnormality
(v) Vision ... Better eye  Worse eye
   6/9       6/9 Corrected
   6/6       6/12 with glasses.

Eyes should be free from congenital or other diseases.

(vi) Hearing ... Normal.
(vii) Good general health and build.
(viii) Hernia, Hydrocele, Varicocele and Piles are temporary disqualifications to be rectified before joining.

Opinion of the Institute Medical Board set up by the Institute where the candidate is interviewed shall be final and there shall be no appeal.

REGULATION NO. 2

Admission to the First Year Class of the Special Three-Year Courses for the B. Tech. Degree

(a) Minimum Educational Qualifications:

Admission to the First Year class of the special Three-Year courses for the B. Tech. Degree shall be open to candidates who have passed or are expected to pass, before the 1st August of the year of admission, the Bachelor of Science (B.Sc.) Degree examination of a recognised University with (i) Honours in Chemistry or in Mathematics or in Physics and Physics and Mathematics, or Chemistry and Physics, or Chemistry and Mathematics as subsidiary subjects respectively; or (ii) Chemistry, Mathematics and Physics as major subjects in case no Honours course is offered by the University concerned.

A student of the Institute who has successfully completed the first two years of the 5 and 1/2-year B. Tech. Degree course is also eligible.

(b) Age Limit:

To be eligible for admission to the First Year class a candidate must have completed 18 years of age on the 1st October of the year of admission.

(c) Standard of Physical Fitness:

(i) Height ... 1.52 metre.
(ii) Weight ... 43 Kilogram.
(iii) Chest Measurement ... 71 Centimetre (with satisfactory limits of expansion and contraction).
(iv) Heart and Lungs ... There should be no abnormality.
(v) Vision ... Better Eye  Worse Eye
   6/9       6/9 Corrected
   6/6       6/12 with glasses.

Eyes should be free from congenital or other diseases.

(vi) Hearing ... Normal.
(vii) Good general health and build.
(viii) Hernia, Hydrocele, Varicocele and Piles are temporary disqualifications to be rectified before joining.

The decision of the Institute Medical Board in regard to the fitness of a candidate shall be final and there shall be no appeal.
SCHEDULE II

REGULATION NO. 3

Entrance Examination for Admission to the First Year classes of the five-year, five-and-a-half year and Six-Year courses (B. Tech. and B. Arch. Degrees)

1. Admission to the First Year class of the five-year, five-and-a-half year and Six-Year courses shall be made on the results of a written Entrance Test to be called Joint Entrance Examination for admission to all the five Indian Institutes of Technology. The Examination shall be organised and conducted by an Admission Committee to be constituted by the Senate each year.

2. The Entrance Examination shall be held at various centres on dates normally in the first week of May to be fixed by the Senate. Candidates may take the Entrance Examination at a centre nearest to their place of residence or at any other centre where the examination may be held.

3. The Standard of the Examination shall be, as may be determined by the Senate from time to time. The question papers shall be set in English and the candidates shall be required to answer in English.

4. Subjects of the Joint Entrance Examination shall be:

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<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
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<tbody>
<tr>
<td>English</td>
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<tr>
<td>Mathematics</td>
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<tr>
<td>Physics</td>
<td>Physics &amp; Chemistry</td>
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<tr>
<td>Chemistry</td>
<td>Drawing</td>
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Each paper shall be of three hours' duration and carry 100 marks. Papers on English and Mathematics shall be common for Group A and Group B. Paper on Physics & Chemistry for Group B candidates shall be in two halves each carrying 50 marks.

5. Syllabi for the subjects of Joint Entrance Examination shall be as may be determined by the Senate from time to time. (Present Syllabi are given in Schedule V).

6. The marks of the Entrance Examination shall be treated as confidential.

7. Candidates whose performance in the written examination is of the requisite standard in the opinion of the Admission Committee shall be required to appear at their own expense, before a Committee or Committees for interview and also for a medical examination on a date and at a place to be notified to such candidates in due course.

REGULATION NO. 4

Entrance Test for admission to the First Year Class of the Special Three-Year Courses for the B. Tech. Degree

1. A preliminary selection of candidates shall be made by an Admission Committee after scrutiny of applications including mark sheets and testimonials and only the candidates who prima facie satisfy the minimum requirements will be called for the entrance test, the scope of which shall be determined by the Admission Committee. The Entrance Test, written and/or oral, shall be held at the Institute on a date to be fixed by the Senate.

2. Admission to the First Year Class of the Special Three-Year Course for the B. Tech. Degree shall be made in order of merit on the results of the Entrance Test.
SCHEDULE III

REGULATION NO. 5

Undergraduate Courses of Study and Duration

Degree of Bachelor of Technology (B. Tech.) (Five-Year Course):

1. The Institute shall provide undergraduate courses leading to the Honours Degree of Bachelor of Technology (B. Tech.) in any or all the branches, mentioned below, as the Senate may decide from time to time taking into consideration the accommodation and staff position and other facilities available:

   (i) Aeronautical Engineering; (ii) Agricultural Engineering; (iii) Chemical Engineering; (iv) Civil Engineering; (v) Electrical Engineering; (vi) Electronics and Electrical Communication Engineering; (vii) Mechanical Engineering; (viii) Metallurgical Engineering; (ix) Mining Engineering.

2. The curricula for the Degree of Bachelor of Technology in the branches, mentioned above, shall extend over not less than five academic sessions, each consisting of three terms except that there shall be an additional fourth term of about four weeks' duration in the final session.

3. The course work as mentioned in the preceding paragraph shall also include industrial or professional training of about twelve weeks at appropriate stages as may be determined by the Senate from time to time, except that in the case of Mining Engineering, such training shall extend over a period of at least six months.

REGULATION NO. 6

Degree of Bachelor of Technology (B. Tech.) in Naval Architecture

(Five-and-a-half-year Course)

1. The Institute shall provide undergraduate course leading to the Honours degree of Bachelor of Technology (B.Tech.) in Naval Architecture provided that the Senate is satisfied that adequate accommodation, staff and other facilities are available.

2. The curriculum for the degree of Bachelor of Technology in Naval Architecture shall extend over not less than five academic sessions each consisting of three terms except that in the final session there shall be two terms, each of three months' duration, to be devoted to course work and another term of about nine months' duration to be devoted to practical training.

3. The course work mentioned in the preceding paragraph shall also include practical training extending over a period of about four months at appropriate stages, as provided in the curriculum or as may be decided by the Senate from time to time.

REGULATION NO. 7

Degree of Bachelor of Technology in Naval Architecture

(NAVAL CONSTRUCTION)

(Six-Year Course)

1. The Institute shall provide undergraduate course leading to the Honours Degree of Bachelor of Technology (B.Tech.) in Naval Architecture (Naval Construction) provided the Senate is satisfied that adequate accommodation, staff and other facilities are available.

2. The curriculum for the degree of Bachelor of Technology in Naval Architecture (Naval Construction) shall extend over not less than six academic sessions each consisting of three terms except that there shall be an additional fourth term of about four weeks' duration in the final session.

3. The course work, as mentioned in the preceding paragraph shall include practical training in shipyards extending over a period of about four months at appropriate stages as provided in the curriculum, or as may be decided by the Senate from time to time.
REGULATION NO. 8

Degree of Bachelor of Technology

(Three-Year Course)

1. The Institute shall provide Special Three-Year courses leading to the Honours Degree of Bachelor of Technology in any or all the branches, mentioned below, as the Senate may decide from time to time, taking into consideration the accommodation and staff position and other facilities available:

(i) Engineering Science (Civil, Electrical or Mechanical);
(ii) Chemical Engineering;
(iii) Electronics and Electrical Communication Engineering;
(iv) Metallurgical Engineering.

2. The curricula for the Degree of Bachelor of Technology in the branches, mentioned above, shall extend over not less than three academic sessions each consisting of three terms, except that there shall be an additional fourth term of about six weeks' duration in the first session and of four weeks' duration in the final session.

Students from the 5-year B.Tech. Course admitted to the First Year of this Course shall follow a special curriculum as prescribed by the Senate.

3. The course work as mentioned in the preceding paragraph shall, in addition, include industrial or professional training of about six weeks at appropriate stages as may be determined by the Senate from time to time.

REGULATION NO. 9

Degree of Bachelor of Architecture (B. Arch.)

(Five-and-a-Half-Year Course)

1. The Institute shall provide undergraduate course leading to the Honours Degree of Bachelor of Architecture (B. Arch.) provided that the Senate is satisfied that adequate accommodation, staff and other facilities are available.

2. The curriculum for the Degree of Bachelor of Architecture shall extend over not less than five academic sessions, each consisting of three terms except that there shall be an additional fourth term of about six months' duration in the final session and that the first term of the final session and the preceding summer vacation shall be devoted to practical training in an Architect's office.

3. The course work mentioned in the preceding paragraph, shall also include professional training extending over a period of about twelve weeks at appropriate stages as provided in the Curriculum or as may be decided by the Senate from time to time.
SCHEDULE IV
REGULATION NO. 10
Graduation Requirement
Bachelor’s Degrees (B.Tech. and B.Arch.)

A. General Regulation:

1. Every student for the Bachelor’s Degree must, before entering on the curriculum, have complied with the admission requirements.

2. A student shall not be permitted to proceed to the next higher class unless he has fulfilled to the satisfaction of the Senate all the requirements in respect of attendance and study and has passed the prescribed examinations.

3. A student shall not be permitted to take any of the examinations unless (i) he has been regular in attendance (a student shall be expected to be regular in attendance in all lectures, tutorials, laboratories, guided studies, drawing office, field work and workshop classes), and (ii) he has satisfied all class teachers that he has conducted himself well within and outside the class room and that he has been regular, diligent and methodical in his study and has independently and satisfactorily performed the home and sessional assignments and has regularly submitted these for teachers’ scrutiny.

4. A student may study in the fourth and fifth sessions an additional subject of his choice from amongst the approved optional subjects listed in Schedule X if he desires and receive in the examinations such credit over and above his total aggregate marks in the obligatory subjects, as may be prescribed by the Senate.

5. During the first two sessions, it shall be obligatory for all men students to participate in one of the Units of the National Cadet Corps; for the foreign students, the women students, and for those men students who may not be up to the standard of physical fitness required in the National Cadet Corps, it shall be obligatory to participate in Physical Training.

In the third, fourth and fifth sessions all students are expected to participate in Physical Training or Social Service Programme, as may be organised for them and may receive in the examinations such additional credit over and above their aggregate total marks in the obligatory subjects, as may be prescribed by the Senate.

6. Subjects of each examination shall be as given in Schedule VII. In each subject of examination there shall be written paper or papers and/or sessional assignments as prescribed in the Regulations. The sessional assignments may comprise tutorial, guided studies, laboratory and field work, workshop practice and drawing office work.

7. The marks allotted to each subject in the terminal as well as the end-session examinations shall be as prescribed in Schedule VI.

8. The Senate shall determine, in respect of each subject of study, the scope of the course and the relative proportion in each course of lectures and/or practical or laboratory work. The Senate shall also determine in respect of several examinations leading to the degree conditions for admission and the standard of examination.

9. Special Senate instructions specifying the standard of examination shall be kept with the Registry to be made available only to the Senate and the Board of Examiners.

10. A student who does not comply with all the provisions of the Ordinances and Regulations for an Honours degree but has, in the opinion of the Senate, shown sufficient merit in his studies and examination may, on the special recommendation of the Senate, be admitted by the Board of Governors to the ordinary Degree and the Diploma be suitably inscribed to that effect.

11. A student who, after admission to the first or the second year class, does not qualify in the First or the Second Examination respectively within one academic session of attendance at the Institute shall be required to leave the Institute unless specifically permitted by the Senate to repeat the course on grounds to be recorded by the Senate.
12. A student who fails in any of the subsequent examinations may be allowed to repeat the course, subject to the following conditions:

An entrant into the First Year Class shall be required to qualify in the First, Second and the Intermediate Examinations within a maximum period of four years of study at the Institute and an entrant into the Second Year class shall be required to qualify in the Second and the Intermediate examinations within a maximum period of three years of study at the Institute unless specifically permitted by the Senate to exceed these on being allowed to repeat any part of the prescribed course and take the examinations on grounds to be recorded by the Senate.

Thereafter, every student shall be required to qualify in the Fourth and Final Examinations within a maximum period of three years of study at the Institute unless specifically permitted by the Senate to exceed this period on being allowed to repeat any part of the prescribed course and take the examinations on grounds to be recorded by the Senate.

The same principle, mutatis mutandis, shall apply to the Special Three-Year and Six-Year courses for B.Tech. Degree.

13. If a student fails in an examination and is permitted to repeat the course, his marks shall be as may be secured by him when he repeats the course.

14. If a student is allowed to appear at an examination without repeating the course, the marks allotted to him for the sessional assignments and the terminal examination shall be the marks as he had secured when he completed the course.

15. The Senate shall be competent, on the recommendation of the Board of Examiners, to deviate from the prescribed Ordinances & Regulations relating to the examination and consider the special cases of students not covered by the Ordinances and Regulations, subject to the approval of the Board of Governors.

B. The Degree of Bachelor of Technology

(a) Five-Year and Five-and-a-Half-Year Courses

1. Subject to the provisions of the Ordinances and Regulations the Degree of Bachelor of Technology shall be conferred on students who have followed the prescribed curricula for not less than five academic sessions studying subjects set forth in the Regulations (Schedule VII) and who have reached the Honours standard in the examinations in one of the following branches:

(i) Aeronautical Engineering;
(ii) Agricultural Engineering;
(iii) Chemical Engineering;
(iv) Civil Engineering;
(v) Electrical Engineering;
(vi) Electronics & Electrical Communication Engineering;
(vii) Mechanical Engineering;
(viii) Metallurgical Engineering;
(ix) Mining Engineering;
(x) Naval Architecture.

2. There shall be five complete examinations for the Degree of Bachelor of Technology (B.Tech.), viz., (i) the First Examination, (ii) the Second Examination, (iii) the Intermediate Examination, (iv) the Fourth Examination, and (v) the Final Examination.

3. For each examination a Board of Examiners shall be constituted by the Senate and the Board of Examiners shall comprise the teachers in the subjects of examination and the Additional Examiner or Examiners and other experts.

4. No student may present himself for examination in any subject until he has duly completed the prescribed courses of instruction to the satisfaction of the teachers concerned,
5. **The First Examination:**

(i) The First Examination shall be taken in three sections consisting of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the First Examination.

(ii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iii) A student shall be deemed to have passed the First Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, and in the aggregate.

6. **The Second Examination:**

(i) No student may present himself for examination in any subject of the Second Examination until he has passed the whole of the First Examination except those who have been granted admission direct to the Second Year class and exempted from the First Examination.

(ii) The Second Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Second Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Second Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, and in the aggregate.

7. **The Intermediate Examination:**

(i) No student may present himself for examination in any subject of the Intermediate Examination until he has passed the whole of the Second Examination except those who have been granted admission direct to the Third Year class and exempted from the First and Second Examinations.

(ii) The Intermediate Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Intermediate Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Intermediate Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

8. **The Fourth Examination:**

(i) No student may present himself for examination in any subject of the Fourth Examination until he has passed the whole of the Intermediate Examination except those who have been granted admission direct to the Fourth Year Class and exempted from the First, Second and Intermediate Examinations,
(ii) The Fourth Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Fourth Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Fourth Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

9. The Final Examination:

(i) No student may present himself for Examination in any subject of the Final Examination until he has passed the whole of the Fourth Examination.

(ii) The Final Examination shall be taken in five sections comprising the two Terminal Examinations, each covering the term's work and an End-sessional Examination, a Viva-voce Examination and an examination on a thesis on an approved subject which each student shall be required to carry out in the Fourth term of the Final session.

The Final Examination for the Naval Architecture course shall be taken in five sections comprising one Terminal Examination covering the term's work and an End-sessional Examination, a Viva-voce Examination and an examination on a thesis on an approved subject which each student shall be required to carry out in the final session and practical training during the extended third term.

(iii) No student may present himself for any subject of the End-sessional Examination, in the Viva-voce Examination, and in the Thesis Examination unless he has secured on the total of the two Terminal Examinations the requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

Except that a student of Naval Architecture course may not present himself for any subject of the End-sessional Examination, in the Viva-voce Examination and in the Thesis Examination unless he has secured in the Terminal Examination requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) The End-sessional Examination shall cover the entire course prescribed for the Final Examination.

(v) A student shall be deemed to have passed the Final B. Tech. Examination if he has secured on the total of the two Terminal and the End-sessional Examinations in requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, in the Viva-voce Examination, in the Thesis Examination and in the aggregate.

A student for the Degree of Bachelor of Technology in Naval Architecture shall be deemed to have passed the Final Examination, if he has secured on the total of the Terminal and End-sessional Examinations the requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments including practical training during the extended third term, in the Viva-voce Examination, in the Thesis Examination and in the aggregate.
10. **The Maximum Marks**:

(i) The maximum marks for the First, Second, Intermediate and the Fourth Examinations shall be the total of the maximum marks prescribed for the obligatory subjects of the respective End-sessional Examinations plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.

(ii) The maximum marks for the Final Examination shall be the total of the maximum marks prescribed for the obligatory subjects of the End-sessional Examination, for the Viva-voce Examination and for the Thesis Examination plus fifty percent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.

(iii) The maximum marks for the final Examination for the degree of Bachelor of Technology in Naval Architecture shall be the total of the maximum marks prescribed for the obligatory subjects of the End-sessional Examination, for the Viva-voce Examination, and for the Thesis Examination plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of the First Terminal Examination plus the maximum marks prescribed for practical training during the extended third term.

11. **The Weighted Maximum Marks**:

(i) The weighted maximum marks for the First, Second and the Fourth Examinations shall be the maximum marks for the First, Second and the Fourth Examinations respectively.

(ii) The weighted maximum marks for the Intermediate Examination shall be the maximum marks for the Intermediate Examination plus two-thirds of the weighted maximum marks of the Second Examination plus one-third of the weighted maximum marks of the First Examination.

(iii) The weighted maximum marks for the Final Examination shall be the maximum marks of the Final Examination plus two-thirds of the weighted maximum marks of the Fourth Examination plus one-third of the weighted maximum marks of the Intermediate Examination.

12. A student passing in all the five Examinations for the Degree of Bachelor of Technology (B. Tech.) shall be declared to have passed with Honours in the appropriate branch on the basis of his overall performance in all the five Examinations.

13. The students found eligible for the Honours Degree shall, in each branch, be classified in three groups to be denominated respectively First Class with Distinction, First Class and Second Class on the basis of the weighted total marks they secure out of the prescribed weighted maximum marks of the Final Examination. The names of the students in the First Class with Distinction shall be arranged in order of merit and of others in the alphabetical order.

14. The students satisfying all the conditions prescribed and having passed the prescribed Examinations shall be entitled to receive the Degree of Bachelor of Technology (B. Tech.) with Honours in the appropriate branch of study.

15. A student who has been admitted at a stage higher than the First Year class may be allowed to graduate with First class Honours with Distinction, First class Honours or Second class Honours on the results of the complete Examinations which he takes to the satisfaction of the Board of Examiners, on a criterion to be determined by the Senate. He will not, however, be ranked.

16. For the degree of Bachelor of Technology with Honours in any branch as set forth above the graduate shall receive a Diploma wherein shall be set forth the branch of study in which he has obtained Honours and the Class in which he has been placed.

(b) **Six-Year Bachelor of Technology Degree Course**:

1. Subject to the provisions of the Ordinances and Regulations the Degree of Bachelor of Technology shall be conferred on students who have followed the prescribed curricula for not less than six academic sessions studying subjects set forth in the regulations (Schedule VII)
and who have reached the Honours standard in the Examinations in Naval Architecture (Naval Construction).

2. There shall be six complete Examinations for the Degree of Bachelor of Technology (B. Tech.) in Naval Architecture (Naval Construction), namely, (i) the First Examination, (ii) the Second Examination, (iii) the Intermediate Examination, (iv) the Fourth Examination, (v) the Fifth Examination, and (vi) the Final Examination.

3. For each Examination a Board of Examiners shall be constituted by the Senate and the Board of Examiners shall comprise the teachers in the subjects of Examination and the additional examiner or examiners and other experts.

4. No student may present himself for an Examination in any subject until he has completed the prescribed course of instructions to the satisfaction of the teachers concerned.

5. The First Examination:

(i) The First Examination shall be taken in three sections consisting of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the First Examination.

(ii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iii) A student shall be deemed to have passed the First Examination provided he has secured on the total of the two terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, and in the aggregate.

6. The Second Examination:

(i) No student may present himself for examination in any subject of the Second Examination until he has passed the whole of the First Examination except those who have been granted admission direct to the Second Year Class and exempted from the First Examination.

(ii) The Second Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Second Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Second Examination provided he has secured on the total of the two terminal and End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

7. The Intermediate Examination:

(i) No student may present himself for examination in any subject of the Intermediate Examination until he has passed the whole of the Second Examination except those who have been granted admission direct to the Third Year class and exempted from the First and the Second Examinations.

(ii) The Intermediate Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Intermediate Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.
A student shall be deemed to have passed the Intermediate Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

8. The Fourth Examination:

(i) No student may present himself for Examination in any subject of the Fourth Examination until he has passed the whole of the Intermediate Examination except those who have been granted admission direct to the Fourth Year class and exempted from the First, Second and Intermediate Examinations.

(ii) The Fourth Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Fourth Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Fourth Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

9. The Fifth Examination:

(i) No student may present himself for examination in any subject of the Fifth Examination until he has passed the whole of the Fourth Examination except those who have been granted admission direct to the Fifth year class and exempted from the First, Second, Intermediate, and the Fourth Examinations.

(ii) The Fifth Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Fifth Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Fifth Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

10. The Final Examination:

(i) No student may present himself for examination in any subject of the Final Examination until he has passed the whole of the Fifth Examination.

(ii) The Final Examination shall be taken in five sections comprising the two Terminal Examinations each covering the term's work and an End-sessional Examination, a Viva-voce Examination and an Examination on thesis on an approved subject which each candidate shall be required to carry out in the Final session.

(iii) No student may present himself in any subject of the End-sessional Examination, in the Viva-voce Examination, and in the Thesis Examination unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) The End-sessional Examination shall cover the entire course prescribed for the Final Examination.

(v) A student shall be deemed to have passed the final B. Tech. Examination if he has secured on the total of the two Terminal and the End-sessional Examinations
requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, in the Viva-voce Examination, in the Thesis Examination, and in the aggregate.

11. The Maximum Marks:

(i) The maximum marks for the First, Second, Intermediate, Fourth and the Fifth Examinations shall be the total of the maximum marks prescribed for the obligatory subjects of the respective End-session Examination plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.

(ii) The maximum marks for the Final Examination shall be the total of the maximum marks prescribed for the obligatory subjects of the End-session Examination, for the Viva-voce Examination and for the Thesis Examination plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.

12. The Weighted Maximum Marks:

(i) The weighted maximum marks for the First, the Second, the Fourth, and the Fifth Examinations shall be the maximum marks for the First, the Second, the Fourth and the Fifth Examinations respectively.

(ii) The weighted maximum marks for the Intermediate Examination shall be the maximum marks for the Intermediate Examination plus two-thirds of the weighted maximum marks of the Second Examination plus one-third of the weighted maximum marks of the First Examination.

(iii) The weighted maximum marks for the Final Examination shall be the maximum marks of the Final Examination plus two-thirds of the weighted maximum marks of the Fifth Examination plus half of the weighted maximum marks of the Fourth Examination plus one-third of the weighted maximum marks of the Intermediate Examination.

13. A student passing in all the six Examinations for the degree of Bachelor of Technology (B. Tech.) shall be declared to have passed with Honours in Naval Architecture (Naval Construction) on the basis of his overall performance in all the six Examinations.

14. A student found eligible for the Honours degree shall be classified in three groups to be denominated respectively First Class with Distinction, First Class, and Second Class on the basis of the weighted total marks he secures out of the prescribed weighted maximum marks of the final Examination. The names of the students placed in the First Class with Distinction shall be arranged in order of merit and of others in the alphabetical order.

15. A student who has been admitted at a stage higher than the first year class may be allowed to graduate with First Class Honours with Distinction, or First Class Honours, or Second Class Honours on the results of the complete Examinations he takes to the satisfaction of the Board of Examiners on a criterion to be decided by the Senate. He will not, however, be ranked.

16. Students satisfying all the conditions prescribed and having passed the prescribed Examinations shall be entitled to receive the Degree of Bachelor of Technology (B. Tech.) with Honours in Naval Architecture (Naval Construction).

17. For the Degree of Bachelor of Technology with Honours in Naval Architecture (Naval Construction) a graduate shall receive a Diploma wherein shall be set forth the branch of study in which he has obtained Honours and the Class in which he has been placed.

(iii) Special Three-Year B. Tech. Degree course

1. Subject to the provisions of the Ordinances and Regulations the Degree of Bachelor of Technology shall be conferred on students who have followed the prescribed curricula for not less than three academic sessions studying subjects set forth in the regulations (Schedule IX), and who have reached the Honours standard in the Examinations in one of the following branches:

(i) Engineering Science (Civil, Electrical or Mechanical);

(ii) Chemical Engineering;
(iii) Electronics & Electrical Communication Engineering;
(iv) Metallurgical Engineering.

2. There shall be three complete Examinations for the Degree of Bachelor of Technology (B. Tech.) viz., (a) the Part I Examination, (b) the Part II Examination, and (c) the Final Examination.

3. For each Examination a Board of Examiners shall be constituted by the Senate and the Board of Examiners shall comprise the teachers in the subjects of Examination and the Additional Examiner or Examiners and other experts.

4. No student may present himself for Examination in any subject until he has duly completed the prescribed course of instruction to the satisfaction of the teachers concerned.

5. The Part I Examination:

(i) The Part I Examination shall be taken in four sections consisting of two Terminal Examinations each covering the term’s work and an End-sessional Examination covering the entire course of the first three terms and an Examination on the work of the fourth term.

(ii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iii) A student shall be deemed to have passed the Part I Examination provided he has secured on the total of the two terminal, the End-sessional, and the fourth term Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, and in the aggregate.

6. The Part II Examination:

(i) No student may present himself for examination in any subject of the Part II Examination until he has passed the whole of the Part I Examination except those who have been granted admission direct to the Second Year class and exempted from the Part I Examination.

(ii) The Part II Examination shall be taken in three sections consisting of two terminal Examinations each covering the term’s work and an End-sessional Examination covering the entire course of the Part II Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Part II Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

7. The Final Examination:

(i) No student may present himself in any subject of the Final Examination until he has passed the whole of the Part II Examination.

(ii) The Final Examination shall be taken in five sections comprising the two terminal Examinations each covering the term’s work and an End-sessional Examination, a Viva-voce Examination and an Examination on a thesis on an approved subject which each student shall be required to carry out in the Fourth term of the Final session.

(iii) No student may present himself in any subject of the End-sessional Examination, in the Viva-voce Examination and in the thesis Examination unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.
(iv) The End-sessional Examination shall cover the entire course prescribed for the Final Examination.

(v) A student shall be deemed to have passed the Final B. Tech. Examination if he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, in the Viva-voce Examination, in the Thesis Examination and in the aggregate.

8. The Maximum Marks:

(i) The maximum marks for the Part I Examination shall be the total of the maximum marks prescribed for the obligatory subjects of the End-sessional Examination plus two-thirds of the total of the maximum marks prescribed for the obligatory subjects for the first and the Second Terminal Examinations plus fifty per cent of the maximum marks prescribed for the obligatory subjects of the fourth term Examination.

(ii) The maximum marks for the Part II Examination shall be the total of the maximum marks prescribed for the obligatory subjects of the End-sessional Examination plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects for both the Terminal Examinations.

(iii) The maximum marks for the Final Examination shall be the total of the marks prescribed for the obligatory subjects of the End-sessional Examination, for the Viva-voce Examination and for the Thesis Examination plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.

9. The Weighted Maximum Marks:

(i) The weighted maximum marks for the Part I and the Part II Examinations shall be the maximum marks of the Part I and Part II Examinations respectively.

(ii) The weighted maximum marks for the Final Examination shall be the maximum marks of the Final Examination plus two-thirds of the weighted maximum marks of the Part II Examination plus half of the weighted maximum marks of the Part I Examination.

10. A student passing in all the three Examinations for the Degree of Bachelor of Technology (B. Tech.) shall be declared to have passed with Honours in the appropriate branch on the basis of his overall performance in all the three Examinations.

11. The students found eligible for the Honours Degree shall in each branch be classified in three groups to be denominated respectively: First Class with Distinction, First Class and Second Class on the basis of the weighted total marks they secure out of the prescribed weighted maximum marks of the Final Examination. The names of the students in the First Class with Distinction shall be arranged in order of merit, and of others in alphabetical order.

12. The students satisfying all the conditions prescribed and having passed the prescribed Examinations shall be entitled to receive the Degree of Bachelor of Technology (B. Tech.) with Honours in the appropriate branch of study.

13. A student who has been admitted at a stage higher than the First Year class may be allowed to graduate with First class Honours with Distinction, First class Honours or Second class Honours on the results of the complete Examinations which he takes to the satisfaction of the Board of Examiners, on a criterion to be determined by the Senate. He will not, however, be ranked.

14. For the degree of Bachelor of Technology (B. Tech.) with Honours in any branch, as set forth above, the graduate shall receive a Diploma wherein shall be set forth the branch of study in which he has obtained Honours and the Class in which he has been placed.

(C) The Degree of Bachelor of Architecture

(Five-and-a-Half-Year Course)

1. Subject to provisions of the Ordinances and Regulations the Degree of Bachelor of Architecture shall be conferred on students who have studied, on the prescribed curriculum for
not less than five academic sessions, subjects as set forth in the Regulations (Schedule VII) and who have reached the Honours standard in the Examinations in Architecture.

2. There shall be five complete Examinations for the Degree of Bachelor of Architecture (B. Arch.), viz. (i) the First Examination; (ii) the Second Examination; (iii) the Intermediate Examination; (iv) the Fourth Examination; and (v) the Final Examination.

3. For each Examination a Board of Examiners shall be constituted by the Senate and the Board of Examiners shall comprise the teachers in the subjects of Examination and the Additional Examiner or Examiners and other experts.

4. No student may present himself for Examination in any subject until he has duly completed the prescribed course of instruction to the satisfaction of the teachers concerned.

5. The First Examination:

(i) The First Examination shall consist of two Terminal Examinations each covering the term’s work and an End-sessional Examination covering the entire course of the First Examination.

(ii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iii) A student shall be deemed to have passed the First Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, and in the aggregate.

6. The Second Examination:

(i) No student may present himself for examination in any subject of the Second Examination until he has passed the whole of the First Examination except those who have been granted admission direct to the Second Year class and exempted from the First Examination.

(ii) The Second Examination shall consist of two Terminal Examinations each covering the term’s work and an End-sessional Examination covering the entire course of the Second Examination. There shall be review by the Board of Examiners of all the studio work done by the students up to the Second Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Second Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

7. The Intermediate Examination:

(i) No student may present himself for Examination in any subject of the Intermediate Examination until he has passed the whole of the Second Examination except those who have been granted admission direct to the Third Year class and exempted from the First and Second Examinations.

(ii) The Intermediate Examination, shall consist of two Terminal Examinations each covering the term’s work and an End-sessional Examination covering the entire course of the Intermediate Examination. There shall be a review by the Board of Examiners of all the studio work done by the students up to the Intermediate Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite
minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Intermediate Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, and in the aggregate.

8. The Fourth Examination:

(i) No student may present himself for examination in any subject of the Fourth Examination until he has passed the whole of the Intermediate Examination except those who have been granted admission direct to the Fourth Year class and exempted from the First, Second and Intermediate Examinations.

(ii) The Fourth Examination shall be taken in three sections comprising the two Terminal Examinations each covering the terms work and an End-sessional Examination covering the entire course of the Fourth Examination. There shall be a review by the Board of Examiners of all the studio work done by the students up to the Fourth Examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Fourth Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, and in the aggregate.

9. The Final Examination:

(i) No student may present himself for Examination in any subject of the Final Examination until he has passed the whole of the Fourth Examination.

(ii) The Final Examination shall be taken in six sections comprising the practical training in the first term of the final session and the preceding summer vacation, the Second Terminal Examination covering the second term's work, and an End-sessional Examination covering the work of the second and third terms, the Fourth Terminal Examination covering the fourth term work, a Viva-voce Examination, and an examination on a thesis on an approved subject which each student shall be required to carry out in the fourth term of the final session.

(iii) No student may present himself in any subject of the End-sessional Examination, in the Fourth Terminal Examination, in the Viva-voce Examination and in the thesis Examination unless he has secured in the second terminal Examination requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments including practical training of the first term and the preceding summer vacation.

(iv) The End-sessional Examination shall cover the course prescribed for the second and third terms of the final session.

(v) A student shall be deemed to have passed the final B. Arch. Examination provided he has secured on the total of the Second terminal and the End-sessional Examinations and the Fourth Terminal Examination the requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments including practical training in the first term and the preceding summer vacation, on the thesis, and in the viva-voce Examination and in the aggregate.

10. The Maximum Marks:

(i) The maximum marks for the First, Second, Intermediate and the Fourth Examinations shall be the total of the maximum marks prescribed for the obligatory subjects of the respective End-sessional Examinations plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.
(ii) The maximum marks for the Final Examination shall be the total of the maximum marks prescribed for the obligatory subjects of the End-sessional Examination, the Fourth Terminal Examination, for the Vis-a-vis test, for the thesis examination plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of the Second Terminal Examination plus the maximum marks prescribed for the practical training in the first term and the preceding Summer Vacation.

11. The Weighted Maximum Marks:

(i) The weighted maximum marks for the First, Second and the Fourth Examinations shall be the maximum marks for the First, Second and Fourth Examinations respectively.

(ii) The weighted maximum marks for the Intermediate Examination shall be the maximum marks of the Intermediate Examination plus two-thirds of the weighted maximum marks of the Second Examination plus one-third of the weighted maximum marks of the First Examination.

(iii) The weighted maximum marks for the Final Examination shall be the maximum marks of the Final Examination plus two-thirds of the weighted maximum marks of the Fourth Examination plus one-third of the weighted maximum marks of the Intermediate Examination.

12. A student passing in all the five examinations for the Degree of Bachelor of Architecture (B. Arch.) shall be declared to have passed with Honours on the basis of his overall performance in all the five examinations.

13. The students found eligible for the Honours Degree shall be classified in three groups to be denominated respectively First class with distinction, First Class, and Second Class on the basis of the weighted total marks they secure out of the prescribed weighted maximum marks for the Final Examination. The names of the students in the First Class with Distinction shall be arranged in order of merit and of others in alphabetical order.

14. The students satisfying all the conditions prescribed and having passed the prescribed examinations shall be entitled to receive the Degree of Bachelor of Architecture (B. Arch.) with Honours in Architecture.

15. A student who has been admitted at a stage higher than the First Year class may be allowed to graduate with First Class Honours with Distinction, First Class Honours or Second Class Honours on the results of the complete examinations which he takes to the satisfaction of the Board of Examiners, on a criterion to be determined by the Senate. He will not, however, be ranked.

16. For the Degree of Bachelor of Architecture with Honours the graduate shall receive the Diploma wherein shall be set forth the subject and the Class in which he has been placed.
SCHEDULE V

REGULATION NO. 11

Syllabi for the Joint Entrance Examination

The syllabi for the subjects of the Joint Entrance Examination for admission to the First Year of the five-year, five-and-a-half-year and six-year courses (B.Tech. and B.Arch. Degrees) shall be as may be decided by the Senate from time to time. The present syllabi are given below:

1. ENGLISH

(Common for Groups A and B)

- English Composition, e.g., Essay Writing (Description, Narration, Discussion)—Organisation and Presentation of Ideas—Clear Expression. Comprehension and Precis Writing.
- English Grammar and Structure—Syntax—Punctuation—Use of Idioms—Indirect Speech etc.
- Vocabulary—ability to recognise and use common and useful English words.

2. MATHEMATICS

(Common for Groups A and B)

- Algebra—Remainder theorem ; Laws of indices ; Surds ; Logarithms ; Imaginary numbers ; Solution of quadratic equation, theory of quadratic equation and expression ; Simple simultaneous equations ; Elimination ; Arithmetic, geometric and harmonic progressions ; Permutation and combination ; Statement, proof and applications of Binomial theorem with positive integral index.

- Plane Geometry—Simple properties of triangle and circle ; similar triangles ; Practical constructions.

- Trigonometry—Addition and subtraction formulae ; Multiple and sub-multiple angles ; General solution of simple trigonometric equation ; Relations between sides and angles of a triangle ; Solution of triangle ; Heights and distances ; Graphs of simple trigonometric functions.

- Coordinate Geometry—Rectangular cartesian coordinates in a plane ; Length of segment ; Area of a triangle ; Straight line.

- Mensuration—Parallelpiped ; Right circular cone ; Prism and pyramid ; Cylinder and sphere (expressions without proof for surface and volume of these solids).

3. CHEMISTRY

(For Group A only)

- Laws of Chemical combination : gas laws; Avogadro's hypothesis; Avogadro's number; elements of atomic structure and valency; ionic and covalent bonds; equivalent, atomic and molecular weights; electrolysis; oxidation, reduction and neutralisation; chemical analysis; chemical calculations.

Chemistry of the following elements: hydrogen, halogens (excepting fluorine), oxygen, sulphur, nitrogen, carbon, sodium, potassium, magnesium, calcium, aluminium, copper, silver, zinc, tin, lead and iron.
Chemistry of the following compounds: oxides, hydroxides, sulphides and halides of the above metals; oxides of hydrogen, carbon, nitrogen and sulphur; hydrogen halides, hydrogen sulphide, ammonia and ammonium salts; hypochlorous acid, chloric acid, perchloric acid, sulphurous acid, sulphuric acid, nitrous acid, nitric acid, carbonic acid and their salts; methane, ethylene, acetylene, chloroform, carbon tetrachloride, carbon di-sulphide and ethyl alcohol.

4. PHYSICS

(For Group A only)

Units and measuring instruments; Newton's Law of motion; simple kinematics; conditions of equilibrium; centre of gravity; balance, lever and pulley; conservation of energy and momentum; centripetal and centrifugal forces; simple harmonic motion; simple pendulum.

Statement of the general properties of solids, liquids and gases; pressure at a point; Pascal's law, hydraulic press, Archimedes' principles; specific gravity and density; barometer; siphon and pumps; Hooke's Law and elastic constants.

Heat and temperature; thermometry; thermal expansion of solids and liquids; gas laws; perfect gas scale of temperature; specific heat, calorimetry; change of state; vapour pressure; gas and vapour; relative humidity, hygrometry, dew point; mechanical equivalent of heat; heat transfer by conduction, convection and radiation.

Electric and Magnetic intensity; potential and lines of force; electrostatic and magnetostatic induction; electrophorus; gold leaf electroscope; capacity; magnetic moment; magneto-meter; elements of terrestrial magnetism. Primary and secondary cells; Ohm's law; measurement of resistance; combination of cells and resistance; heating, chemical and magnetic effects of current; galvanometer, ammeter, voltmeter; electromagnetic induction, induction coil, principles of telegraph and telephone.

Rectilinear propagation of light; eclipses; photometry, reflection and refraction at plane and curved surfaces; refractive index and its measurements; critical angle; total reflection, mirage; behaviour of thin lens; prism, minimum deviation; dispersion; pure spectrum; descriptive treatment of ultraviolet, visible, infrared radiations; simple optical instruments; velocity of light.

Nature of sound and its propagation in a medium; velocity of sound; intensity; pitch and quality of sound, reflection and refraction of sound; echo; beats; laws of transverse vibration of string; sonometer; vibration of air column in pipes.

5. CHEMISTRY AND PHYSICS

(For Group B only)

(a) Chemistry—Matter, its composition and properties; gas laws and laws of chemical combination; Avogadro's hypothesis; valency; equivalent, atomic and molecular weights; electrolysis; simple chemical calculations.

An elementary study of the following: hydrogen, oxygen, water, nitrogen, ammonia and ammonium salts, nitric acid, chloride, hydrogen chloride, sulphur, hydrogen sulphide, sulphuric acid, carbon and its oxides; sodium, calcium, magnesium, aluminium, copper, iron, and their oxides, hydroxides, chlorides, sulphides, sulphates, nitrates and carbonates.

(b) Physics—Units and measuring instruments; Newton's laws of motion; simple kinematics; conditions of equilibrium; centre of gravity; balance lever and pulley; conservation of energy and momentum; centripetal and centrifugal forces; simple harmonic motion; simple pendulum.
Statement of the general properties of solids, liquids and gases; pressure at a point; Pascal's law, hydraulic press. Archimedes' principle; specific gravity and density; barometer; siphon and pumps; Hooke's law and elastic constants.

Heat and temperature; thermometry; thermal expansion of solids and liquids; gas laws; perfect gas scale of temperatures; specific heat, calorimetry; change of state; vapour pressure; gas and vapour; relative humidity, hygrometry, dew point; mechanical equivalent of heat; heat transfer by conduction, convection and radiation.

Electric and Magnetic intensity; potential and lines of force; electrostatic and magnetostatic induction; electrophorus; gold leaf electroscope; capacity, magnetic moment; magnetometer; elements of terrestrial magnetism. Primary and secondary cells; Ohm's law; measurement of resistance; combination of cells and resistances; heating, chemical and magnetic effects of current; galvanometer, ammeter, voltmeter; electromagnetic induction, induction coil; principles of telegraph and telephone.

6. DRAWING

(For Group B only)

(a) Lettering (Block and Italics), Scales (Plain and Diagonal), regular Polygons, Curve drawing and their applications (circle, ellipse, parabola, involute and cycloid);

(b) Elementary problems on orthographic projection of simple objects and isometric views from orthographic projections.

(c) Imaginative free hand sketching of objects from day to day experience.

(d) General layout and neatness of drawing.

*Note*—The candidates will use their own drawing instruments and scales, set squares, pencils, etc., and answer in the Answer Book to be supplied.
SCHEDULE VI

REGULATION NO. 12

Schedule of courses and Distribution of Marks for 5-year, 5½-year and 6-year Bachelor of Technology and 5½-year Bachelor of Architecture Courses

1. The academic year of about 30 weeks is divided into three terms except that in the final year there is an additional fourth term as prescribed in the Regulations. In the Schedule of courses given in the following pages the number of hours per week for each subject is indicated. Number of hours per week denotes the hours in class, that is, lectures, seminars (represented by the first figure) and the hours in tutorials, laboratory, field, drawing and design (represented by the second figure). Each student is expected to devote about 20 hours per week to study and home preparation.

2. Marks, the number of papers and the duration of each paper for each subject of examination are also shown against each subject. The first figure under the column “Marks” indicates marks for written paper or papers and the second figure for sessionsal assignments including practical training, etc.

3. Each subject of instruction is given a reference number, the first year subjects being numbered from 111 to 199, the second year subjects from 211 to 299 and so on. List of optional subjects is given in Schedule X, the subjects being numbered separately.

The following is the key to the abbreviations used to indicate the departments which shall normally be responsible for organising the courses of study and examinations:

Aeronautical Engineering .... .... .... .... AE
Agricultural Engineering .... .... .... .... AgE
Applied Chemistry .... .... .... .... Ch
Architecture and Regional Planning .... .... .... Ar
Chemical Engineering .... .... .... .... ChE
Civil Engineering .... .... .... .... CE
Electrical Engineering .... .... .... .... EE
Electronics and Electrical Communication Engineering .... .... .... Comm
Geology and Geophysics .... .... .... .... Ge
Humanities and Social Sciences .... .... .... .... Hu
Mathematics .... .... .... .... Ma
Mechanical Engineering .... .... .... .... ME
Metallurgical Engineering .... .... .... .... Met
Mining Engineering .... .... .... .... Min
Naval Architecture and Marine Engineering .... .... .... NA
Physics and Meteorology .... .... .... .... Ph
### Course Schedule and Distribution of Marks

**A. Bachelor of Technology (B. Tech.)—5-year 5½-year and 6-year Integrated Courses**

#### I FIRST YEAR

[Common to all courses leading to the degree of Bachelor of Technology (B. Tech.)]

(For Science Stream candidates)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the First Examination</th>
<th>All Terms</th>
<th>No. of papers for examination</th>
<th>Duration of Examination papers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hours per week</td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>Hu 111</td>
<td>English</td>
<td>2 — 2</td>
<td>100 — 50</td>
<td>1</td>
</tr>
<tr>
<td>Hu 112, Hu 113</td>
<td>History, Principles of Government</td>
<td>2 — 0</td>
<td>100 — 0</td>
<td>1</td>
</tr>
<tr>
<td>Ch 111</td>
<td>Chemistry</td>
<td>3 — 3</td>
<td>150 — 100</td>
<td>1</td>
</tr>
<tr>
<td>CE 111</td>
<td>Drawing and Descriptive Geometry</td>
<td>1 — 4</td>
<td>50 — 150</td>
<td>1</td>
</tr>
<tr>
<td>Ma 111</td>
<td>Mathematics and Mechanics</td>
<td>4 — 2</td>
<td>200 — 30</td>
<td>2</td>
</tr>
<tr>
<td>ME 121</td>
<td>Workshop Practice</td>
<td>1 — 3</td>
<td>50 — 150</td>
<td>1</td>
</tr>
<tr>
<td>Ph 111</td>
<td>Physics</td>
<td>3 — 3</td>
<td>150 — 100</td>
<td>1</td>
</tr>
<tr>
<td>NCC or Physical Training</td>
<td></td>
<td>0 — 3</td>
<td>0 — 100</td>
<td>—</td>
</tr>
<tr>
<td>*Orientation Course</td>
<td></td>
<td>1 — 0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Hindi or Regional language (other than mother tongue)</td>
<td></td>
<td>1 — 0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 — 20</td>
<td>800 — 700</td>
<td>8</td>
</tr>
</tbody>
</table>

*Orientation course will be given by the respective departments.

**Note:** All papers for the End-Sessional examination for all the years shall be of 3 hours' duration.
(For Technical stream candidates)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the First Examination</th>
<th>All Terms</th>
<th>No. of papers for examination</th>
<th>Duration of examination papers</th>
</tr>
</thead>
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* Orientation course will be given by the respective departments.*
II—SECOND YEAR
Common to all courses leading to the Degree of Bachelor of Technology (B. Tech.)

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*Students of the Naval Architecture course will have the following subject instead of “Engineering Drawing” with changed number of hours and marks:

| NA 221     | Ship Drawing and Calculation       | 2—3       | 50—100                       | 1                             | 3 hrs.                        | 18—20 | 850—650 |

@50 marks shall be allotted in the First Term to the students of the Naval Architecture course for Practical Training during the preceding Summer Vacation.
### III—THIRD YEAR

#### 1. AERONAUTICAL ENGINEERING

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<td>Comm 311 EE</td>
<td>Principles of Electronics Electrical Technology</td>
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<td>ME 331</td>
<td>Heat Technology</td>
<td>2—1</td>
<td>100—50</td>
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<tr>
<td>ME 351</td>
<td>Machine Elements Design and Drawing</td>
<td>2—3</td>
<td>100—100</td>
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<tr>
<td>Met 311 Phy</td>
<td>Elements of Metallurgy Physics</td>
<td>3—0</td>
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<td>3 hrs.</td>
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<tr>
<td>AE 311 AE 351</td>
<td>Principles of Aeronautics Mechanics</td>
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#### Summary

- **Subject No.**
- **Subjects for the Intermediate Examination**
- **All Terms**
  - Hours per week
  - Marks
- **No. of papers for examination**
- **Duration of Examination papers**

#### Total

- Hours per week: 18—15
- Marks: 900—600
- Papers: 8
## 2. AGRICULTURAL ENGINEERING

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<td>Botany</td>
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| All | 20—16 | 1000—500 | 9 |


### 3. CHEMICAL ENGINEERING

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## 8. METALLURGICAL ENGINEERING

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### IV. FOURTH YEAR

#### 1. AERONAUTICAL ENGINEERING

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<td>Metal Processing</td>
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* 50 marks in the first term for practical training during the preceding Summer vacation.
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<td>Farm Machinery</td>
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<td>Theory and Design of Farm Structures</td>
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* 50 marks from each in the first term for six weeks' Practical training during the preceding Summer Vacation.
### 3. CHEMICAL ENGINEERING

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<td>Ch 420</td>
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<td>Chemical Process Technology (Tech—I)</td>
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<td>Flow of fluids and fluid handling (Unit Op. I)</td>
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<td>Heat Transfer (Unit Operation II)</td>
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* 50 marks in the first term for Factory Training during the preceding Summer Vacation and 75 marks in all terms for Drawing and Design.

** 25 marks for Educational Tour.
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* 50 marks in the first term for Professional Training during the preceding Summer Vacation,
* 50 marks for Educational Tour in the second term and
* 50 marks for Survey Camp in the third term.
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* 50 marks in the first term for Practical Training during the preceding Summer Vacation and 50 marks for Educational Tour.
** 100 marks in the third term for Laboratory Test.
## 6. ELECTRONICS AND ELECTRICAL COMMUNICATION ENGINEERING

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Fourth Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hours/per Week</td>
<td>Marks</td>
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</tr>
<tr>
<td>Hu 414</td>
<td>General and Industrial Psychology</td>
<td>2—0</td>
<td>100—0</td>
<td>1</td>
</tr>
<tr>
<td>Comm 412</td>
<td>H.F. Measurements and Electro Acoustics</td>
<td>2—0</td>
<td>100—0</td>
<td>1</td>
</tr>
<tr>
<td>Comm 413</td>
<td>Networks and Transmission Lines</td>
<td>2—1½</td>
<td>100—50</td>
<td>1</td>
</tr>
<tr>
<td>Comm 414</td>
<td>Electronic Circuits</td>
<td>3—1</td>
<td>150—50</td>
<td>1</td>
</tr>
<tr>
<td>Comm 415</td>
<td>Radio Engineering I</td>
<td>2—1</td>
<td>100—50</td>
<td>1</td>
</tr>
<tr>
<td>Comm 416</td>
<td>Electronics and Electrical Communication Engineering Laboratory</td>
<td>0—6</td>
<td>0—150</td>
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</tr>
<tr>
<td>EE 415</td>
<td>Electrical Measurements, Transmission and Distribution</td>
<td>3—1</td>
<td>150—50*</td>
<td>1</td>
</tr>
<tr>
<td>EE 416</td>
<td>Electrical Machines</td>
<td>3—1</td>
<td>150—50*</td>
<td>1</td>
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<tr>
<td>EE 417</td>
<td>Electrical Laboratory</td>
<td>0—4½</td>
<td>0—150**</td>
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<tr>
<td>Ph 411</td>
<td>Physics</td>
<td>2—0</td>
<td>100—0</td>
<td>1</td>
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<tr>
<td>Option</td>
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<tr>
<td>Physical Training</td>
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|                      | 19—16                      | 950—550  | 8
|                      | 21—16                      | 0—100    |

* 25 marks from each for Educational Tour report (total 50 marks).
** 50 marks in the first term for Practical Training during the preceding Summer Vacation and 100 marks in the third term for Laboratory Test.
### 7. MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Fourth Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. paper</th>
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</thead>
<tbody>
<tr>
<td>Hu 414</td>
<td>General and Industrial Psychology</td>
<td>2—0</td>
<td>100—0</td>
<td>1</td>
</tr>
<tr>
<td>EE 412</td>
<td>Electrical Technology II</td>
<td>2—3</td>
<td>100—100</td>
<td>1</td>
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<tr>
<td>ME 421</td>
<td>Production Technology</td>
<td>2—3</td>
<td>100—100*</td>
<td>1</td>
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<tr>
<td>ME 431</td>
<td>Heat Power Technology I</td>
<td>2—2</td>
<td>100—100</td>
<td>1</td>
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<tr>
<td>ChE 433</td>
<td>Testing of Fuels</td>
<td>2—2</td>
<td>100—75</td>
<td>1</td>
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<td>ME 441</td>
<td>Hydraulic Machines</td>
<td>2—2</td>
<td>100—75</td>
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<tr>
<td>ME 451</td>
<td>Machine Design</td>
<td>2—3</td>
<td>100—75</td>
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<tr>
<td>ME 454</td>
<td>Theory of Machines and Mechanisms II</td>
<td>2—1</td>
<td>100—50</td>
<td>1</td>
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<td>ME 461</td>
<td>Mechanics of Solids I</td>
<td>2—3</td>
<td>100—100*</td>
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<tr>
<td>Ma 413</td>
<td>Mathematics</td>
<td>1—1</td>
<td>50—50</td>
<td>1</td>
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<td>Option</td>
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<td>100—0</td>
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<td>Physical Training</td>
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* 50 marks (25 marks from each subject) in the:
  1. Term towards Practical Training during the preceding Summer Vacation:
  2. Term towards Educational Tour.
# 8. METALLURGICAL ENGINEERING

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Fourth Examination</th>
<th>1st and 3rd Terms</th>
<th>Duration of exam. papers</th>
<th>2nd Term</th>
<th>No. of papers for Exam.</th>
<th>Duration of exam. papers</th>
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<td>No. of papers for exam.</td>
<td>Hrs. per Week Marks</td>
<td>No. of papers for Exam.</td>
<td>Duration of exam. papers</td>
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<td>Hu</td>
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<td>1</td>
<td>2 hrs.</td>
<td>2—0 100—0</td>
<td>1</td>
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<tr>
<td>Ch</td>
<td>Assaying and Metallurgical Analysis</td>
<td>1—3 50—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>1—3 50—100</td>
<td>1</td>
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<tr>
<td>ChE</td>
<td>Mineral Dressing</td>
<td>2—2 100—50</td>
<td>1</td>
<td>2 hrs.</td>
<td>2—2 100—50</td>
<td>1</td>
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<tr>
<td>Met</td>
<td>Extractive Metallurgy of Iron and Steel 1</td>
<td>2—1 100—50</td>
<td>1</td>
<td>3 hrs.</td>
<td>2—1 100—50</td>
<td>1</td>
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<tr>
<td>Met</td>
<td>Refractories</td>
<td>1—0 50—0</td>
<td>1</td>
<td>0—2 0—50</td>
<td>0—2 0—50</td>
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<tr>
<td>Met</td>
<td>Foundry Metallurgy</td>
<td>2—3 100—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>2—3 100—100</td>
<td>1</td>
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<tr>
<td>Met</td>
<td>Physical Metallurgy—I</td>
<td>2—3 100—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>2—3 100—100</td>
<td>1</td>
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<tr>
<td>Met</td>
<td>Mechanical Metallurgy—I</td>
<td>2—3 100—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>2—3 100—100</td>
<td>1</td>
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<tr>
<td>Met</td>
<td>Extractive Metallurgy of Non-Ferrous Metals</td>
<td>2—1 100—50</td>
<td>1</td>
<td>2 hrs.</td>
<td>2—1 100—50</td>
<td>1</td>
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<tr>
<td>Met</td>
<td>Metallurgical Thermodynamics and Chemical Kinetics</td>
<td>2—1 100—50</td>
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<td>2 hrs.</td>
<td>2—1 100—50</td>
<td>1</td>
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<td></td>
<td></td>
<td>18—17 900—600</td>
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<td>17—19 850—650</td>
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<td>1</td>
<td>2—0 100—0</td>
<td>1</td>
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<td>Physical Training</td>
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<td>0—100</td>
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## 9. MINING ENGINEERING

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<thead>
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<th>Subject No.</th>
<th>Subjects for the Fourth Examination</th>
<th>Hours per Week</th>
<th>Marks</th>
<th>Duration of the paper for terminal exam.</th>
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<td>2nd term</td>
<td>3rd term</td>
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<td>Hu 414</td>
<td>General and Industrial Psychology</td>
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<td>0</td>
<td>2</td>
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<td>ChE 432</td>
<td>Mineral Dressing</td>
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<td>EE 413</td>
<td>Electrical Technology II</td>
<td>...</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Ge 423</td>
<td>Stratigraphy, Paleontology, Economic Geology and prospecting</td>
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<td>4</td>
<td>2</td>
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<td>Min 411</td>
<td>Mining Engineering II</td>
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<td>Min 412</td>
<td>Mining Engineering III</td>
<td>...</td>
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<td>Min 413</td>
<td>Mining Engineering IV</td>
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<td>3</td>
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<tr>
<td>Min 414</td>
<td>Mining Machinery I</td>
<td>...</td>
<td>3</td>
<td>2</td>
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<td>Min 415</td>
<td>Mine Surveying I</td>
<td>...</td>
<td>3</td>
<td>3</td>
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<tr>
<td></td>
<td>*Visa-voice</td>
<td>...</td>
<td>...</td>
<td>...</td>
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<tr>
<td></td>
<td>Vacation Training Report</td>
<td>...</td>
<td>...</td>
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<tr>
<td></td>
<td>*Survey Field Work</td>
<td>...</td>
<td>...</td>
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<td>**Mining Field Trip</td>
<td>...</td>
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<td>20</td>
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<td>Physical Training</td>
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<td>25</td>
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</table>

*10 days during the IV year Educational Tour period.
**Two weeks at the beginning of 3rd Term.
Two days excursion to Mosabani Mine towards the end of second term.
## 10. NAVAL ARCHITECTURE

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subject for the Fourth Examination</th>
<th>First and Second Terms</th>
<th>Third Term</th>
<th>Subject No.</th>
<th>Subject for the Fourth Examination</th>
<th>First and Second Terms</th>
<th>Third Term</th>
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<td>Marks</td>
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<td>Duration of Exam. papers</td>
<td>Hrs./per Week</td>
<td>Marks</td>
</tr>
<tr>
<td>Hu</td>
<td>General and Industrial Psychology</td>
<td>2 0</td>
<td>100—0</td>
<td>1</td>
<td>2 hrs.</td>
<td>2 0</td>
<td>100—0</td>
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<tr>
<td>ChE</td>
<td>Plastics and Paints</td>
<td>...</td>
<td>1 0</td>
<td>50—0</td>
<td>1</td>
<td>2 hrs.</td>
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<tr>
<td>CE</td>
<td>Advanced Strength of Materials</td>
<td>2 2</td>
<td>100—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>2 2</td>
<td>100—100</td>
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<tr>
<td>ME</td>
<td>Applied Thermodynamics and Heat Power (Marine Power Engineering)</td>
<td>2 2</td>
<td>100—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>2 2</td>
<td>100—100</td>
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<tr>
<td>Met</td>
<td>Engineering Metallurgy</td>
<td>2 0</td>
<td>100—0</td>
<td>1</td>
<td>2 hrs.</td>
<td>...</td>
<td>...</td>
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<tr>
<td>NA</td>
<td>Sea-going Qualities of Ships</td>
<td>... 1 0</td>
<td>150—0</td>
<td>1</td>
<td>3 hrs.</td>
<td>... 2 0</td>
<td>200—0</td>
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<tr>
<td>NA</td>
<td>Resistance of Ships</td>
<td>... 2 0</td>
<td>150—0</td>
<td>1</td>
<td>3 hrs.</td>
<td>... 2 0</td>
<td>200—0</td>
</tr>
<tr>
<td>NA</td>
<td>Strength of Ships</td>
<td>... 2 0</td>
<td>100—0</td>
<td>1</td>
<td>2 hrs.</td>
<td>... 2 0</td>
<td>100—0</td>
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<tr>
<td>NA</td>
<td>Ship Drawing and Calculations III</td>
<td>0 14 0—400*</td>
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<td>...</td>
<td>0 14 0—500</td>
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<tr>
<td>NA</td>
<td>Ship Hydrodynamics—I</td>
<td>2 0</td>
<td>100—0</td>
<td>1</td>
<td>2 hrs.</td>
<td>2 0</td>
<td>100—0</td>
</tr>
<tr>
<td>NA</td>
<td>Ship Design—I</td>
<td>... 1 0</td>
<td>100—0</td>
<td>1</td>
<td>3 hrs.</td>
<td>... 2 0</td>
<td>100—0</td>
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<tr>
<td></td>
<td></td>
<td>17 18 900—600</td>
<td>9</td>
<td>16 18 300—700</td>
<td>7</td>
<td>18 18</td>
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</table>

*50 marks in the first term for Practical Training of six weeks in a shipyard during the preceding Summer Vacation.
### Fifth Year

1. Aeronautical Engineering

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam.</th>
<th>Paper</th>
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<tr>
<td></td>
<td></td>
<td>Hours/per Week</td>
<td>Marks</td>
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</tr>
<tr>
<td>Hu</td>
<td>*Humanities Elective (any one)</td>
<td>1 0</td>
<td>50—0</td>
<td>1</td>
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<tr>
<td>AE 511</td>
<td>Aerodynamics</td>
<td>2 3</td>
<td>100—100</td>
<td>1</td>
<td>2 hrs.</td>
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<tr>
<td>AE 512</td>
<td>Aircraft stability and control</td>
<td>2 1</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
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<tr>
<td>AE 522</td>
<td>Aircraft Structures II</td>
<td>2 3</td>
<td>100—100</td>
<td>1</td>
<td>2 hrs.</td>
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<tr>
<td>AE 531</td>
<td>Aircraft Propulsion II</td>
<td>2 3</td>
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<tr>
<td>AE 541</td>
<td>Aircraft Design II</td>
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<td>50—200</td>
<td>oral examination to be arranged by the Dept.</td>
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<tr>
<td>**</td>
<td>Elective—A (any one)</td>
<td>2 1</td>
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<td>2 hrs.</td>
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<tr>
<td>@ @AE 552</td>
<td>Systems Engineering I and II</td>
<td>2 3</td>
<td>100—100</td>
<td>1</td>
<td>2 hrs.</td>
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<tr>
<td>Comm 552</td>
<td>@ Elective—B (any one)</td>
<td>2 0</td>
<td>100—0</td>
<td>1</td>
<td>2 hrs.</td>
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<tr>
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<td>Option</td>
<td>16 18</td>
<td>800—700</td>
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<td>2 0</td>
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<tr>
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<td>Physical Training</td>
<td>18 18</td>
<td>0—100</td>
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<tr>
<td></td>
<td>*For Humanities Electives see Foot-note on page 55</td>
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</table>

**Elective—A**

- AE 513 Gas Dynamics
- AE 514 Wind Tunnel Design and Testing
- AE 515 Helicopter, VTOL & STOL Aircraft
- AE 521 Aero-elasticity
- AE 523 Aircraft Fatigue.

**Elective—B**

- AE 532 Combustion Engineering.
- MA 521 Elements of orbital Mechanics and space vehicles
- MA 522 Computational methods and mathematical programming
- ME 511 Industrial Management
- Ph 522 Meteorology and Aeronomy.

@AE 552 Third term only
Comm 552 First and Second Terms.
### 2. AGRICULTURAL ENGINEERING

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. paper</th>
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</thead>
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<tr>
<td>Hu 511</td>
<td>Farm Management</td>
<td>1 2 0</td>
<td>50- 0</td>
<td>1 2 hrs.</td>
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<tr>
<td>AgE 512</td>
<td>Agricultural Co-operation and Extension</td>
<td>1 0 50- 0</td>
<td>1 2 hrs.</td>
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<td>AgE 513</td>
<td>Soil and Water Conservation Engineering</td>
<td>2 3 100-100</td>
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<tr>
<td>AgE 514</td>
<td>Irrigation and Drainage</td>
<td>2 3 100-100</td>
<td>1 2 hrs.</td>
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<tr>
<td>AgE 515</td>
<td>Farm Engines and Tractors</td>
<td>2 3 100-100</td>
<td>1 2 hrs.</td>
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<tr>
<td>AgE 516</td>
<td>Farm Machinery and Power Management</td>
<td>1 0 100- 0</td>
<td>1 2 hrs.</td>
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<tr>
<td>AgE 517</td>
<td>Problems</td>
<td>0 3 0-100</td>
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<tr>
<td>AgE 521</td>
<td>Project, Report and Seminar</td>
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<td>2 2 100- 50</td>
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<td>2 0 100- 0</td>
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<tr>
<td>Physical Training</td>
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<td>0-100</td>
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<tr>
<td>Viva-voce</td>
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<tr>
<td>Thesis/Project</td>
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<td>0-300</td>
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**Electives**

1. AgE 518 Earth Moving Machinery.
2. AgE 519 Tube Wells and Pumps.
3. AgE 520 Agricultural Process Engineering.
4. CE 520 Dam and Water Power Engineering.
5. ME 523 Production Engineering.

†100 marks in the first term for practical training during the preceding Summer Vacation and 50 marks for tour report at the end of Second term.

### *Humanities Electives*

- Hu 511 Modern Drama.
- Hu 512 Shakespeare.
- Hu 513 Asia in Transition.
- Hu 514 Public Administration.
- Hu 515 Industrial Relations.
- Hu 516 Human Engineering.
- Hu 517 Contemporary Problems.
- Hu 518 Problems of Philosophy.
### 3. CHEMICAL

| Subject No. | Subjects of the Final Examination | First Term | | | | |
|---|---|---|---|---|---|
| | | Hours/Week | Marks | No. of papers for exam. | Duration of exam. papers |
| Hu | †Humanities (Elective) ... | 1 0 | 50—0 | 1 | 2 hrs. |
| ChE 511 | Diffusional Operations ... | + 2 | 200—100 | 1 | 3 hrs. |
| ChE 515 | Unit Operations Lab. II | 0 6 | 0—200 | — | — |
| ChE 516 | Chemical Process Technology (Tech—II) | 2 3 | 100—100 | 1 | 2 hrs. |
| ChE 521 | Materials of Construction | 1 0 | 50—0 | 1 | 2 hrs. |
| ChE 522 | Instrumentation and Process Control | | | | |
| ChE 523 | Chemical Engineering Thermodynamics ... | 2 1 | 100—50 | 1 | 2 hrs. |
| ChE 524 | Engineering Economics | 1 0 | 50—0 | 1 | 2 hrs. |
| ChE 526 | Fundamentals of Molecular Phenomena | 2 1 | 100—50 | 1 | 2 hrs. |
| ChE 527 | Chem. Engg. Plant and Equipment Design ... | 1 3 | 50—200* | 1 | 2 hrs. |
| **Elective (any one) ... | 2 0 | 100—0 | 1 | 2 hrs. |
| 16 16 | 800—700 | 9 |
| Option ... | 2 0 | 100—0 | 1 | |
| 18 16 | | |
| Physical Training | ... | 0—100 | | | |

*50 marks in the first term for Factory Training during the preceding Summer Vacation.

**Electives
- ChE 528 Petroleum Refinery Engineering:
- ChE 529 Synthetic Fuel Engineering:
- ChE 530 Coal Chemicals:
- ChE 531 Biochemical Engineering.

†For Humanities Electives see foot-note on page 55.

††25 marks for Educational Tour.

***25 marks for Seminar.
## ENGINEERING

<table>
<thead>
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<th>Hours/Week</th>
<th>Marks</th>
<th>No. of papers for exam.</th>
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<th>Duration of exam. papers</th>
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Viva voce

Thesis/Project

0—200

0—300
## 4. CIVIL ENGINEERING

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<th>All Terms</th>
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<th>Duration of exam. paper</th>
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<td>Roads, Railways and Airports</td>
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<td>CE 515</td>
<td>Geodesy and Construction</td>
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<td>Design of Steel Structures</td>
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<td></td>
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|             |                                   | 20         | 17                     |                         |                         |                         |

*For Humanities Electives see foot-note on page 55

**Electives:
- CE 520 Dam and Water Power Engineering
- CE 521 Irrigation and Maritime Engineering
- CE 522 Bridge Engineering
- CE 523 Advanced Structural Engineering
- CE 524 Highways, Airports and Tunnels

†50 marks in the first term for Professional Training during the preceding Summer Vacation and 50 marks in the second term for Educational tour.
### 5. ELECTRICAL ENGINEERING

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<th>Duration of exam. paper</th>
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<td>Marks</td>
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<tr>
<td>Comm 511</td>
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<td>Instrumentation and Control</td>
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<td>EE 531</td>
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<td>Option</td>
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<td>2</td>
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</table>

|                  |                                    | 18        | 16      | 900—600                 | 9                     |

**Physical Training**

*50 marks in the first term for Practical Training during the preceding Summer Vacation.

**100 marks in the Third Term for Laboratory Test.

***50 marks for Educational Tour.

††For Humanities Electives see foot-note on page 55.

††Comm 531 First Term.

Ma 511 Second and Third Terms.
### 6. ELECTRONICS AND ELECTRICAL COMMUNICATION ENGINEERING

<table>
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<th>Subject No.</th>
<th>Subject for the Final Examination</th>
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<th>Duration of exam. paper</th>
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<td>Comm 512</td>
<td>Line Communication Engineering</td>
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<td>Mathematics of Circuit Analysis</td>
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<td>Comm 514</td>
<td>Radio Engineering II</td>
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<td>Comm 516</td>
<td>E. M. Waves, Radiation and Propagation</td>
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<td>E. C. E. Laboratory</td>
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<td>20 17</td>
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**Electives**

Comm 520 Antenna and Wave Propagation.
Comm 521 Servomechanism and Control Engineering.
Comm 522 Microwave Engineering.
Comm 523 Electronic Computers.
Comm 524 T. V., Radar and Aids to Navigation.
Comm 525 Acoustics.
Ph 511 Semi-conductor Physics.

*For Humanities Elective see footnote on page 55.
†50 marks in the first term for Practical Training during the preceding Summer Vacation and 50 marks in the third term for Tour Report.
<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of Papers for Exam.</th>
<th>Duration of Exam. Paper</th>
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<td>Metal Processing</td>
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<td>100—100</td>
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<td>Production Engineering Project</td>
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<td>ME 531</td>
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**Electives:** ME 528 Engineering Quality Control (1—1).
ME 568 Applied Fluid Flow, Plasticity and Experimental Stress Analysis (1—1).
* 50 marks (25 from each subject) in the:
  1 term for Practical Training during the preceding Summer Vacation;
  II term for Educational Tour.
@ For Humanities Elective see foot-note on page 55.
## 8. Metallurgical Engineering

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<td>Extractive Metallurgy of Iron and Steel II</td>
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<td>Physical Metallurgy II</td>
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Physical Training

Viva-voce
Thesis/Project

* For Humanities Electives—see foot-note on page 55

** Electives: Met 516 Advanced Metallurgy of Alloy Steel.
Met 518 Furnace Technology.
Met 520 Advanced Foundry Metallurgy.
## 9. MINING ENGINEERING

<table>
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<th>Duration of Exam. Papers</th>
<th>Marks 2nd Term</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. papers</th>
<th>Marks 3rd Term</th>
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<td>Industrial Management</td>
<td>2 0 2 0 100—0</td>
<td>0 1 2 hrs. 100—0</td>
<td>0 1 2 hrs. 100—0 1 3 hrs.</td>
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<td>0 1 2 hrs. 50—0</td>
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* For Humanities Electives see foot-note on page 55.
** One week to open cast (mines of the 2nd term).
*** Three weeks at the beginning of the third term.
## 10. NAVAL ARCHITECTURE

**(REGULAR COURSE)**

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<thead>
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<th>Subject No.</th>
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<td>Ship Hydrodynamics II</td>
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- **Physical Training**: 0—100
- **Viva-voce**: 0—200
- **Thesis/Project**: 0—300

Practical Training for about nine months during the third term, Summer Vacation and first two terms of the following year, 0—750.

*100 marks in the first term for four weeks training in the department during the preceding Summer Vacation.

†For Humanities elective see foot-note on page 55.
### 11. NAVAL ARCHITECTURE

*(Naval Construction—Option)*

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<td>Metallurgy</td>
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†For Humanities elective see foot note on page 55
### SIXTH YEAR

1. **NAVAL ARCHITECTURE**

   (Naval Construction—Option)

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**Viva-voce**  
**Thesis/Project**  

0—200

0—300
### B. BACHELOR OF ARCHITECTURE

#### (i) FIRST YEAR

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<td>Hu 216</td>
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*100 marks in the first term for Training during the preceding Summer Vacation.
### (iv) FOURTH YEAR

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<th>Third Term</th>
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<th>Duration of exam. papers</th>
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†EE 414 First Term only
ME 435 Second Term only
### FIFTH YEAR

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<td>Professional Practice</td>
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<td>Housing and Urban Design</td>
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</table>

†For Humanities elective see Footnote on page 57.
Practical training in an Architect's Office during the first term and the preceding summer vacation — 0.750.

Fourth Term of about six months from June to November of Sixth Year.

(a) Course work as mentioned above from July to September — 300—300
(b) Thesis/Project — 0—600
(c) Visas-vice — 0—200
DISTRIBUTION OF MARKS
(For each Examination)

I. Five-Year B. Tech. Degree Course

<table>
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<th>Examination</th>
<th>First Term Examination Marks</th>
<th>Second Term Examination Marks</th>
<th>End-Sessional Examination Marks</th>
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+ Viva-voce ... 200
+ Thesis ... 300

II. Five-and-a-Half-Year B. Tech. Degree Course in Naval Architecture

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+ Viva-voce ... 0—200
+ Thesis ... 0—300
+ Training ... 0—750

III. Six-Year B. Tech. Degree Course in Naval Architecture
with Naval Construction option

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<th>End-Sessional Examination Marks</th>
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+ Viva-voce ... 200
+ Thesis ... 300

IV. Five-and-a-Half-Year B. Arch. Degree Course

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+ Viva-voce ... 200
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SCHEDULE VII
REGULATION No. 13
Subjects of instruction for 5 and 51-year integrated B. Tech. and
B. Arch. Degree Course
Aeronautical Engineering (AE)

311. Principles of Aeronautics : (1-1).

Scope of the subject : This is a kind of slightly elevated orientation course covering the
broad principles of Aeronautics without mathematical details.

Aerodynamic forces on lifting surfaces and bodies, Non-dimensional force coefficients,
Aerofoils, How they produce lift, Variation of lift, drag and pitching moment with incidence
for typical aerofoils. Finite wings and types of flow. Effect of Reynolds number, Mach
number and sweep.

Types of flying machines, Description and purpose of the aeroplane components, the
Mechanics of flight.

Experimental techniques, lowspeed wind tunnels, components and application.

341. Aircraft Layout and Detail Design : (1-4).

Requirements for a good layout ; Descriptive geometry for airplane layout ; Lifting ;
Aerofoils ; General design considerations ; Connections, Fabrication methods ; Strength
Calculations for riveted and bolted joints ; Bending and Torsional Stresses, Strength of
struts and columns, Thin web beams.

351. Mechanics (2-1).

Kinematics : Expression for acceleration in different systems, rotating axes, Coriolis
acceleration, displacement of rigid bodies, Euler's theorem, Eulerian angles, rate of change
of Eulerian angles and their relation to rates of yaw, pitch and roll of an aeroplane. Basic
equations of rigid dynamics from equation for system of particles. Two-dimensional motion
under finite and impulsive forces including motion of imperfectly rough bodies. Motion when
mass enters or leaves the system with elementary application to jets. Three dimensional
motion ; billiard ball on imperfectly rough plane, sphere on perfectly rough cylinder, rolling
discs, gyroscope, gyrostatic action of propellers, use of gyroscope for turn indicator, artificial
horizon etc., Motion under no force.

411. Fluid Mechanics (2-2).

Inviscid Flow : Basic equations of motion, Basic definitions Circulation, Vorticity,
Stream function, Velocity potential. Types of two-dimensional flows : sources, doublets,
vortices, Principle of combination of flow types with selected examples ; Flow past a circular
cylinder with circulation, Conformal transformations the Blasius Theorem, the Joukowski
transformation, the karman-Treffitz transformation. Complex potential Derived aerofoil,
the Kutta-Joukowski theorem, Origin of circulation and the Kutta-Joukowski hypothesis.

Viscous Flow : Elementary treatment of the Navier-Stokes equation, Various forms
of energy equations. Some exact solutions of the Navier-Stokes equation : the Poiseuille
flow. Elements of two-dimensional laminar boundry layer theory. Elementary study of
turbulence, Simple treatment of turbulent boundry layer theory. Elements of heat transfer
theory.

412. Aircraft Performance (1-1).

Standard atmosphere ; Power plant data ; Power available calculations ; Estimation
of Drag of the airplane ; Power (or thrust) available and power (or thrust) required curves,
performance analysis ; calculation of range, endurance, rate of climb, glide, maximum speed
take off and landing distances. Effect of wing loading, power loading and aspect ratio.
Manoeuvring turn, dive, pull out from a dive, roll, loop, spin and inverted flight.
421. Elements of Aircraft Vibration (2-1).

Vibration of one and two degrees of freedom systems free and forced, damped or undamped; dynamic vibration absorber; Coupling. Principal modes and principal frequencies. Conservative multidegree freedom systems. Approximate solutions; Normal modes; orthogonality relations. Vibrations of slender beams. Vibration measuring instruments. Resonance testing of structures. Elements of Aeroelasticity; mechanism of flutter; brief mention of derivatives; binary flutter of a typical wing section in two-dimensional incompressible flow.

422 Aircraft. Structures I (2-3).


431. Aircraft Propulsion I (2-3).

Introduction to propulsive system—aircraft and guided weapon propulsion units. Power plants.


441. Aircraft Design I (1-4).

General Design: Introduction to the scope and principles of Aircraft Design. Aircraft specifications and airworthiness requirements. Design organisation and Design procedures. Materials, specification & parts of the plane like spars, ribs, fittings, engine mounts, etc. (to be carried out by the students). Familiarisation with design office procedures and hand books.

Aerodynamic Design: Choice of aerofoil section, collection of aerodynamic characteristics of aerofoils; plotting wing sections.

511. Aerodynamics (2-3).

Incompressible Flow: Thin Aerofoil theory, Elements of thick aerofoil theory: Theodorsen’s method and by distribution of singularities.

Finite wing Theory: Prandtl’s lifting line theory, Solution of the basic integral equation (i) Glaucert’s method, (ii) Mullhopp’s method Aerodynamic characteristics of three-dimensional wings.

Compressible Flow: Basic equations. Aerofoils in compressible flow, similarity rules. Shock and expansion waves, Method of characteristics and its applications influence of compressibility on two and three-dimensional wings, sweptback wings.

Elements of two-dimensional supersonic aerofoil theory, Brief discussion of transonic flows past aerofoils. The slender body theory.

512. Aircraft Stability and Control (2-1).

Concept of stability, stability criterion. Longitudinal static stability, stick-fixed and stick free stability margins, C.G. position and travel; Manoeuvring stability, manoeuvre margins, load factors; control forces, hinge moments, aerodynamic and mass balancing, powered controls. Lateral stability and directional stability.

513. Gas dynamics (2-1).

Basic thermodynamics.

Equations of one-dim. compr. flow; normal shocks, weak waves and their reflections and interactions; one-dim. flow with heat addition and with friction.

Equation of two-dim. flow; Mach angles and Mach cones, weak waves; Prandtl-Meyer expansion; oblique shock waves, intersections and reflections; Shock expansion theory, weak waves and first-order theory for thin aerofoils; Occurrence of shock-waves in practical situation.


Experimental techniques.

An introduction to real gas effects with emphasis on effects on viscosity.

514. Wind Tunnel Design and Testing (2-1).

Types of wind tunnels and general design features; Principles of design and operation of subsonic, transonic and supersonic wind tunnels. Methods of flow Visualisation Measurement of fluid velocity and model forces, manometres and balances; special measurements. Model testing procedure and reduction of test data.

515. Helicopter, VTOL & STOL Aircraft (2-1).


521. Aeroelasticity (2-1).


522. Aircraft Structures II (2-3)

Analysis of multicell and multibay structures. Torsion of open sections, torsion-bending theory of Wagner-Kappus. Introduction to the instability of thinwalled structures, Primary instability, flexural—torsional instability and local instability. Plates under transverse and end loads, flat stiffened panels in compression; Tension field beams. Introduction to Energy methods and matrix methods of structural analysis. Analysis and design of composite structures.

523. Aircraft fatigue (2-1).


531. Aircraft Propulsion II (2-3).


Engine performance under varying conditions of power, altitude and forward speed.


Elements of propeller theory.
532. Combustion Engineering (2-0).


541. Aircraft Design II (1-4).

Aerodynamic, structural and systems engineering aspects of design and their interaction.

Loads of an aircraft: aerodynamic loads, inertia loads; aircraft in symmetrical steady and accelerated flights; flight envelope. Manoeuvre loads; a symmetric flights. Gust loads. Landing and ground manoeuvring loads. V-g recorders.

Preliminary design; power plant selection; weight control and weight estimation; preliminary side view drawing; balance diagram and cg travel; three view drawing.

(The class work as a team in the design of a complete plane from a specification laid down by the staff. The preliminary design of the plane is carried out by the class or worked out by the staff and the data given to the students so that each group of students not exceeding three in number work out the detail design of one unit like fuselage, tail plane or control system).

552. System Engineering (2-3) Third Term


Agricultural Engineering (AgE)

311. Botany (2-2)


Morphology and characteristics of important economic plants.


411. Soil Science (2-3).


412. Crop Production (2-2).

Farm crops of India—distribution, acreage add yield; Tillage—its objectives and methods; Manures and fertilizers; Principles of manuring—doses, time and methods of application; Weeds and weed control; Important field crops of India—seed bed preparation, sowing time, seed rate, spacing, manuring, intercultivation, water requirement, harvesting, threshing and processing; Principles underlying crop rotation; Cropping schemes; Mixed cropping; Agronomical practices for soil management; Important pests and diseases of crops and control measures; Calendar of farm operation.

413. Farm Machinery (2-3).

Farm Power; Manual, animal and mechanical power—their application, availability, limitations, cost; Manual and animal power operated tools and implements—classification according to source of power and functions.
Materials of construction; Wood, iron, steel, selection, properties and use.

Tools and implements: Types, construction, working and performance cost of ploughs, harrows, cloo crushers, levelers, scoops, V-draggers, ridgers, seed drills, planters, dibblers, hoes, cultivators, harvesting and threshing equipment, winnowing fans; processing equipment, such as chaff cutters, sugar-cane crushers, oil ghanis, rice hullers, cotton gins, feed preparation devices, cleaning and grading tools; Plant protection equipment; Farm transport: Dairy machines.

414. Theory and Design of Farm Structures (2-3).

Columns—Formulae for their design, Beams—design principles distribution of shear and bending stresses—deflection of beams.

Reinforced Trusses—graphical and analytical procedures for evaluating forces in members—design of joints, members and gusset plates truss connections—Riveted and welded joints.

Reinforced Concrete—Technique of good concrete making—design of mixes—principles of design of simple slabs and beams—balanced section regulations for design—shear distribution in R. C. Sections—doubly reinforced beams—T beams—Design of columns and column footings.

Farm Structures—Location and layout—their functional requirements—requirement of building for special uses—Floor roof loads—design of foundations—Estimating quantities and costs—Rural water-supply, sanitation and roads.

415. Rural Electrification (1-1).

Power generation transmission and distribution of Electric supply—A.C. and D.C. circuits. Applications of electricity on the farm; storage batteries. Electric motors used in agriculture—types, operating characteristics, installation, maintenance, and selection.


511. Farm Management (2-2).

Types and systems of farming—their characteristics, suitability to Indian conditions. Types of farms, their characteristic features; selection, purchase and acquisition of land. Land development—culturable wastes and reclaimable areas—Farm layout—requisites of an ideal layout. Farm organisation—principle, selection and combination of enterprises, farm machinery and power in relation to system of farming and size of holdings; their working cost. Economics of farm practices and cost of production studies. Factors affecting profits of a farm, Marketing of farm produce. Farm records. Field experimental technique.

512. Agricultural Co-operation and Extension (1-0).

Origin and nature of Agricultural Cooperation; General principles; The history of movement in India; General forms of co-operation—credit, production, purchase and sale. Crop and cattle, implement and machinery, Insurance, Consolidation of holding, Better farming, Irrigation etc. Co-operative development, organisation and management in India and in other countries; Multipurpose co-operatives; Co-operation and Agricultural planning.

Agricultural Extension—Its philosophy and scope; Extension methods; Extension worker, his role and quality; Extension Service. Adoption of improved Agricultural technique for community welfare schemes.

513. Soil and Water Conservation Engineering (2-3).

Conservation defined—Erosion as a cause of damage—various types of erosion—mechanics of wind erosion and its control—water erosion—types of water erosion and their causes.

Rainfall and its measurement—Runoff as a major factor of erosion—factors affecting runoff—measurement of runoff—Water Stage Recorder—stream gauging—evaluation of runoff from rainfall.
Control of erosion—methods of controlling sheet erosion—biological and engineering methods and their limitations—terrace outlets and grassed waterways and their hydraulics.

Gully erosion and methods of control—biological methods—various structures used in control—permanent and temporary structures—their planning and design phases.

Farm ponds—flood routing—principles of flood control. Earth dams—their design and construction.

Stream bank erosion and its control—temporary and permanent structures—their layout and design.


514. Irrigation and Drainage (2-3).

History and extent of Irrigation in India—Sources and types of irrigation—importance of irrigation in the development plans—Planning and design of minor irrigation projects—Design of canals and canal structures.

Soil moisture relationships—Relationship between moisture and properties of soils—movement of soil moisture. Infiltration; methods of finding infiltration rates—permeability—field and laboratory methods of measuring permeability—Water conductivity—surface, tension—tensiometers—methods to determine soil moisture content—soil water storages.

Disposal of Irrigation water applied to the soil: Surface waste—deep percolation—plant transpiration ratio—consumptive use of water—factors affecting consumptive use—duty of water.


Field irrigation systems and structures: Functional requirement of field channels—capacity and design—methods of construction—pipelines—Head gates—diversion boxes—check gates—drops—road crossings.

Water requirements of crops. Measurement and cost of irrigation water: Units of measurement—flow through orifices, weirs and flumes—measuring devices—irrigation rates:


515. Farm Engines and Tractors (2-3).


516. Farm Machinery and Power Management (1-0).

Factors affecting selection of farm implements, machines and power units. Their maintenance and repairs. Economics of using farm machines and power.

517. Problems (0-3).

To work out numerical exercises on Agricultural Engineering Problems.
518. Earth Moving Machinery (2-2).

Land Reclamation—Methods of clearing tropical forests and scrub jungle—Selection of machinery—Reclamation of weed infested lands—Crawler tractors—Bulldozers—Angle and tree dozers—Power control units—Rooters and root rakes—Scrapers and graders—Construction of bunds, terraces and ditches—Machinery for field maintenance and servicing—Field and base workshops—Handling fuel oils, lubricants and greases—Stocking of spares and mechanical store handling—Cost of operations.

519. Tube Wells and Pumps (2-2).


520. Agricultural Process Engineering (2-2).

Considerations in processing cereal grains, oil seeds, leaf crops and fodder crops. Flow measurements, heat transfer, mass-transfer, air-moisture mixtures. Fans, crop-drying, milling and allied equipment. Crop handling equipment. Crop Storage. Cold storage. Plant layout. Economics. Processes and machines for processing of animal products, such as milk and milk products, poultry products etc.


Students will be given project work with a view to develop initiative, planning and organization to carry out research work and to write reports and to give seminar talks.

Note: Lectures on Palaeo-botany are given to the students of Geology in the third term by this department for course No. Ge-222 (Elements of Palaeontology and Indian Stratigraphy).

ARCHITECTURE AND REGIONAL PLANNING (Ar)

111. Principles of Architecture (1-4)

Lettering, calligraphy.


Plan, Section, Elevation, Scale Drawing—Simple design problems in relation toconstruction and materials.

112. Free-hand Drawing I (0-4).

Simple line sketches, studies of natural forms, combination of geometrical solids, object drawing and still life.

113. Descriptive Geometry (0-4).

Solid forms; Interpenetration of Solids. Isometric, Axonometric, Oblique and Planometric projections, Perspective, parallel, angular and three point. Study of Sciography on plain, curved and irregular surfaces. Application to buildings, furniture, etc.

120. Building Materials and Workshop Practice (1-3).

Primary elements of building and their functions. Detailed study of Basic materials like brick, stone and timber; strength of materials. Workshop practice.
212. Free-Hand Drawing I (0-3).

Outdoor sketching with particular reference to composition of simple building forms in relation to their setting. Colour circle, Oswald system, contrast and harmony. Tone and colour. Techniques of rendering—crayon, pastel, water-colour, poster colour. Colouring techniques on printed drawings.


Design of single storey buildings containing two or three large cells with auxiliary units—e.g., residential buildings, small school, dispensary, club town hall, etc.—with particular attention to room uses, circulation and orientation. Scale models.

220. Building Construction I (2-6).


314. History of Architecture II (2-0).


Design of complex vertical buildings—repeating and non-repeating units. Small frame structures. The studio work should include time sketches, project drawings, perspectives, models and interior design and details.

320. Building Construction II (2-6).


323. Specifications (2-0).

Definition and use of specifications. Methods of writing and order sequence. Specifications of materials and finishes.

330. Climatology and Architecture (2-1).

Types of tropical climate. The main climatic groups, temperature, humidity, rain fall, wind, sky, ground, vegetation, etc. Importance of micro-climatological factors. Measurement of climatic factors, study of indoor climate and its effect on comfort and efficiency. Problems of lighting and acoustics in tropics. Community traditions and their effects on planning problems. Advanced study of climatic factors and their effects on design. Hot dry regions, warm humid regions, monsoon climates. Special problems, such as, maritime climates, monsoon climates. Building materials and techniques in relation to climates. Economic considerations. Study of special types of buildings such as schools, hospitals, etc.
414. Introduction to Landscape Architecture (1-0).

Landscape design in relation to topography, surroundings, climate and buildings. Use, purpose and maintenance of gardens, as part of recreational planning. Analysis of factors relating to site planning. Design Synthesis.

General survey of history of garden art with special reference to gardens in India, Japan, China, Italy and Spain.

A general understanding of horticultural practices in India.


Planning of groups of houses. Analysis and inter-relationship of areas devoted to residential, commercial, industrial, recreational and other uses. Multi-storey frame-buildings; planning of units in relation to each other along with financial, legal and administrative problems of public regulations of landuse.


Contemporary building materials such as plastics, metals and alloys. Lightweight construction. Influence of environmental technology on construction. Methods of Building Science.

515. Architectural Design IV (0-10) Second and third Terms (0-19) Fourth term.

Problems of Urban design. A building complex to be attempted; appreciation of building byelaws, planning legislation, landscaping, etc.—Group project with planning AR 606 and AR 706.

516. Professional Practice (2-0).

The duties and responsibilities of the profession, its code of ethics and etiquette including standard of charges as adopted by the profession. Administration of an architect's office in private practice and in Governmental set-up. Building laws, types of Contracts, handling of tenders, valuation of buildings, accountancy, professional salesmanship and public relations. Programming, work-study and computation.

517. Housing and Urban Design (2-3).

The beginning of modern town. Development of planning in North India and southern peninsula in mediaeval times. The Renaissance and early industrialization. The contributions of eminent town planners, like Haussman, Burnham, Howard, Geddes, Perry, Stein, Abercrombie and others; Contemporary planning trends.

Housing for all income groups. Relation of housing to national economy. Problem of land ownership and control in relation to housing; the public interest in the provision of adequate housing, slum clearance. Development of national Housing policy.

525. Historical Development of Contemporary Architecture (2-0) Second and Third terms.


Thesis—

Thesis Design shall be on a major Building Project and its programming worked out by the student himself. The work should include an intensive study of topography, climatology and problems concerned with development of useful pattern in space and structure,
based on correlation and interpretation of the social, economic and physical, data. Solution of the problems with the methods of Architect, Engineer, Planner and Landscape architect in the preparation of written report and the drawings. The project work should include the following:—

The preliminary design, presentation drawings, working drawings (whole project or part thereof) written report of about 20,000 words. Any two of the following topics as advanced objectives:—

1. Structural drawings supported with detailed calculations.
2. Detailed estimates and specifications.
5. Study of interiors, furnishings, fittings and finishes.
6. Or any other approved by the Department.

APPLIED CHEMISTRY (Ch.)

111. Chemistry (3-3).

Physical Chemistry:

Properties of gases; Kinetic theory; equation of state; ideal gas laws; deviations; van der Waal’s equation, liquefaction and continuity of states; Joule Thomson’s effect; liquefaction of air. Solutions: Nomenclature, modes of expressing the composition; solubility curves; colligative properties of dilute solution. Solution of electrolytes: Deviations and van’t Hoff’s factor, Arrhenius’ theory of dissociation; degree of dissociation; strong and weak electrolytes; Faraday’s laws; electrolysis of fused and aqueous solution of electrolytes of technical importance; specific and equivalent conductance; conductance ratio; ionic conductance; mobility and transport numbers; simple application. First law of Thermodynamics and thermochemistry: Internal energy; heat content; specific heats of gases; heat of reaction; Hess’s law, Kinchhoff’s law.

Organic Chemistry:

Classification; nomenclature; general methods of preparation; properties and uses of hydrocarbon including benzene, alcohols, ethers, amines, aldehydes, ketones, acids and their derivatives.

General and Inorganic Chemistry:

Matter and its properties; Kinds of matter; specific properties; isolation and purification. Atoms, molecules and crystals; dalton’s atomic theory; size of atoms and molecules; their crystals; van der Waal’s forces. Elements and compounds: Definition and differentiation; Avogadro’s Number; atomic weight and its scale; physical and chemical methods of determination; electron, proton and neutron; their sources, charges and masses. Elements of atomic theory: Electronic shells; stability of electronic groups; periodic law; periodic table and its basis. Valency; Covalency; electrovalency; octet theory and deviations. Oxidation and reduction: Electronic interpretation; oxidising and reducing agents; oxidation equivalent; balancing of equations. Systematic study of elements of groups V, VI and VII of periodic table.

Chemistry Laboratory:

Study of Bunsen burner; fitting up of simple apparatus; separation of mixtures involving distillation, crystallisation and filtration. Detection of the following acid radicals by dry and wet tests: CO₃, NO₃, SO₄, S, Cl, Br, I in a mixture containing not more than two radicals. Detection of the following basic radicals by dry tests only: Na, K, NH₄, Cu, Ag, Mg, Ca, Sr, Ba, Zn, Hg, Al, Sn, Pb, Bi, As, Fe, Ni, Co, Mn, Cr (mixtures must not contain more than two radicals). Semimicro technique for qualitative analysis of basic radicals in a mixture containing not more than two radicals. (For Science stream).
112. Chemistry (4-3).

Same as Ch. 111 and.

Equivalent weights; laws of chemical combination and atomic theory, Avogadro’s law and its application; acidimetry; alkaliometry. Study of the following elements and their compounds: H₂, O₂, N₂, P, C, Si, B, S, halogens and inert gases. (For Technical stream).

113. Chemistry (3-2).

Physical Chemistry:

kinetic theory, equation of state, deviation, van der Waal’s equation, theory of corresponding state, first law of thermodynamics, thermochemistry, chemical equilibrium, phase rule, chemical kinetics, electrochemistry, colloids.

Organic Chemistry:

classification, nomenclature, general methods of preparation, properties and uses of hydrocarbons, alcohols, ethers, aldehydes, ketones and acids; solvents and dyes.

General and Inorganic Chemistry:

fundamental laws and concepts, fundamental particles, atomic structure & valency, periodic classification of elements, oxidation and reduction, simple chemical calculations.

Engineering and Industrial Chemistry:

clay and clay products, cement, glass and other refractories, treatment of water for industrial use, paints and varnishes, wood, rubber and plastics, iron and steel, alloys, corrosion and its inhibition.

Chemistry Laboratory:

simple qualitative analysis. (For Architects).

211. Chemistry (3-3).

Physical Chemistry:

Law of Mass action and chemical equilibrium in homogeneous and heterogeneous systems, Le chatelier and Braun’s principle for effect of external factor on equilibrium. Chemical Kinetics: Order and molecularity of reactions; rate equation for first and second order; temperature coefficient and energy of activation; catalysis. Homogeneous and heterogeneous, criteria of catalysis and its technical application. Ionic equilibrium; common ion effect; solubility product; ionic product of water; pH; hydrolysis; indicator; buffer solution; standard electrode potential; simple galvanic cell; secondary cell. Colloid: Classification; preparation; purification and properties of colloidal systems. Emulsions: Types; stability and application. Phase rule: Single component system.

General and Inorganic Chemistry:

Systematic study of the elements of groups I to IV of the periodic table. Atomic Structure: Cathode ray; Bohr’s theory; sublevels in electronic shell; Rutherford’s experiments; Mosley’s work and atomic number. Radio-activity and Nuclear Chemistry: α β γ—rays; U-series; isotopes and mass spectrography; binding energy; nuclear transformation; artificial radioactivity; nuclear fission and nuclear energy.

Water and its treatment, corrosion-causes and prevention.

Chemistry of Engineering materials

Important metals and alloys; lime; cement; mortar and glass (only chemistry of manufacture and utilisation).

Rubber, plastics and wood (a brief survey of the chemistry of processes and utilisation).

Elementary treatment of fuels: solid, liquid and gaseous.
Chemistry Laboratory:

Quantitative analysis: Use of chemical balance; estimation of equivalent weight of metals; solubility; water of crystallisation; acidimetry and alkalimetry; hardness of water; estimation of Fe by permanganate and dichromate; estimation of Cu by iodometry; estimation of Ca; gravimetric estimation of Fe; gas analysis. (For Science stream).

412. Assay and Metallurgical analysis (1-3).


Principles underlying polarographic and spectroscopic methods of analysis. Identification of simple compounds and mixtures by X-ray method (for Metallurgists).

419. Physical Chemistry for Chemical Engineers (2-3).


Physical Chemistry Laboratory:

Determination of molecular weights by freezing point method and vapour density method, determination of surface tension, viscosity, partition coefficient, vapour density, refractive index, optical activity, order of a reaction, solubility, adsorption, pH, conductance, transition temperature, conductometric and potentiometric titrations.

420. Organic Chemistry for Chemical Engineers (2-3)

Purification and analysis of organic compounds. Formulae, constitution and classification of organic compounds.

Aliphatic compounds; paraffins, halogen derivatives, alcohols, ethers, aldehydes, ketones, fatty acids and their derivatives, and chlorides, anhydrides, amides, esters, sulphur compounds, unsaturated hydrocarbons and their derivatives, polyhydric alcohols, carbohydrates, dibasic acids, Stereochemistry and electronic theory of valency.

Aromatic compounds: hydrocarbons, halogen compounds, nitro and amino compounds, diazonium salts and diazo compounds, azo compounds, sulphonlic acids, phenols, aromatic alcohols, aldehydes, ketones and quinones, aromatic acids, terpenes and camphors, multinaulcar hydrocarbons and their derivatives, naphthalene, anthracene and their derivatives.

Complex compounds: Heterocyclic compounds, alkaloids, ureides, compounds of biological importance.

Organic Chemistry Laboratory:

Qualitative detection of elements (N, S, P, halogens) and functional groups (COOH, OH, CHO, CO, NO₂, NH₂ & COOR). Preparation of organic compounds involving acetylation, benzyolisation, nitration, halogenation, esterification, reduction, oxidation, hydrolysis, etc. Qualitative determination of equivalent weights of acids and bases. Estimation of phenols, acids and aldehydes.
111. Orientation (1-0)

Introduction to chemical engineering profession. Scope of chemical engineering, ethics of chemical engineers.

311. Chemical Engineering Stoichiometry (2-1).

Units and dimensions employed in chemical engineering calculations. Introduction to dimensional analysis. Material balance of chemical engineering processes.

Vapour pressure, humidity and saturation, solubility and absorption. Thermophysics and thermochemistry. Fuels and combustion. Chemical systems and processes.

312. Chemical Engineering Equipment Drawing (0-2).

Simple drawings like,

Pipe fittings: Socket, bend, tee, reducer, union, plug, flange, etc.

Valves: Gate, globe, needle, non-return, butterfly, etc.

Equipments: Heat-exchangers, autoclaves, overhead tanks, crushers, grinders, etc.

315. Fuels and Furnaces (3-2).

Fuels

Classification of fuels and general uses.

Liquid fuels: Petroleum and its characteristics, coal tar distillation products, shale oil, alcohol.


Testing of liquid fuels: Specific gravity, viscosity, flash point and calorific value.

Heat transfer

Conduction: Mechanism of heat transfer, Fourier's law, steady state heat transfer for several bodies in series. Logmean area, unsteady state heat transfer.


Furnace Design


FOR METALLURGICAL ENGINEERS

411. Chemical Process Technology (Tech. I)—(2-0) First Term, (0-3) Second Term, (2-3) Third Term.

Heavy Chemical industries: Sulphuric acid, nitric acid, caustic soda, chlorine, industrial gases, etc.
Fertilisers—Nitrogenous, phosphatic and mixed fertilisers.

Electro-chemical and electro-thermal industries: Industrial salts, e.g., potassium permanganate, potassium dichromate, sodium hydrosulphate, etc.

Technology of silicate industries: Cement, porcelain, refractories, glass, etc.

Present development and progress of the above industries in India.

412. Flow of fluids and fluid handling (Unit Op. I)—(2-0) First and Second Terms. (1-0) Third Term.

Energy of a fluid in motion. Lost work due to friction. Elements of boundary layer theory.

Hagen-Poiseuille’s law, viscosity. Newtonian and non-Newtonian fluids.


Introduction to flow of compressible fluids. Measurement of fluid flow, e.g. orifice and venturi meters, pitot tubes, rotameters, flow nozzles, weirs, anemometers, dilution meters, etc.

Transportation of fluids. Operating characteristics of reciprocating, rotary and centrifugal pumps, compressors, blowers, fans and other devices for fluid handling.


413. Heat Transfer (Unit Op. II)—(2-0) Second and Third Terms.


414. Size reduction and mechanical operations (Unit Op. III)—(2-0) First and Third Terms.

Size reduction: Types of crushers, grinders and disintegrators for coarse, intermediate and fine grinding. Relation between power requirements and size reduction. Closed circuit grinding. Important operating variables.

Size separation: Particle size analysis, screening, industrial screening equipments.


Flotation, electrostatic and magnetic separations. Centrifugal separation.


Mechanical handling of materials: Elevators, conveyors, fluidisation and pneumatic conveyance. Storage of solids.

415. Unit Operations Laboratory—(0-5).

Laboratory experiments and design calculations to illustrate the principles covered in Ch.E. 412, 413 and 414.

416. Fuels, combustion and furnaces—(2-2) First and Second Terms, (2-0) Third Term.

Fuels: Review of world's fuel resources. Principal solid, liquid and gaseous fuels.


Liquid Fuels: Petroleum and its derivatives, coal tar, shale oil, synthetic liquid fuels.

Gaseous Fuels: Coal gas, water gas, producer gas. Mechanism of gasification.


Laboratory experiments based on the above syllabus.

417. Applied Mathematics for Chemical Engineers—(2-0) Second Term, (1-0) Third Term.


431. Mineral Dressing (2-2).

Mineral characteristics. Hardness and surface liberation. Size reduction. Equipments for coarse, intermediate and fine grinding, e.g., Jaw crusher, Gyratory crusher, Ball mill, Rod mill, etc. and their characteristics. Energy requirement in comminution, Rittinger's, Kick's and Bond's laws.

Mechanical separation: Sieve analysis, mechanical size separation units, Grizzlies, industrial screens, capacity and efficiency of size separation units. Hydraulic and pneumatic classification, laws of settling, Stoke's law, Newton's law, different industrial classifiers and their characteristics.

Froth flotation: Contact angle and its application to flotation, wetting agents, frothing agents, industrial froth flotation apparatus and their application.

Filtration and dewatering processes. Drying. Transport and conveyance of material.

Process flowsheets for important indian ores, e.g., Gold, Copper, Lead, Zinc, Iron and Uranium ores.

(For Metallurgical Engineers)
432. Mineral Dressing—(2-0) First Term, (2-3) Second and Third Terms.

Recovery of minerals from ores. Machines and operations used for coarse and fine grinding. Classification and preparation for concentration. Methods of concentration including gravity and magnetic methods, flotation etc. Flow-sheet study of important mineral dressing operations.

Laboratory experiments based on the above Syllabus.
(For Mining Engineers)

433. Testing of Fuels (0-2).

Sampling of coal, proximate analysis, calorific value of solid fuels, bomb calorimeter, caking index of coal. Calorific value of liquid fuels, flash and fire points, pour point, viscosity, Conradson carbon residue test, ASTM distillation.

Calorific value of gaseous fuels, Junker’s gas calorimeter. Orsat gas analysis.
(For Mechanical Engineers)

435. Plastics and Paints (1-0) First and Second Terms.

Plastics: Natural and synthetic resins, types of synthetic resin, thermoplastic and thermosetting; polymerisation and condensation—polymerisation; general properties and uses; outline of methods of production of plastics.

Paints: Types of paints and compounds, methods of setting; mechanical and chemical protection by painting, painting sequences for iron and steel, zinc and aluminium; various types of paint failure, economics of painting.
(For Naval Architects)

511. Diffusional Operations (Unit Op. IV) (4-2) First Term, (4-1) Second and Third Terms.


Leaching: Different types of equipments. Ideal stages in counter-current leaching. Stage efficiency.

Liquid-liquid extraction: Different types of equipments. Principles of extraction, triangular and rectangular co-ordinates, design calculations for extraction in packed and spray columns.

Crystallization: Principles, crystal formation and growth. Different types of batch and continuous crystallizers, design calculations.


Air-water contact operations: Hygrometry and humidity charts, Mechanism of contact operations, rate equations for simultaneous heat and mass transfer. Methods of humidification, dehumidification and air conditioning. Design of different types of equipments. Water coolers and their design.

515. Unit Operations Laboratory II (0-6).
Laboratory experiments to illustrate the principles covered in ChE 431 and 511.

516. Chemical Process Technology (Tech. II) (2-3) First and Second Terms, (2-0)
Third Term.
Unit processes of organic synthesis with special reference to selected industries.
Nitrification: Explosives, T.N.T., nitroglycerine, nitrobenzene, nitrocellulose.
Amination by reduction: Aniline.
Sulfonation: Benzene sulfonic acid, dodecyl benzene sulfonic acid, naphthalene-sulfonic acid, etc.
Oxidation: Acetaldehyde and formaldehyde from ethanol and methanol respectively, acetic acid from acetaldehyde, styrene from ethylbenzene, phthalic anhydride from naphthalene, chemicals from partial oxidation of petroleum products.
Hydrolysis: Phenols, napthols, ethyl alcohol, soap, paper, hydrolysis of cellulose to sugar.
Esterification: Industrial solvents e.g. ethyl acetate, butyl acetate, amyl acetate, cellulose acetate, vinyl acetate.
Hydrogenation: Edible oils and fats, coal tar hydrogenation, hydroforming, hydro-cracking, etc.
Alkylation: Special reference to petroleum industry, cumene, ethyl benzene.
Diazotization: Dye-stuff.
Polymerisation: Rubber, plastics, synthetic fibres, etc.
Development and present position of organic chemical industries in India.
Flowsheets with material and energy balances.

520. Fuels (1-0) First Term, (2-3) Second and Third Terms.
Principles of coal washing. Washability curves. Design and operation of different types of coal washing plants.

(For Mining Engineers)

521. Materials of construction (1-0) First and Second Terms.
Corrosion: Types of corrosion and their prevention. Cathodic protection with special reference to pipe line protection.
Metals: Ferrous, non-ferrous and their alloys with special reference to application in chemical and petroleum industry.
Nonmetals: Formation, structure and physical properties. Special polymeric materials of construction.

Refractories: Study and application.

522. Instrumentation and process control (2-1) Second Term, (2-3) Third Term.

Standards of measurements, components of an instrument, static and dynamic characteristics of instruments.

Temperature measuring instruments: Filled system thermometer, radiation and optical pyrometers, other temperature measuring devices.

Pressure measuring elements: Mechanical pressure elements, strain gauges and other pressure transducers, high vacuum measurement.

Flow measuring elements: Head and area flow meters, positive displacement meters, mass and magnetic flow meters.

Liquid and solid level measuring elements.

Measurement of chemical composition: Emission and mass spectrometry, ultraviolet absorption and infra-red analysis, solution potential measurement, pH and electrical conductivity measurement, thermal conductivity gas analysis, O₂ and CO₂ analysis, other methods of analysis.

Measurement of miscellaneous process variables, e.g. velocity, density and specific gravity, viscosity and consistency, humidity and photometric variables.

Indicating and recording instruments, scanning instruments, galvanometers and other moving coil instruments, potentiometers, electrical bridge and self-balancing instruments.

Concept of feedback loop, process characteristics, modes of control, generation of control actions, final control elements and valve positioners, transmitting and telemetering devices, typical industrial control schemes.

Application of Fourier and Laplace transformations. Open loop response of simple systems, feedback element and controller characteristics. Elements of frequency response analysis, stability and quality of a control system, optimum controller settings, feed forward control, cascade control. Process dynamics of heat exchangers, level and flow systems, distillation columns and chemical reactors. Introduction to systems engineering, plant dynamics study for optimisation, elements of control design, computer control.

523. Chemical Engineering Thermodynamics (2-1) First and Second Terms, (1-1) Third Term.


524. Engineering Economics (1-0) First and Second Terms, (2-0) Third Term.


Resources of India: Transport, minerals, fuels, electricity, etc. Trade, balance of payment, finance.

Industry: History and development of different industries in India, Tariff, subsidy, patent, national plans.

Cost Accounting: Methods of calculating depreciation, different types of costing and costing calculations. Accounting, book-keeping, balance sheet.
Factory design: Economic location, layout and cost estimation. Different types of organisation for factory management, sales, purchases, reports, charts, budgets, time-and-motion study and other methods of factory control.

526. Fundamentals of Molecular Phenomena (2-1) First and Third Terms.


Molecular phenomena—II: Transport properties with high entropy changes. Homogeneous reactions, catalytic reactions, flow reactor concept.

Gas-solid and liquid-liquid reactors of industrial importance.

527. Chemical Engineering Plant and Equipment Design (1-3) First Term, (1-6) Second and Third Terms.


The work will include design and fabrication drawings of simple units of plants, e.g. heat exchangers, reactors, dryers, evaporators, absorbers, distillation columns, etc. to meet specified requirements with reference to functional efficiency, ease of control and maintenance.

528. Petroleum Refinery Engineering (Elective) (2-0) First and Second Terms.

Origin and occurrence of petroleum, classification of crude oils, physical properties of petroleum and petroleum products.

Evaluation of crude oil, selection of products, straight-run distillation of crude. Details of equipments, e.g. tube-still heater, stripper, etc.

Introduction to chemical treatments of gasoline, light and heavy distillates.

Gas processing and natural gasoline production. Refinery location and layout, storage and transportation.

Thermal cracking, catalytic cracking, catalytic reforming, hydrogenation and alkylation.

529. Synthetic Fuel Engineering (Elective) (2-0) First and Second Terms.

Fischer-Tropsch process. Bergius process. High pressure and high temperature techniques.

530. Coal Chemicals (Elective) (2-0) First and Second Terms.


531. Biochemical Engineering (Elective) (2-0) First and Second Terms.

Processing, preservation and disposal of materials of biological, biochemical and microbiological origin.

Food processing techniques, thermal processing of in-can foods, freezing, thawing and freeze drying, pasteurization and sterilization by thermal or other methods, irradiation, preparation and handling of biol, suspensions, dehydration, preservation through fermentation, production of proteins and amino-acids by large-scale fermentation, etc. Use of continuous culture techniques, methods of air, equipment and media sterilization by various ways, mass transfer in biol systems, biochemical kinetics, rheological properties of biol, fluids, etc.

Processing of synthetic foods, antibiotics, yeasts, vitamins and steroids, biopolymers, organic acids, etc.
CIVIL ENGINEERING (CE)

111. Drawing and Descriptive Geometry (1-4).

Lettering, Scales, Mathematical curves, lines and planes, Isometric and Oblique views, Orthographic Projections, Conventions and Dimensioning, Sketching and elementary Machine drawing.

Representation of plane figures and solids, edge views and true shapes, location of planes, inclination of planes, distances of lines and planes, Intersection of planes, Sections, Interpenetration of bodies, Development of surfaces, Determination of shadows and perspective drawings.

(For Science Stream)

112. Drawing and Descriptive Geometry (0-3).

Revision of Mathematical curves, Isometric and Oblique views, Orthographic Projections, Sketching and elementary machine drawing, Intersection of surfaces and Development of Surfaces.

Cycloids, Involute, Helices and screw threads, Graphic Statics, elementary Building and Structural Drawing, Determination of shadows and perspective drawing.

(For Technical Stream)

211. Engineering Drawing (0-4).

Graphical determination of Centroid, first and second moments of areas; Building and Structural drawing—elementary and advanced; Cycloids, Involute, Helices and Screw threads, drawing of complex machine parts, assembly drawing and details, tracing and blue printing.

(Except for Naval Architects)

215. Surveying (1-3).

Principles and use of scales both metric and British. Use of the various types of instruments, including the dumpy level. Levelling; the use of the staff, contouring, spot levels, plotting. Use of survey maps; reducing and enlarging.

(For Architects)

216. Structural Mechanics—I (1-3).

Stress, Strain, Hooke’s law for elastic bodies; Elastic constants; moments of inertia; composite sections; Loads on buildings; bending moments and shear forces in simple beams and cantilevers; Theory of simple bending; deflection of simple beams; Introduction to principles of Reinforced concrete.

Graphical methods of determination of bending moments and shear forces; analytical and graphical determination of forces in trusses.

(For Architects)

311. Applied Mechanics II (2-2).

Properties of Fluids: Buoyancy and metacentre; laws of fluid motion; Bernoulli’s theorem—application, Momentum equations, Vortex notion, Flow through Orifices, mouthpieces, notches; Flow through pipes and nozzles; Water hammer, Pipe fittings, Open channel flow, Back water curves, Measurement of Fluid flow.

313. Surveying and Building Construction and Estimating (2-4).

Surveying: Principles and Practice of Chain and compass surveying, plane table surveying; two and three point problems. Use and adjustment of instruments; levelling; Contours and sections; Setting out buildings, measurement of earthwork; Planimeter—its theory and use. (Field Practice).

Building Construction and Estimating: Foundations, safe bearing pressures. Timbering of trenches, brickwork and masonry construction; opening in brickwork and masonry. Damp proof courses; timber construction; joints in wood work; floor and roof construction; drawing of brickbonds; foundation (Plain Concrete); details of doors, windows, roof trusses and simple buildings.
315. Building Construction and Surveying (2-3).

Building Construction: Foundations; Brickwork and Masonry; Damp-Proof course; Timber Construction; Joints in Timber Floors and Roofs.

Building Drawing: Foundations and Footings; Brick bonds; Details of Doors, Windows, trusses and lintels.

Estimating: Taking Quantities, Rates and Costing; Plinth area and cubic meter rates, approximate estimates.

Principles and Practice of Chain and compass Surveying and Plotting; Plane table surveying; two and three point problems. Use and adjustment of instruments; levelling; contours and sections; setting out buildings, measurement of earth work, Planimeter—its theory and use.

Elementary principles of Theodolite traverse (Field Practice).

(For Agricultural Engineers)

316. Structural Mechanics—II (2-2).

Fixed and continuous beams; determination of moments and shear forces in continuous beams from hand books.

Further problems in reinforced concrete including framed structures; Foundations;—footings, pile and grillages.

(For Architects)

317. Fluid Mechanics (2-2).

Properties of fluids, buoyancy and metacentre, laws of fluid motion, Bernoulli’s theorem—applications, momentum equations, vortex motion, flow through orifices, mouthpieces, notches, flow through pipes and nozzles, water hammer, pipe fittings, open channel flow, backwater curves, measurement of fluid flow.


Strain energy—repeated and impact loading, riveted and welded joints bending and shearing stresses in composite beams including reinforced concrete sections.

Deflection of statically determinate beams, statically indeterminate beams, combined direct and bending stresses, columns.

Special Topics: Moment of inertia, unsymmetrical bending, thick cylinders, shear centre etc.

321. Services I (Plumbing Drainage and Sanitation) (2-0).

Internal water supply to buildings; Lay out drawings—Principles and design of internal water supply lines including those for multistoried buildings—materials and fittings for water supply. Drawing system for buildings—lay out drawings—principles and design of waste pipe line—materials and fittings for waste water collection system—Septic tank, Soak well and tile fields principles of design. Rain water drainage—principle of design. Maintenance problems for internal water supply and waste water systems—Refuse collection for buildings.

(For Architects)


412. Design of Structures—Concrete and Steel (2-2).

Reinforced concrete, simple beams and slabs, short columns, Footings, Retaining walls, Staircases, Design of Riveted and Bolted joints, Welded connections, Design of columns, Roof Trusses and plate Girders.

413. Hydraulics, Hydrology and Irrigation (3-2).

Open channels—non-uniform Flow, Hydraulic Jumps, Fluming; Dimensional analysis, Viscous Flow, Boundary layer, Hydroelectric Turbines, Pumps, and other Hydraulic machines.

Measurement and study of rainfall, run off and storage. Well and flow irrigations. Duty of water, Diversion works, Canal systems, Falls and Cross-drainage works.

414. Surveying and Construction (2-5).

Surveying: Theodolite surveying; traversing and adjustment of errors; tacheometric surveying. Curves—circular and transition, setting out. (Field Practice).


415. Engineering Laboratory (0-6).

Experiments connected with Hydraulics, Structures (including models), Soil Mechanics (including Highways) and Sanitary Engineering.

416. Structural Design I (2-3).

Design of flat slabs; rigid frames analysis, moment distribution and slope deflection methods.

Design of riveted joints, and connections; design of tension and compression members and beams; design of members subjected to axial compression and bending—design of Grillage foundation.

General principles of design of prestressed concrete.

(For Architects)

417. Sanitary Engineering (2-2).

Estimation of water consumption, Sources, quality, Collection, purification, Conveyance and distribution.

Flow in Sewers, design of sewerage system, sewer appurtenances, pumping, sewage disposal works, laboratory work.

418. Advanced Strength of Materials and Structures (2-2).

Failure under steady stress; slip and separation in relation to shear and bulk stresses. Maximum principal stress, strain and shear hypotheses. Total and shear strain-energy theories.

Beams; distribution of stresses in curved beams, elastic and plastic design of beams.

Deflection from tangent; application to encastré, tapered and continuous beams; Clapeyron's theorem; relaxation methods.

Influence line; moving loads.

Struts and ties; ideal; eccentrically loaded; laterally loaded; end constraints; analytical and polar diagram treatments; tapered and continuous struts.

Torsion of circular and non-circular sections; effective J; open-coiled springs with and without end constraints.

Arched ribs; three pin, two pin and encastré arches; temperature stresses; influence lines.
Portals; closed frames; application to ship and submarine frames.

Strain-energy methods for direct bending and shear deflections. Distribution of shear stress in riveted, boned and other joints.

Framed structures; typical frames; Clerk Maxwell diagram; method of sections.

Space frames; Southwell's tension coefficients.

Elastic and plastic design of portals.

Deflection of frames by kinematics and energy methods.

Redundant plane and space frames; secondary stresses in deficient and redundant frames; stiff-jointed frames.

*Laboratory Work* A selection from the following:

- Determination of elastic constants of engineering materials.
- Tests to fracture; in tension, compression and torsion.
- Hardness tests.
- Notched-bar impact tests.
- Instability of slender struts.
- Lateral instability of beams.
- Deflection and reactions of continuous beams.
- Calibration of electrical resistance strain gauges.

*(For Architects)*

421. Estimating and specifications (2-0).

- General introduction and estimates on floor area and cubic contents.
- Detailed methods of taking out quantities of buildings—small and large.
- Costing: Standard rates and their derivation from given data.
- Definition and use of specifications. Methods of writing order and sequence.
- Specification of material finishes etc. Clause by clause analysis of standard specifications.
- Inspection of works in progress.

*(For Naval Architects)*

511. Structural Analysis and Foundation Engineering (2-2).

Structural Analysis: Analysis of Statically indeterminate structures by slope deflection, moment distribution methods and influence lines, curved beams, fixed arches, Spandrel braced arches and continuous trusses.

Foundation Engineering: Theories of foundation failures, Principles of foundation action, spread footings, mats, piles and pile foundations, coffer dams, caissons.

512. Design of Concrete Structures (2-1).

- Design of concrete mix. Review of design of beam and slab, ultimate load design, Variation in modular ratio.
- Raft and pile foundations, R. C. column subject to direct and bending stresses, Retaining walls, Rectangular and circular water towers, flat slab construction, Shell constructions, Dams, Principles of prestressed concrete construction, Common methods.

513. Roads, Railways, and Airports (2-0).

Roads and Railways—Location, Ruling curves and gradients typical sections for roads in plain and hilly areas, Construction and maintenance of macadamised bituminous concrete
and paved roads, construction and maintenance of railway track, Superelevation. Points and crossings, station buildings, signalling and safety device, curve compensation. Airports—Location and layout of airports and land strips, Construction and design of runways.

515. Geodesy and Construction (3-2).

Geodetic Surveying: Baseline measurements and triangulation; precise and trigonometrical levelling. Field astronomy determination of azimuth, latitude, longitude and time. Setting of parallels of latitude and longitude. Tunnel surveying, hydrographic surveying, aerial surveys.


516. Structural Design II (2-3).

Architectural concepts of structural engineering; general principles of shell structures; design of spherical domes and cylindrical shells.

(For Architects)

517. Building Materials (2-0) III term only.

Soils—Classification and identification, hydraulic and Mechanical properties. Bricks—Types, manufacture and uses, brickbonds. Building stones: Types, properties and uses; correction and prevention of defects. Concrete: Composition, properties and uses of cements and concrete mixtures. (For Mining Engineering).

(For Mining Engineers)

520. Dam and Water Power Engineering (2-1).

Principles of Design of dams of Gravity, Arch, Buttress, Earth and other types. Appurtenant works—spillways, gates, galleries, outlets, contraction joints, grouting, river diversion, project planning, selection of type of dam.

Problems involved in location, design, construction and economics of hydroelectric developments, estimates of water power from stream flow data, hydraulic turbines, intakes, conduits and penstocks, power-house structures.

521. Irrigation and Maritime Engineering (2-1).

Application of Khosla's theory—the design of weirs on permeable foundations, fluming of canals, non-uniform flow and back water curves, river training, guide banks, inland navigation, reclaiming land from sea.

Tides and tidal currents, wave action, beach erosion, methods of shore protection, layouts of channels and harbour basins, wet, dry and floating docks, quay walls, jetties appurtenances.

522. Bridge Engineering (2-1).

Brief historical review and modern development with examples of outstanding bridge constructions. Classification of bridges and bridge components.

Bridge site, essential design data, designed maximum discharge waterway, scour calculations, depth of foundations, afflux, economics of span lengths and pier location, Loadings and forces.

Foundations (open, pile and well), abutments, piers, wingwalls—different types.

Design of slab, T-girder and Hollow girder R. C. bridges, Simply supported and cantilever types of spans, general features of design of arch. Continuous, rigid frame and prestressed concrete bridges. Plate girder and truss—Bridge bearings.

Aesthetics of Bridge Design.
523. Advanced Structural Engineering (2-1).

Analysis of building frames, continuous trusses and bents, continuous girders and frames with variable moments of inertia. Analysis of statically determinate structures such as cables, suspension systems and space frames.

Brief introduction to advanced structural mechanics including analysis of plates and shells, buckling behaviour and response of structures to dynamic loading.

Introduction to elementary concepts of plastic theory as applied to slab and reinforced concrete structures. Analysis of R. C. members in combined bonding and Torsion.

524. Highways, Airports and Tunnels (2-1).


Classifications of airports, standards and design of geometric elements, Drainage of airports.

Tunnels—types, construction, ventilation and lighting, precautions for safety.

525. Design of Steel Structures (2-1).


591. Advanced Structural Engineering I (2-1).

Thick tubes under internal and external pressure; elastic and plastic stress distributions; compounding of elastic tubes; residual stresses due to partial yield; approximations for pipes and thin shells.

Torsion of non-circular sections; membrane analogy; Bredt-Batho theory for thin shells.

Membrane stresses: Surfaces of revolution under internal pressure; pipe bends; shear flows and torsion-bending; sheet-stringer hypothesis; and constraint and Wagner theory.

Beams on an elastic foundation; application to grillages and to local bending at discontinuities in thin shells.

Bending of flat plates under lateral loads; circular plates; edge constraint and joint efficiency; minimum energy principle for rectangular plates; grillages; plastic design.

Elastic instability struts, beams, plates and shells.

(For Naval Constructors)

691. Advanced Structural Engineering II (2-2).

Alternating stresses; fatigue; S-N curves; dynamic loading of structure and components; combined steady and alternating stress; Goodman and Gerber lines for high tensile and mild steels; hysteresis; nature of fatigue fractures; corrosion fatigue; fatigue at stress concentrations.

Elasto Plastic analysis of structural systems.

Plane stress in two dimensions; photo-elasticity; application to stress concentrations and to shear diffusion problems.

Limit analysis and design, Variational methods and application to structural problems.

Vibration of complex structures and structural system.
Periodic motion: simple and complex harmonic motions, representation of harmonic motion in phase diagrams, natural damped and forced vibrations in stable systems; frequency of vibration of shallow and deep beams of uniform section, of irregular section, and of ships' structure; whirling of shafts with damping and thrust and torsion.

Torsional vibrations: shafts, structural members and ships; critical speeds.

Vibration of propeller blades; in air and water; flutter; hysteresis.

Gyros; characteristics and principles.

Stress waves: propagation; characteristics of stress waves in elastic medium.

Contained Plasticity and non linear analysis of typical structural systems.

Henkey’s theorem and plastic flow problems associated with structural systems.

**Experimental Stress analysis:**

*Laboratory Work:*

- Tensile tests, plain and welded specimens.
- Strain gauges.
- Overstrain of metals.
- Elastic and plastic behaviour of thick tubes.
- Plastic bending of beams.
- Shear-centre of asymmetric beams.

  (For Naval Constructors)

**ELECTRICAL ENGINEERING (EE)**

111. Orientation (1-0).

311. Electrical Technology (2-2).

Introductory study of magnetic and electric fields and circuits. Direct and alternating current machines. Current, voltage, power, and energy meters. Electrical installation of buildings. Elements of power generation, transmission and distribution. (For Aeronautical, Agricultural, Chemical, Civil, Metallurgical Engineers and Naval Architects).

312. Electrical Technology I (2-2).

Introductory study of magnetic and electric fields and circuits. Elements of circuit theory. Construction, principles of operation and characteristics of d.c. machines, transformers and alternators. Measurements and measuring instruments. (For Mechanical and Mining Engineers).

321. Electrical Circuits and Machines (3-4).

Electric and magnetic field concepts and system parameter calculations. Formulation of equilibrium equations for simple d. c. and a.c. networks and evaluation of transient and steady state behaviour. Vector loci and circle diagrams. Newwork theorems and application to single and three-phase circuits.

Theory and performance of d.c. machines including windings, armature reaction, and commutation. Special types of machines. Storage batteries. Laboratory assignments covering circuits and machines. (For Electrical and Electronics & Electrical Communication Engineers).

412. Electrical Technology II (2-3).

413. Electrical Technology II (2-1).

Synchronous motors; induction motors; single-phase machines, converters and rectifiers. Transmission and distribution. Mining cables; flameproofing and intrinsic safety; mining switchgear and protecting devices; signalling systems for shafts and roadways; electric drives for compressors, pumps, fans, mine winders and electric locomotives.

(For Mining Engineers)

414. Services II (2-0) First Term.

Electric installation of buildings, electrical appliances, illumination, lighting of interior and exterior of buildings.

(For Architects).

415. Electrical Measurements, Transmission and Distribution (3-1).


(For Electronics & Electrical Communication Engineers).

416. Electrical Machines (3-1).


(For Electronics & Electrical Communication Engineers).

417. Electrical Laboratory (0-44).

Experiments covering EE 415 and EE 416.

(For Electronics and Electrical Communication Engineers)

421. Electrical Circuits and Measuring Instruments (2-1).


431. Electrical Machines (3-1).


441. Power Systems I (2-2).


451. Electrical Laboratory I (0-41).

Experiments covering EE 421, 431 and 441.
521. Instrumentation and Control (3-1).


531. Machines and System Components (2-1).


Constructional details of electrical machines and transformers. Insulation, ventilation and cooling. Evaluation of machine parameters.

541. Power Systems II (2-4).


551. Electrical Laboratory II (0-4).

Experiments covering EE 521, 531 and 541.

561. Project (0-4).

Specification and design of typical machines and transformers. Project assignments on automatic control schemes.

ELECTRONICS AND ELECTRICAL COMMUNICATION ENGINEERING (Co.)

311. Principles of Electronics (1-0).

Vacuum tubes and transistors—equivalent circuits, amplifiers, oscillators, and rectifiers’ Electronic instruments.

(For Aeronautical, Agricultural, Chemical, Civil, Mechanical, Metallurgical and Mining and Naval Architects)

312. Principles of Electronics (2-2).

A.C. circuits, resonance and coupled circuit; Network theorems. Vacuum tubes and transistors, Rectifiers, amplifiers, Feedback; Oscillators; modulation and demodulations; C R O.


Voltage and Power amplifiers, Oscillators. Pulse Circuits, Multivibrator, blocking oscillator, time base generators, counters, logic circuits.

Power rectifiers. Voltage Stabilizers.

Gas tubes, Thyratron, Ignitron; Induction and dielectric heating.

(For Electrical Engineers)
412. H. F. Measurements and Electro-acoustics (2-0).


413. Networks and Transmission Lines (2-1½).


414. Electronic Circuits (3-1).

Small signal amplifiers—AF, RF, Video and operational amplifiers, Feed-back amplifiers; Oscillators. Pulse-circuits, Multivibrators. Blocking Oscillator, time base generators, and counters; Logic circuits.

415. Radio Engineering I (2-1).

Large signal amplifiers—AF, and RF; Generation and detection of AM, PM, FM and SSB signals. Description and design considerations of various units in Radio Transmitters and Receivers.

416. Electronics and Electrical Communication Engineering Lab. (0-6).

Laboratory work to be based on Comm. 414 and 415.


(For Electrical Engineers)

512. Line Communication Engineering (2-1½).


513. Mathematics of Circuit Analysis (2-1).

Matrices and determinants; Vector Algebra, Complex Variables. Special functions Wave equation. Fourier series and Integral. Laplace and Fourier Transforms.

514. Radio Engineering II (3-1).

Elements of Communication theory; Pulse Modulation Systems. System Details of various communication links. Television; Radar, Aids to Navigation; Elements of VHF and Microwave techniques.

515. Engineering Electronics (2-1½).


516. EM Waves, Radiation and Propagation (2-0).

517. Physics of Electronic Devices (2-0).

518. Design and Report (0-6).
Some selected topics from circuits, instruments and systems.

519. Electronics and Electrical Communication Engg. Lab. (0-6).
Based on all departmental courses.

520. Antenna and Wave Propagation (2-0).

521. Servomechanism and Control Engineering (2-0).

522. Microwave Engineering (2-0).

523. Electronic Computers (2-0).

524. TV, Radar and Aids to Navigations (2-0).

525. Acoustics (2-0).

531. Computer Technology (2-0) first term).
(For Electrical Engineers)

552. System Engineering (2-3). First and Second Terms.
(For Aeronautical Engineers)

GEOLOGY & GEOPHYSICS (Ge)

311. Physical and Structural Geology (2-2).
(For Mining Engineers)
312. Geology (2-2).

Principles of crystallography, chemical and physical properties of various rock-forming and ore minerals, their association, origin and modes of occurrence. The nature, composition and classification of igneous, sedimentary and metamorphic rocks, elements of petrogenesis. Nature, origin and occurrences of mineral deposits, types and controls of ore deposition, geographical distribution and details of Indian deposits of Fe, Cu, Mn, Pb, Zn, Ag, Au. Elements of Mining and prospecting. Estimation of ore reserves. India's potentials of metallic and non-metallic minerals and discussion of the mineral development during the five-year plans.

(For Metallurgical Engineers)

313. Mineralogy and Petrology (2-2).

Principal crystal forms of minerals, their recognition, identification and classification, the physical, chemical and optical properties of common rock forming minerals: their association, classification and modes of occurrence.

The nature, composition, classification of igneous, metamorphic and sedimentary rocks, their identification in the field and laboratory: elements of petrogenesis.

(For Mining Engineers)

411. Geology (1-1).


(For Agricultural Engineers)

423. Stratigraphy, Palaeontology, Economic Geology and Prospecting—(4-2)

First Term, (3-2) Second and Third Terms.


Physico-chemical principles of ore deposition. Important Indian metallic and non-metallic mineral deposits, their occurrence, origin, structure and value. Principles and techniques of geological, geophysical, and geochemical prospecting.

(For Mining Engineers)

519. Geology (2-3).


(For Civil Engineers)

HUMANITIES AND SOCIAL SCIENCES (Hu).

111. English (2-2) (for Engineers).

(2-1) (for Architects).

The object of the programme is to teach students how to express themselves in good, simple, and correct English and to help them develop a taste for literature.

TUTORIAL PROGRAMME

1st Term.

The main rules of syntax; the sentence; its structure; punctuation; paragraph: no formal grammar lessons are given; correct use is taught through composition.
2nd Term.
Preciswriting; letterwriting; comprehension test; etc.

3rd Term.
Paraphrasing; imaginative writing; Report writing; dialogue, diary, etc.; writing short notes on topical issues.

Anthologies of essays and poems and a modern play will be chosen as text for the lecture classes. The texts will be changed from time to time.

112. History (1-0).
The purpose of this compulsory course in History is to stimulate the interest of the young students in some of the more important epochs of World History and to help them analyse and interpret the story of India against the background of developments elsewhere.

The legacy of ancient civilisations and the Indian inheritance. Influence of Indian culture abroad. Rise and spread of Islam. Europe in medieval times: Church and State. The intellectual stir and Humanism; Renaissance and Reformation. Cultural Synthesis in India.

3. World order and the U. N. O.

114. History (1-0).
The same as Hu 112 (for Architects).

211. English (1-1) (for Engineers).
(1-0) (for Architects).

TUTORIAL PROGRAMME

Advanced Prose Composition including precis writing; Discussion and review of important books; summarising technical reports.

In the lecture classes two books will be discussed in detail; one, preferably a prose play by an outstanding playwright, in the first two terms and the other, an anthology of poems or short stories or essays.

212. History (1-0).
Commercial Revolution—Growth of nation-states. The rise of the middle class and the bid for political power.

India and the West.
French Revolution and Napoleon.
The Industrial and Technological Revolution as a factor in Modern History.
India, China & Japan and the Impact of the West.
Nationalism, Internationalism, Democracy and Communism as world forces.

215. Industrial Development in India (1-0).
1. Industrial Revolution in the U.K. and other countries.
2. Industrial Structure of India at the beginning of the 19th century—predominance of small industries.
4. Industrial Development and policy up to the first world war.
5. The Inter-war period—changes in the policy of the Government—Adoption of the policy of discriminating protection and its impact on industrial development.

6A. Indian Industries on the eve of the 1st Plan.


(For Engineers)

216. Industrial Development in India (1-0).
The same as Hu 215.

(For Architects)

314. Economics and Economics of Industrial Labour (2-0)

Economics.


5. Organisation of Production—Division of Labour—Use of machinery—Location—Economic, Social and Strategic Consideration in Industrial Location.


7. Scale of Production—Economies and Diseconomies of Large and Small Scale Production—External and Internal Economies—Laws of Returns—Diminishing, Increasing and Constant Returns—scale of production—Economies of increased dimensions and linked processes.

8. Size of a unit—Factors determining size—optimum size.

9. Integration—Motives of Integration—Methods of Integration—Direction of Growth—Integration and Social interest.

10. Value, Depreciation, Depletion and allied Problems.


12. Factor pricing—wage determination.


Economics of Industrial Labour.

1. Industrial Labour in India—Its Distribution.

2. Efficiency of Labour—Responsibility of Employers.

3. Recruitment, Training etc.


5. Scientific System of Wage Payment—Payment by results.
12. Labour Administration in India.

315. Economics (1-0).
5. Organisation of Production—Division of Labour—use of machinery—Location—Economic, Social and Strategic Considerations in Industrial Location.
7. Scale of Production—Economies and Diseconomies of Large and Small Scale Production—External and Internal Economies—Laws of Returns—Diminishing, Increasing and Constant Returns—scale of production—Economics of increased dimensions and linked process.
8. Size of a unit—Factors determining size—optimum size.
10. Value, Depreciation, Depletion and allied Problems.
12. Factor pricing—wage determination.
14. Banking, Central, Commercial and Investment.

414. General and Industrial Psychology (2-0).

_Psychology._

The course gives the basic ideas about human behaviour which forms the basis for the application of psychological principles in industry. It presents a broad picture of the psychological factors underlying human efficiency in industry.

1. General Psychology: Development of experimental psychology.


2. Industrial Psychology—General principles of group behaviour—study of human factor in industry. Human and Social problems of industrialisation.
1. Industrial fatigue and monotony: causation and remedies.  
   Personnel selection: Interviewing and psychological tests.  
   Industrial training: its benefits and principles.  
   Accidents: their causes and prevention.  
   Merit-rating  
   Wage and Incentives.  
   Maladjustment—absenteeism and labour turnover—the maladjusted worker.


3. Leadership and Supervision in industry.

415. Social and Industrial Psychology (1-0)  
   Introduction—some concepts of general psychology—different schools of psychology—  
   Perception—Social perception—human groups—group dynamics—leadership—mass opinion and propaganda—opinion and attitude survey—motivation for work—working environment—  
   environment and fatigue—accident—human engineering—social aspects of industrial psychology.  
   (For Architects)

511. Modern Drama (1-0).
   This course deals with English Drama since G. B. Shaw.  
   Thesis plays, Irish Revival, Poetic Drama, Comedy of Fantasy.  
   George Bernard Shaw: The Doctor's Dilemma, Man and Superman, St. Joan;  
   John Galsworthy: Strife, Justice, Loyalties;  
   Yeats: The Heart's Desire;  
   J. M. Synge: Riders to the Sea;  
   T. S. Eliot: Murder in the Cathedral;  
   Auden and Isherwood: The Ascent of F6;  
   S. an O' Casey: Juno and the Paycock.

512. Shakespeare (1-0).
   The aim is to introduce Shakespeare's plays and sonnets and to give an appreciation of  
   his excellence as a poet and dramatist.  
   A brief introduction followed by lectures round one or two most important plays and a few  
   sonnets.

513. Asia in Transition (1-0).
   This course in History will be offered with a view to acquainting the students with the  
   general nature of the Asian resurgence since about 1850 in some well-marked regions like India,  
   China, Japan, South-East Asia and West Asia. Emphasis shall also be laid on the problems  
   that these different areas face.  
   The following topics will be discussed:—  
   (i) The commercial and political expansion of the West and the Asian reaction.  
   (ii) The impact of the Western civilisation.  
   (iii) The recovery of Asia.  
   (iv) The new factors:  
   (a) The Russian Revolution.  
   (b) First World War.
(c) Second World War.
(v) The challenge of communism.
(vi) The impact of Asia.
(vii) Asia and the world; future trends.

514. Public Administration (1-0).
Definition and scope of Public Administration.

Organisation—mechanical and humanistic views of organisation; the basic concept of organisation—division of work—the principles of hierarchy; delegation of authority; integrated and disintegrated organisation; coordination as an organisation problem; span of control; unity of command.

Administrative units—distinction between line organisation and staff organisation.

Administrative area—distinction between administrative area and governmental areas; centralisation and decentralisation.

Executive Management; The Chief Executive and his function. Principal elements of management.

Administrative Policy, Administrative Powers and Responsibility.

Methods of recruitment and training.

Civil Service in India—Methods of Recruitment and Training—Problems of Discipline and Morale.

Management of Public Enterprise (Public Sector).

515. Industrial Relations (1-0).

The course deals specifically with the psychological problems arising out of interaction between workers and management and with the effect of this interaction on job satisfaction, morale and productivity.

Psychologists’ point of view—Principles of motivation and their application with reference to job satisfaction incentives, income aspiration, etc. Principles of perception and their application with reference to perception of people (union and management), issues and groups; leadership and supervision—type of organisation and organisational effectiveness. Union-management conflict.

516. Human Engineering (1-0).

The prime concern of this course is with the problems related to machine design and control: study of man-machine systems, characteristics of human performance.

Principles of vision and application to problems of visual displays, e.g. design of scales, dials, etc. Problems of visibility and legibility.

Principles of hearing—their application to communication problems.

Characteristics of motor behaviour and their accuracy; their application to design of machine controls, like gear ratio, etc. Relations between displays and controls—coordination—optimal conditions for them.

517. Contemporary Problems (1-0).

This will be in the nature of a composite course laying emphasis on economic problems, political and constitutional developments, and problems of current history. The syllabus may be distributed termwise.

The syllabus shall have to be reviewed every three to five years in the light of new developments with a view to ensuring its adequacy and contemporaneity.

To begin with, selection may be made from the following topics:
(A) CURRENT ECONOMIC PROBLEMS OF INDIA

(i) Agrarian reorganisation with special reference to co-operative farming in India.
(ii) Dynamics of rural development with special reference to community Development.
(iii) The Problems of Industry: small-scale industries; large scale industries.
(iv) Choice of techniques—capital intensive or labour-intensive.
(v) Agricultural labour and Industrial labour.
(vi) Economic incentives and Industrial Relations.
(vii) Money market, Capital market, and Industrial finance.
(viii) Theory of Developmental Planning. India's Five Year Plans.

(B) POLITICAL & CONSTITUTIONAL DEVELOPMENT

(i) Indian Constitution: Trend of amendments.
(ii) Reorganisation of States: Forces at work.
(iii) Language Question: Importance of the regional language. The question of the official language.
(iv) General Elections in India: Indexes of Socio-political trends.
(v) Indian Political Parties: Their role in a democratic state.
(vi) India and the U. N.

(C) PROBLEMS OF CURRENT HISTORY

(i) The Background of India's Foreign Policy.
(ii) Factors behind the Transfer of Power.
(iii) Disenchantment and international peace.
(iv) Middle East and South-East Asia in International politics.
(v) Asia and the Future of Democracy.
(vi) Africa in International Politics.

518. Problems of Philosophy (I-0).

Students will be broadly acquainted with the main philosophical problems that have engaged the attention of thinkers at all times. In course of the discussion of these problems, reference will be made to both thinkers and systems from the East and the West.


   The problem of Appearance and Reality in Indian Philosophy—the Upanishads, Buddhism, Nyaya, Samkhya and Vedanta.


5. Types of Modern Indian Philosophy—Practical Vedanta of Vivekananda, Personalism of Tagore, Ethical Idealism of Gandhi, Integral Idealism of Aurobindo.

**MATHEMATICS (Ma)**

**111. Mathematics and Mechanics (4-2).**

Limit and continuity, Binomial theorem for any index, exponential and logarithmic series, Elements of convergence, Differentiation of simple functions like Algebraic, circular, hyperbolic, logarithmic, successive differentiation, Tangents and normal, elements of partial differentiation.

Integration as the inverse process of differentiation and as the limit of sum.

Methods of integration—substitution, by parts, decomposition into a sum. Reduction formulae; Definite integrals, Integration interpreted as area determination.

Elements of tracing simple curves.

Rectification and quadrature as applied to the simple curves.

Differential Equations.

Indeterminate forms, Maxima Minima, Taylor's, Maclaurin's, Rolle's Theorem, Mean value theorems.

*Mechanics.*

Vectors, Kinematics of motion in a straight line (using calculus)—displacement—parallelogram law of velocity. Force—Newton’s laws, Motion of connected systems, Parallelogram law of forces, Parallel forces, Moments, Couples, Centre of Gravity, Equilibrium of co-planar forces, Friction. Work, Power and Energy; Collision of elastic bodies. (For Science Stream)

**112. Mathematics and Mechanics (5-2).**

Same as Ma 111 and


(For Technical Stream)

**211. Mathematics and Mechanics (4-2).**

Co-ordinate Geometry of two dimensions, Determinants Asymptote, curvature, curve tracing; Trigonometry—Argand diagram, De Moivre’s Theorem, Hyperbolic functions, Gregory’s series.

Co-ordinate Geometry of three dimensions; Planes, straight lines, conicoids in simplified form-sphere, cone, cylinder, ellipsoid, hyperboloid, paraboloid.

*Mechanics.*

Centre of gravity; Virtual work, strings, Stability of equilibrium; Acceleration in different systems of coordinates. Projectiles, Motion under constraints. Simple Harmonic Motion, D’Alembert’s principle, Plane motion of rigid bodies under finite and impulsive forces.

**311. Mathematics (2-1).**

Convergence of series.

Partial Differentiation, Fourier Series and Multiple Integrals.

Elementary Probability theory and Statistics.

Definition of Probability, Theorems on total and compound probability, Random variables and probability distributions, Binomial, Poisson and Normal distributions, Mathematical expectations.

Elements of Complex Variables.

Cauchy Riemann Differential Eqns., Cauchy's Integral Theorems,

Singularities, Mapping of elementary functions.

411. Mathematics (2-0).

Matrices, Vector fields, Complex variables, Partial Differential equations by method of separation of variables with applications to problems of Engineering.

Tensor analysis, Laplace's equation, Fourier transforms, Numerical methods.

(For Civil Engineers)

412. Mathematics of Circuit Analysis (2-0).


Electromagnetism and Mechanics of Continua—Formulation of Maxwell's equations, discussion of their determinacy, Deduction of circuit formula from Field Formulation, Study of Selected special cases of field problems, Formulation of equations of fluids and deformable bodies.

(For Electrical Engineers)

413. Mathematics. (1-1).

Matrices, Laplace and Fourier transforms and their use in solving differential equations.

Numerical methods, Analogue and Digital Computation.


(For Mechanical Engineers)

415. Mathematics (2-1).

Infinite integrals. Selected topics on special functions.


(For Aeronautical Engineers)


Simple programs—Logical decisions—Program Modifications.

Flow diagrams.
The Machine-oriented, symbolic and problem-oriented programs—a general discussion.

Compilers and Interpretative programme: Outlines of the procedures of translating the source to object program.

Subroutines—their specific uses: function generation, address modification, data conversion into different modes.

Source programming languages: a survey.

Fortran and its dialects.

Machine language Programming for IBM 1620; outlines of the compiler for Fortran with Format on IBM 1620. Study of object decks of Fortran with Format programs; Modification of the object deck.

Debugging and tracers; Precompiling and object deck ‘identifiers’, Multiprogramming and Monitors.

Introduction to the theory of Automata: Finite State Machines, Probabilistic automata, Memoray and state, Program modifications and learning.

(For Electrical Engineers)

521. Elements of Orbital Mechanics and Space Vehicles (2-0).

Orbital Mechanics: Orbit established from initial conditions, launching of satellites, Contangential transfer between Coplaner Circular Orbits, Orbital change due to impulsive thrust; perturbation of orbital parameter, elementary treatment of stability of orbits, interception and related problems, long range ballistic trajectories.

Space Vehicles: Review of general equations, thrust misalignment, nearly symmetric bodies, despinning of satellites, altitude diff of space vehicles, general motion of spinning bodies with mass entering or leaving the system.

Performance of Rockets and Optimization Problems:

Performance of single-stage rockets, optimization of multistage rockets, flight trajectory optimization, optimum programme for propellant utilization.

(For Aeronautical Engineers)

522. Computational Methods and Mathematical Programming (2-0).


(For Aeronautical Engineers)

MECHANICAL ENGINEERING (ME).

111. Orientation (1-0). in Mechanical Engineering discipline.

121. Workshop Practice (1-3).

Lecture classes will be based on the following practice:

(a) Carpentry — Classification and use of timber, tools, machines; different types of joints and glues; painting and polishing.

(b) Fitting — Tools and processes.

(c) Smithy — Forging equipment and accessories; tools and operations.

Practical work covering the above.

(For Science Stream)
122. Workshop Practice (0-3)
Practical course as in 121.
(For Technical Stream)

221. Workshop Theory and Practice (1-3)
General metal working processes:—Machining and machine tools; cold working of metals; welding and foundry. Workshop measurements. A course of workshop practice consisting of:—

(a) Machine shop:—Centre lathe, drill press, shaper, milling machine; use of simple measuring instruments. Demonstration of various other uses of lathe, milling machine, planer, boring machine and grinder.

(b) Foundry:—Common tools and equipment; cupola melting; moulding and core making; hand and machine moulding (demonstration only).

(c) Welding:—Gas welding and cutting; arc welding; soldering and brazing.
(For all courses leading to B.Tech. Degree)

Static equilibrium. Plane trusses—graphical and analytical methods.

Kinematics and Kinetics of rigid bodies:—

(a) Rectilinear motion.

(b) Curvilinear motion.

(c) Rotation about fixed axis, and

(d) Plane motion.

Static and kinetic friction in machine members.

(For all courses leading to B.Tech. Degree)

321. Workshop Practice (0-3).
A course of workshop practice consisting of:—

(a) Taper turning, thread cutting, boring, profile and form milling, gear cutting, cylindrical grinding, surface grinding and centreless grinding.

(b) Use of combination square, bevel protractor, clinometer, precision measuring gauges and sine bar.

(c) Operation of press tools.

(d) Advance practice in gas and arc welding, resistance welding, inert gas welding and welding of non-ferrous metals.

(e) Methods of moulding simple castings, machine moulding and pouring.
(For ChE, EE, Comm and ME)
331. Heat Technology (2-1).

Engineering system of metric units.


(For AE, AgE, ChE, CE, EE, Comm, ME, Min and NA)


Drawing : assembly and detail drawings from sketches of complete machines like engines, pumps, compressors and turbines.

Design : (a) principles of design and theories of failure,
(b) design of castings and
(c) design of parts subjected to—
   (i) direct and shear stress : pin joints, cotter joints, rivetted joints, welded joints, press fits, thin cylinders, screw fastenings, turnbuckles, etc.,
   (ii) bending : levers, beams, etc.,
   (iii) torsion : shafts, couplings, keys, valve springs, etc., and
   (iv) thrust : pillar with direct and eccentric loading, push rods, connecting rods, piston rods, etc.

(d) Bearings and lubrication.

(For AE, AgE, ChE, CE, EE, Comm, ME, Met. Min and NA)

354. Theory of Machines and Mechanisms I (1-2).

Analysis and kinematics of plane mechanisms. Mechanisms for intermittent motion.

Inertia forces in machine parts. Piston effort and crank effort diagrams; bearing loads.

Introduction to the theory of lubrication and bearings.


421. Production Technology (2-3).

Theory of metal cutting : design of cutting tools ; machine tools for thread and gear manufacture ; superfinishing processes.

Metrology : limits, fits and tolerances ; methods of assembly, interchangeable and selective ; comparators, thread and gear measurement ; surface flatness and roughness ; interferometry ; machine tool testing.

Foundry engineering : properties and testing of sands ; binders and additives ; solidification of castings ; gates and risers ; modern casting processes ; foundry practice relating to grey iron, malleable iron, steel, copper and aluminium base alloys ; defects in castings ; inspection of castings.

Heat treatment.

A practical course covering the above.

422. Metal Processing (1-2).

Theory of metal cutting and metal forming : cutting forces, tool geometry and cutting fluids ; plastic working, stresses and loads ; forming, machining and drawing of aircraft materials ; introduction to numerical control applied to machining.
Engineering metrology: geometric errors and control of screw thread and gear teeth, etc.; comparators and measuring machines.
Die casting: materials and dies; die casting processes.
Welding: welding of non-ferrous materials, equipment and testing.
Finishes used on aircraft materials.

(For Aeronautical Engineers)


432. Heat Power Engineering (2-2).

Internal combustion engine theory and practice. Refrigeration and cold storage practice and equipment.

(For Agricultural Engineers)


Steam generating equipment and accessories. Steam turbines and auxiliary equipment. Fuels for steam plants and introduction to combustion phenomena.


Single and multistage expansion and compression of gases.
Vapour compression and vapour absorption refrigeration cycles.
Air compressors and auxiliaries.
Introduction to gas turbines.
The course includes tutorials as well as laboratory work in the Steam Laboratory and Internal Combustion Engines Laboratory.

(For Chemical Engineers and Naval Architects)

434. Prime Movers (2-3).

Reciprocating and rotary type internal combustion engines. Water power engineering. Steam power generating equipment.

(For Electrical Engineers)

435. Air Conditioning and Ventilation (2-0), Second Term.


(For Architects)

441. Hydraulic Machines (2-2).

Dynamic action of moving fluids.

Construction, operation and performance of impulse and reaction turbines: Pelton wheel, Francis turbine, Kaplan turbine and tubular turbine.
Dimensional analysis and principle of similitude applied to turbines. Specific speed of turbines.

Construction, operation and performance of positive displacement pumps: reciprocating pump and rotary pumps.

Construction, operation and performance of rotodynamic pumps: centrifugal, mixed flow and axial flow pumps.

Dimensional analysis and principle of similitude applied to rotodynamic pumps. Specific speed of pumps.

Construction and operation of fluid coupling, torque converter and hydraulic dynamometer.

Cavitation in hydraulic machines.

Hydrostatic machines: accumulators, intensifiers, jacks, lifts and presses.

Oil hydraulic systems: oil pressure governors and control mechanisms; oil pressure circuits for machine tools.


Design of machine parts subjected to:

(a) friction, such as clutches, brakes and belt drives;
(b) combined loads and shock loads, such as crankshafts, springs, buffers and gears.

Design of space mechanisms such as universal joints and steering gears.

Design of flywheels, high speed rotors and thick cylinders.

Design of bearings.

Design of pressure vessels such as air receivers and accumulators.


Same as 451 but problems for design practice to be suitably modified.

(For Agricultural Engineers)


Clutches, brakes and different types of drives, such as, belt, rope, chain and gear. High speed bearings. Design of springs for shock and vibration isolation. Design of flywheels and high speed rotors.

(For Electrical Engineers)

454. Theory of Machines and Mechanism II (2-1).


Vibration of single degree of freedom systems. Transverse and torsional vibrations of shafts and rotors. Critical speeds.

461. Mechanics of Solids I (2-3)

Plain stress and strain analysis and strain rosettes; problems of combined bending, twisting and axial loading.

Statically indeterminate beams. Unsymmetrical bending of beams; shear flow in beams. Bending of curved beams; circumferential and radial stresses.

Thick walled cylinders and compound cylinders.

Rotating discs of uniform thickness.
Strain energy under different kinds of loading. Energy methods for statically determinate and indeterminate problems.

462. Mechanics of Materials and Machines (2-1).


(For Aeronautical Engineers)

511. Industrial Management (2-0).

Development of production system and forms of ownership.

Evolution of management science.

Decision making for production system through economic, graphical, statistical and mathematical tools.

Design, operation and control of production systems covering product, organisation, work study, plant location, plant selection and layout, plant buildings, production planning and control, inventory control, quality control, plant maintenance, job evaluation, merit rating, wages and incentives.

Cost control including budgetary control and depreciation studies.

(For AE, EE, Comm, ME, Met and Min)

521. Metal Processing (2-3).


A course of laboratory experiments covering the above.

523. Production Engineering (Elective) (2-2).

Metal manufacturing processes; foundry, forging, machining and welding. Machine tools and small tools; applications. Manufacturing economics.

(For Agricultural Engineers)

524. Production Engineering Project (1-5).

Design of production tooling; jigs and fixtures, cams and layout for turret lathes and single spindle automatics. Plastic working tools. Limit gauges. Introduction to the design of a production system.

A course of project relating to the above.

528. Engineering Quality Control (Elective) (1-1).


Control charts:—X-R charts, p-charts, c-charts, some special control charts. Acceptance sampling:—single, double and multiple sampling plans. Elements of reliability engineering.

531. Heat Power Technology II (2-4).

Elements of gas dynamics. One dimensional flow.

turbine characteristics. Refrigeration cycles and equipment. Air conditioning principles and
practice.

532. Steam and Compressed Air Power, First Term (1-2), Second and Third Terms (1-0).
Steam boilers, boiler fittings and accessories. Steam turbines and condensers. Power
plant economics. Compressed air generation, distribution and utilisation.
Laboratory work in the first term only.
(For Mining Engineers)

554. Instrumentation and Controls (2-1).
Mechanical transients. Instruments and instrumentation for measurement of mechanical
quantities. Accuracy, precision, error and calibration. Introduction to dynamics of auto-
matic controls.

555. Design Project (1-5).
A general design course based on topics covered in the earlier courses on drawing and
design and involving detailed design calculations, economy analysis and preparation of working
drawings of complete machines such as water turbines, pumps, jacks, pulley blocks, winches,
cranes, conveyors, presses and simple machine tools.

557. Cargo Handling (2-2), First and Second Terms.
Equipment on board ships:—Pulley blocks, winches, capstans, derricks and floating
cranes.
Dockyard equipment:—Rotary jib cranes, wharf cranes with grabs, belt and pneumatic
conveyors and bucket elevators.
(For Naval Architects)

561. Mechanics of Solids II (2-1).
Columns and beam-columns. Elements of beams-on-elastic-foundation. Bending of thin
circular plates.
Elements of three dimensional stresses. Theories of elastic failure.
Elements of theory of elasticity. Two dimensional problems in rectangular and polar
co-ordinates.
Torsion of non-circular sections; analogies.

568. Applied Fluid Flow, Plasticity and Experimental Stress Analysis (Elective), (1-1).
Unsteady flow in one dimension; steady flow in two dimensions.
General analytical relations for viscous flow.
Theory of hydrodynamic lubrication.
Elements of plasticity and experimental stress analysis.

METALLURGICAL ENGINEERING (Met.)

311. Elements of Metallurgy (1-0).
Introduction: Indian Mineral resources and metallurgical industries, location of ore
bodies and the extraction plants, economic importance of metallurgical industries.
Extractive Metallurgy: Preparation of ore, elements of ore-dressing and ore benefici-
ation, principles involved in the different processes used in extraction, roasting, reducing, smelting,
refining, simple flowsheets for Fe, steel, Cu, etc.
Physical Metallurgy: Crystal structure and grain formation of pure metals, cold
working of metals, effects and annealing. Equilibrium diagrams of binary alloys.


(For AE, AgE, ChE, CE, EE, Comm., ME)

312. Metallurgical Laboratory (0-2).

Practical work will include metallography, heat-treatment of metals and alloys, use of hardness testing equipment etc.

(For Mechanical Engineers)

313. General Metallurgy (2-2).

Introduction: Indian mineral resources and metallurgical industries, location of ore bodies and extraction plants, economic importance of metallurgical industries.

Extractive Metallurgy: Preparation of the ore, elements of ore-dressing and ore beneficitation, principles involved in the different processes used in extraction, roasting, reducing, smelting, refining, simple flowsheets for Fe, Steel, Cu, Al, Zn and Mg. Familiarising the students with some typical names: checker works, tapping and tap holes, pitside, ingot and ingot molds, soaking pit, reheating furnaces, size of a rolling mill.

Physical Metallurgy (General): Metallic bonds, different kinds of metallic crystals, solid solutions, substitutional and interstitial types. Grain formation in crystals, chill castings nucleation and growth. Electrical and magnetic properties of metals. Elastic and plastic properties of single and polycrystalline solids, cold and hot working, grain-refinement. Binary alloys, equilibrium diagrams, complete solid solubility, partial solubility, complete immiscibility, intermetallic compounds, thermal analysis.


314. Elements of Metallurgy (2-0), First and Second Terms.

Same as Met—311 except paras 1 & 2 (For Final Year Mining Engineers).

411. Extractive Metallurgy of Iron and Steel I (2-1).

Manufacture of Iron & Steel in ancient India; World’s production of Iron & Steel—India’s share, occurrence and distribution of iron ores, iron ores of India, preparation of iron ores.

Blast furnace and its accessories: Iron blast furnace, general features, construction of the furnace, foundation, hearth, tuyeres, bosh and bosh angle, stack and top. Furnace lines, furnace linings, hoisting appliances, trend of modern improvements in blast furnace construction, Two-pass and three-pass stoves, stove burners and valves, stove linings, dust catcher and gas mains, cleaning of blast furnace gas and its utilisation, blowing engines, plant layout.

Operation and other details: Smelting of iron ores in the blast furnace, chemistry of smelting, burden calculations, advantage and necessity of preheating of the blast, evil effects of too much moisture in the blast, conditioning of blast, effect of furnace burden and conditions of working on the different composition of pig iron, heat balance, enrichment of blast, distribution of raw materials, high top pressure and other recent trends leading to reduced coke consumption and increased production. Some common operating troubles—causes and remedies, consideration on the design of blast furnaces, blast furnace products, composition and grading of pig iron, influence of different constituents on the properties of pig iron, manufacture of spiegelisen, ferromanganese, ferrosilicon in blast furnace, manufacture of pig iron by processes other than blast furnace, manufacture of sponge iron, wrought iron.
412. Foundry Metallurgy (2-3).

Cupola and Air furnaces, charge calculation and operation of cupola, sizing, grading and handling of mould materials, standard and modern methods of moulding, melting, alloying, gating, venting, production of non-ferrous castings and inherent difficulties, choice of sands, etc., for non-ferrous alloys, metallurgy of inoculation and nodularising treatment.

Practical work in the Institute's foundry shop based on theoretical syllabus.

413. Physical Metallurgy I (2-3).

Crystalline nature of metals, lattice parameter, miller indices, important crystalline planes, closest packing of atoms in FCC and HCP lattice, grain formation of metals by various processes, nucleation, grain growth, heating and cooling curves. Effect of a second element on the structure of metals, properties, crystal structure, location of the second atom (Fe-C, Cu-Ni etc.). Hume-Rothery rules, substitutional and interstitial solid solutions, intermediate phases, ordered phase—typical example of industrial alloys like Cu-Ni, Fe-C, Cu-Zn, Cu-Sn, etc.

Equilibrium diagrams: Systematic studies of various types of binary diagrams, correlation among equilibrium structure, microstructure and physical properties of alloys like Fe-Fe3C, Cu-Zn, Cu-Sn, Cu-Ni, Pb-Sn, Al-Cu, Al-Si. Ternary equilibrium diagrams, typical alloys. Methods of detection of phase changes and construction of equilibrium diagram, resistivity measurement, dilatometry, cooling and heating curves, specific heat measurement.

Temperature measurement and control: Thermocouple, resistance optical radiation, photoelectric type pyrometers, temperature controllers etc.

Metallurgical Microscope: Types of eyepieces and objectives generally used, blooming, resolving power, magnification, depth of focus, photomicrography.

Practical and sessional work will be based on the above syllabus.

414. Refractories (1-0), First / Third terms, and (0-2), Second term.

Refractories—different types, physico-chemical properties, resistance to erosion, high temperature, temperature variation, molten metal and slag, expansion, contraction, specific heat, porosity, permeability, thermal and electrical conductivity, preparation of refractory materials, their use in the manufacture of firebricks, silica bricks, etc., refractory materials used in different types of metallurgical furnaces.

415. Mechanical Metallurgy I (2-3).

Elastic and plastic deformation of single crystal and polycrystalline aggregates, annealing, recovery, recrystallisation and grain growth, hot and cold working, orange peel effect, stretcher strain, yield point phenomena. Ageing—quench ageing, strain ageing, strain age-hardening. Flow and fracture of metals, effects of temperature, strain rate, composition, structure, triaxiality of stress. Testing—scope, purpose, interpretation of testing methods, sampling and its limitations. Destructive testing—tensile, impact, fatigue, creep etc., dependence of composition and structure. Non-destructive testing—magnetic, ultrasonic, electrical etc., limitations of each method, inspection of defects and different methods of testing.

416. Extractive Metallurgy of Non-ferrous metals (2-1).

Study of the processes relating to recovery of non-ferrous metals, their refining, reclamation of secondary metals, metals to be studied consist of Cu, Pb, Zn, Ni, Sn, Cd, Mn, Au, Mg, Ag, Cr, W, Mo, V and Ti. Recent developments of non-ferrous metals industry in India, metallurgical calculations related to different processes, chief physical, mechanical and chemical properties as well as the uses of the above metals and alloys.

417. Metallurgical Thermodynamics and Chemical Kinetics (2-1).

Laws of thermodynamics, Maxwell relations—applications, thermal capacity of gases and solids, Hess's law, use of standard tables, free energy and thermodynamic potential, condition of equilibrium, chemical equilibrium, equilibrium constants of homogeneous and heterogeneous systems, use of standard tables of thermodynamic functions, solutions, dilute solutions, derivation of Raoult's law, deviations, concentrated solutions, concept of activity, activity coefficient, partial molar free energies, choice of standard state, electrolytic solutions, electrode potential, chemical and electrical energy, reference electrode, polarisation over-voltage, electrodeposition of metals and alloys. Phase rule—application to systems, adsorption and absorption, adsorption on surfaces, Gibb's equation, chemical kinetics, importance of rate of nucleation, concept of activated state, order of reaction, applications.
419. Engineering Metallurgy (2-0), First and Second Terms.

Indian mineral resources and metallurgical industries, location of ore bodies, and the extraction plants, economic importance of metallurgical industries. Crystal structure and grain formation of pure metals, cold working of metals, effects and annealing, equilibrium diagram of binary alloys. Study of Fe-C equilibrium diagram, heat treatment, properties and uses of plain carbon, low alloy structural and high alloy steels, hardenability, selection of steels for specific purposes. Cu-Zn, Cu-Sn, Cu-Ni, Al and its alloys, properties, uses and heat treatment of industrial alloys. Tensile, impact, fatigue and creep, dependence on composition, structure and significance of various tests. Theories of corrosion, general principles of corrosion control, methods of corrosion prevention, selection of metals for use at low and high temperatures, corrosion testing, metal finishing, surface treatments.

(For Naval Architects)

511. Extractive Metallurgy of Iron and Steel—II (2-1).

Cementation and crucible steel making processes, importance and uses of crucible steel, active and inactive metal mixers. Acid and Basic Bessemer processes, construction and lining of converters, raw materials, operation of the converters, recarburisation, teeming, chemistry of the processes, methods used to follow the progress of the blow, after blow in the basic process, modern developments and modification of the process. Acid and Basic open hearth process, raw materials, furnace, general features, size, capacity, bottom, hearth, roof, refractories used, life of furnace, regenerators, parts and valves, fuels, tapping, types of furnaces—stationary and tilting, operation of the furnace, chemistry and kinetics of the processes, furnace charges, slag volume, removal of impurities, slag control, deoxidation, ladle additions, duplex and triplex processes, recent developments leading to increased production. Electric processes, power requirements, arc furnaces and induction, chemistry and kinetics of the reactions, pit side practices, ingot structure and ingot defects, remedies with reference to type of molds, teeming speed, chemistry of steel, dressing of molds, etc., comparison of steels made by different processes, use and general properties, brief outlines of the processes of manufacturing alloy steels.

512. Mechanical Metallurgy—II (1-0).

Working of metals, stress conditions governing the flow of metals in hot and cold working, work of deformation, characteristics and elements of the theories of various shaping operations—forging, rolling, extrusion, drawing relationship between the properties of metal and shaping processes. Metallurgical defects and difficulties encountered in metal forming, joining methods, welding, brazing and soldering.

513. Physical Metallurgy—II (2-3).

Heat treatment of cast iron and carbon steels, various processes and their effects on microstructures and physical properties, isothermal transformation in steel, effects of alloy additions in steel, modification of heat treatment operations, heat treatment of important alloy steels. Grain size, grain growth, overheated and burnt steel, temper brittleness. Mass effect, hardenability, measurement, calculation, calculation from composition, effect of quenching severity of cooling media etc. Special methods of heat treatment, martempering, austempering, deep freezing, case hardening, cyaniding, nitriding, induction hardening, gas carburizing, brief reviews of the theories of age-hardening. Furnaces for heat treatment, atmosphere and temperature control. Microscopic, dilatometric, magnetic and resistivity methods of studying equilibrium and isothermal diagrams.

Practical work based on the above syllabus covering all phases of theoretical study.

514. Applied X-Ray and Metal Physics (2-3).


Industrial Radiography: Operation of X-Ray Industrial unit limitations and precautions. Use of Radiography and radiotherapy with radioactive cobalt, comparison between their fields of applications.

Metal Physics: Structure of atom, quantum numbers, exclusion principle, electronic configuration of important elements and its influence on the properties. Bonds, Hume Rothary
rules and formation of alloys, uncertainty principle, electron theory of metals, electrical and thermal conductivity, magnetism, specific heat of metals. Elements of Zone theory and its application. Elements of the following topics—internal friction, diffusion, radiation damage, electron microscopy and diffraction, metallurgy of the liquid state.

515. Extractive Metallurgy Laboratory (0-3).

Experiments are designed to illustrate the principles involved in the extraction of metals—thermal decomposition of carbonates, oxides, sulphides etc., reduction of iron oxides, C—CO—CO reaction, chloridation metallurgy, matte-metal reaction, electrometallurgy experiments. The students are required to study the thermodynamics and kinetics of the reactions.

516. Advanced Metallurgy of Alloy Steel (Elective) (2-2).

Detailed study of important low, medium, high alloy steel manufacture, fabrication, heat treatment, constitution metallography, selection and application. Austenitic transformation by nucleation, growth and other mechanisms, application of stress to austenitic steels and their effects on Ms, hardenability, and its determination.

517. Material Engineering / Powder Metallurgy (1-0).

Materials for heavy structures (plain carbon and alloy steels), materials for tools, materials for electrical industries magnets, resistance elements, electrical contacts etc., elements of Powder metallurgy.

518. Furnace Technology (Elective) (2-2).


520. Advanced Foundry Metallurgy (Elective) (2-2).

Advanced study of the topics covered under Met. 412.

521. Seminar (Works visit, vocational training etc.) (0-1).

522. Project and Report (0-6).


Physical and extraction metallurgy of metals and alloys used in Atomic Energy generation, niobium, plutonium, thorium, uranium, etc., discussion of the metallurgical processes of fabrication and handling techniques of these metals and their alloys, metallurgy of liquid metals and radiation damage.

525. Electrometallurgy and Corrosion (1-1).

Principles of extraction and refining of metals and alloys and electroplating of metals and alloys, flow sheet of electrolytic extraction and refining of the following metals—Ca, Mg, Al, Cu, Zn, Ni, Pb, Mn, Au, Ag. Electro-plating of Cu, Zn, Cd, Ni, Cr and their alloys. Electro-thermal process of reducing iron from its ore. Theories of corrosion, general principles of corrosion control methods (corrosion prevention, selection of metals for use at high and low temperatures, corrosion testing, metal finishing, surface treatment.

529. Metallurgy (2-2).

Hot working of steel ingots : forging : hammer forging, drop forging, press forging; rolling of plate, sheet, sections, bar, rod, etc.: fibre, effect of working temperature on final structure and properties, defects; final heat treatment; effect of size. Cold working; reasons for cold working; strengthening, surface finish, dimensional accuracy etc. ; cold forming,
strain ageing, etc. Surface hardening of steels; flame hardening, induction hardening; carburising; nitriding. Alloy steels; the functions of alloying elements; effects on thermal equilibrium and resulting changes in response to heat treatment; hardenability—effect on overall mechanical properties; other effects of alloying elements. Engineering steels and their treatment; oilhardening steels, temper brittleness. Alloy structural steels; heat treatment, weldability. Stainless steel and heat-resisting steels: martensitic, i.e. heat treatable stainless ferritic stainless irons; austenitic steels, weld decay and its prevention, Hadfield manganese steel. Tool steels: carbon steels, low alloy die-steels; high speed steel, red hardness, carbide-tipped tools. Armour plate: Cemented plate alloy plate. Creep: Metallurgical aspects, and creep resistance, compositions. Brittle fracture: relation to lattice structure; effect of composition on transition temperature. Cast irons: equilibrium relationships; effect of composition, rate of cooling, superheat, on carbide/graphite reaction. White iron, grey iron, phosphoric iron; mallealised iron castings, spheroidal graphite iron, alloy cast irons. Joining of metals: Fusion welding of steels: grain structure of welds; single and multi-run welds; stresses in weld-metal; effect of martensite and hydrogen in welds; weld cracking and its avoidance; welding of dissimilar steels. Welding of aluminium and other non-ferrous metals. Brazing and soldering. Cold welding. Laboratory work: To cover the different aspects of the above syllabus.

MINING ENGINEERING (Min.)

311. Mining Engineering I (2-0).

Boring: Simple hand methods, percussive and rotary boring methods for prospecting and miscellaneous purposes (both surface and underground); drilling for petroleum; deviation of boreholes; difficulties in borehole surveying and logging; directional drilling.

Explosives: Nature, characteristics and classification; tests; fuses, detonators, blasting devices and accessories; substitutes for explosives; handling and storage; charging and firing; safety precautions.

Blasting: Theory of blasting; pattern of holes; blasting practices in coal and metal mines.

Mine Support: Mine timber; simple timber-, steel-, masonry- and concrete supports for roadways and faces; pillars; filling.

Mine Gases: Occurrence, properties, physiological effects, detection and estimation.

411. Mining Engineering II—First Term (3-0). Second and Third Terms (2-0).

Mine Development: general principles of planning for coal and metal Mines; mine entries; drifting and tunnelling; winzing and raising; other subsidiary developments.

Shaft Sinking: Ordinary and special methods for vertical and inclined shafts; shaft support; widening and deepening of shafts; internal shafts.

Rock Mechanics: physico-mechanical properties of rocks; rock pressure, its measurement and influence on mine design; mine subsidence.

412. Mining Engineering III (2-0).

Underground methods of mining coal: general principles and modern practices of underground mining methods.

Underground metalliferous mining methods: general principles, and methods of stoping; caving methods.

413. Mining Engineering IV (2-3).

Temperature and humidity; air conditioning for mines; mechanics of air-flow; natural ventilation: mechanical ventilation; distribution and regulation of air quantities; auxiliary ventilation; ventilation measuring instruments; ventilation surveys; ventilation planning.
Mine fires and mine explosions.

Mine Illumination: Vision; standards of lighting; problems and practices of illumination in mines; flame and electric safety lamps; lamphouses, maintenance and organisation.

Mining Engineering Laboratory work in Ventilation: measurement of air quantity, pressure, temperature, humidity, cooling power, resistance in an air-way; determination of pressure loss due to bends and changes of cross-section in ducts, fan characteristics. Calibration of air measuring instruments: detection and estimation of firedamp; analysis of mine air.

414. Mining Machinery I (3-2) First Term (2-2) Second & Third Term.

Elementary treatment of mechanical transmission of power, couplings and clutches, brakes, pneumatic and electric drills, drill steels and bits.

Pneumatic picks; coalcutting Machines.

Ropes, rope haulages and rope haulage calculations. Mine locomotives and locomotive haulage calculations.

Mine cars; tracks.
Cages, skips; shaft-fittings; head frames and bins.
Pitbottom and surface layouts.
Mine pumps.
Mining Machinery Laboratory work.

415. Mine Surveying I (3-3). First and Second Terms, (2-3)—Third Term.

Principles of mine surveying. Linear Surveying.
Ordinary levelling: Definitions; the earth’s curvature and atmospheric refraction.
Methods of levelling. Levels: types, their construction, adjustment and care.
Types of levelling. Setting out levels. Errors in levelling, accuracy.
Angles and directions: Bearings and azimuth.
The Compasses: their construction tests and adjustments.
Compass surveying, sources of errors.

The theodolites: Types, construction and adjustments.
Measurement of angles. Sources of errors.
Theodolites Surveys: Methods of traversing surface and underground. Checks, accuracy, and adjustments.

Triangulation: systems, classification, location of stations, measurement of angles and the base line, adjustments.

Stadia surveying: Theory, instruments, methods. Errors and accuracy.
Contours, contouring and contour-map studies.

Dip and fault problems, computation of areas and volumes, enlarging and reducing of plans. Fieldwork, computations and plotting connected with the above surveys.

511. Mining Engineering V (3-2).

Opencast mining: general principles and modern practices of opencast mining of coal, lignite, ores and other minerals; alluvial mining. Mine rescue and recovery work; water dangers in mines.
Advanced face and roadway support.

Methods of roof control: caving; partial-, and solid stowing methods. Mine Hygiene: occupational diseases; pathogenic dust, its measurement and control.

A more advanced treatment of special subjects dealt with in Mining Engineering III & IV.

A course of lectures on First Aid to the injured.

512. Mining Machinery II (3-0) First Term (2-0) Second and Third Terms.

Conveyors: shaker-belt, steel plates, and scraper chain types, their construction and design; spiral chutes.

Aerial ropeways: their construction and design.

Mine hoists: types, safety and control devices; brakes. Loading machines at coal faces, in stopes, and tunnels.

Coal face mechanisation.

Advanced treatment of some opencast mining equipment.


Statutory provisions relating to safety, welfare, connession and conservation, and their administration.


World mineral economics; mineral industry in India. Mine sampling; mine reserves; mine examination and valuation; mineral conservation. Organisation of mining enterprises; mine organisation and administration.

514. Mine Surveying II (2-3).

Precise levelling: Instruments and method, accuracy. Transferring the meridian through vertical and inclined mine openings.

Control of direction and grade of inclined workings.

Measurement of depth of shaft; shaft plumbing.

Setting out curves on surface and underground.

Stope surveys; Opencast survey.

Mine plans, projections and sections. Tridimensional representation of mine workings.

Special mine surveys: Boundary surveys, surveys for installation of mine structures and equipment, subsidence etc.

Elements of Photogrammetry.

Elements of astronomy and astronomical observations.

Computation of volumes of opencast excavations, spoilbanks, storage piles etc. Fieldwork; Mine survey camp.

515. Project (0-6).

The preparation of a comprehensive plan for a part or complete coal or metal mining project.

Thesis:—A study of some special subject in coal or metal mining approved by the Head of the Department. Details of investigation are submitted for examination in the form of a thesis.
NAVAL ARCHITECTURE & MARINE ENGINEERING (N.A.)

111. Orientation (1-0).

221. Ship Drawing and Calculation I (2-3).
Simpson's, Tchebycheff's, Gauss's and Trapezoidal rules.
Conditions of equilibrium, Initial stability.
Longitudinal metacentre and trim.

Launching.

Linesplan, Bonjean curves, Hydrostatic calculations.

311. Ship Theory I (2-0).
Planimeter, Integrator and Integraph.
Stability of ships at large angles.
Flooding and subdivision.
Capacity, Loading calculations, Tonnage.

312. Practical Shipbuilding (2-0).
Types of ships, Shipbuilding Materials, Riveting and Welding.
Hull structures. Rules of the Classification Societies and the Ministry of Transport.
Ship's equipment and outfit.

313. Statics of Ship Forms (2-0).
Theorems on fluid pressure under gravity. Thrust on plane and curved surfaces. Centre of pressure.


Surface Tension.


321. Ship Drawing and Calculation II (0-6).
Launching calculations.
Flooding calculations.

411. Seagoing Qualities of Ships (1-0) First and Second terms. (2-0) Third term.
Waves—theory and data.
Unresisted and resisted motions (rolling, pitching and heaving) in still water and in a regular seaway. Motion stabilisers.


412. Resistance of Ships (2-0).
Components of total resistance.
Dimensional analysis. Reynolds number. Froude number.
Frictional resistance. Planck experiments.
Boundary layer concept. Separation.
Effect of roughness.
Wave resistance and wave interference.
Resistance of a ship in shallow water.
Presentation of Resistance data.
Estimation of the resistance and effective power of ships from methodical series and statistical data.
Features of the hull form.

413. Strength of Ships (2-0).

Longitudinal strength. Bending moment in still water and in waves. Section modulii and stresses in structure. Weight, buoyancy and load curves. Deflection of ships.


Transverse strength.

Strength of plating and bulkheads.

Estimate of steel weight of ships.

Full scale experiments on strength of ships.

421. Ship Drawing and Calculation III (0-14).

Longitudinal and transverse strength calculations. Midship section, hold section, bulkheads, and shell expansion drawings.
Calculation of frequency of vertical vibration by full integral method.
Estimation of effective power from series and statistical data. Preliminary calculation for design project.

424. Ship Hydrodynamics I (2-0).


428. Ship Design I (1-0) First and Second Terms (2-0) Third Term.


515. Shipyard Organisation, Tenders and Contracts (3-0) First & Second Terms.

Shipyard layout, equipment, and ship building methods.


516. Propulsion and Steering (4-6) First and Second Terms.


517. Propulsion and Steering (4-3) First and Second Terms (0-3) Third Term.

Same as NA 516 but with reduced number of hours for Naval Construction Option.

521. Ship Drawing and Calculation IV (0-12) First and Second Terms.


524. Ship Hydrodynamics II (2-1) First and Second terms for regular course, and (2-1) all terms for Naval Constructor Option.


(For Naval Construction Option) Third Term: Elliptic cylinder in a stream, elliptic coordinates, force and moment on elliptic cylinder in a stream; Moving cylinders, kinetic energy, resistance; Cylinder moving under gravity, Rotating cylinders containing fluid, Motion symmetrical about an axis, Stokes stream function, submarine explosion, airship forms, Sphere in a stream, Spherical harmonics; Moving sphere, pressure distribution, Concentric spheres. Motion of two spheres, Sphere in the presence of a wall; Motion of a solid through a liquid, the impulse, Kirchoff's equations, axes of permanent translation, stability.

525. Design of Warships (2-0).

Ship Design procedure; Dimensions and form; General layout.

Estimation of effective power; Selection of suitable forms; Propulsion requirements.

Displacement and weight groups; Armament group; Radio and underwater protection group; Machinery group; Equipment group; Hull group; Fuel and endurance.

Aircraft carriers; Submarines.

Completion and trials.

526. Warship Drawing and Calculation I (0-12) First and Second Terms. (0-16) Third Term.

Warship design project: preliminary calculations and drawings.

527. Practical Warship Building (1-0) First and Second Terms (2-0) Third Term.

Building slip; Hull structure; All welded construction by prefabrication methods; and Launching arrangements.

Fresh and salt water services, Fuel oil system, Fire protection, Ventilation and air conditioning, Accommodation, Hull equipment and outfit.

Warship construction, Materials, Riveting and welding, Docks and caissons and Special types of ships.

Some problems of laying-off.
528. Ship Design II (3-0) First and Second Terms.

Design Factors in different types of vessels.
Fixing of main dimensions.
Freeboard regulations and applications.
Method of calculation of weights.
Application of Classification Society and Ministry of Transport regulations.
Types of main and auxiliary machinery. Allotment of machinery space. Bunker capacity. Fire precautions etc.

529. Stability of Warships (2-0).

Special problems of warship, Production of stability curves (naval practice). Effect of free surface and moving weights, List and loll, Dynamical stability, Effects of grounding and docking. Effects of bilging and adding weights, Stability standards, Effect of subdivision, Stability after damage, Metacentric diagrams and their geometry; Effect of dimensions and form, Pumping out of liquids from compartments, Submarine flotation and stability.

611. Resistance and Propulsion of Warships (2-0).

Some special problems of warships, Methods of calculating resistance, Model experiments, Iso- (K) diagrams, Methodical series, Effect of shallow water, Interaction between ships, Effect of changes of dimensions and speed, Pinning forms.

Some practical problems of propulsion, Hull efficiency components, Cavitation and cavitation tunnels, Propulsive efficiency, Prediction of optimum propulsive coefficient for new design, Propeller design, Estimation of endurance, Speed trials and their analyse.

612. Structural Design of Warships (2-0).

Basic principles, Types of loading, Longitudinal strength, Stress concentrations and discontinuities, Flat plates, Bending of stiffened plate, Superstructures, expansion joints, Grillages. Docking problems, Relaxation methods, Elastic instability, Submarine strength and structure, Plastic design, Dynamic loading, Vibration of ships, Brittle fracture, Under-water explosion and shock, Experimental stress analysis, Structural materials, Special structures, Main transverse bulkheads, Complete structure of ship.

615. Shipyard Organisation, Tenders and Contracts (2-0).

Same as NA 515 with reduced number of hours for Naval Constructor Option.

624. Ship Hydrodynamics III (2-1).

Wave motion, Shallow and deep water waves, Waves in a tank. Waves at an interface, Wave resistance, Surface tension; ripples, Effect of wind.

Matrices and Tensors.


Probability; Frequency distributions; Means, moments, expected values, standard deviation, variance; Binomial, Poisson, Gaussian and Gamma distributions; The distribution of errors.

626. Warship Drawing and Calculation II (0-20).

Warship design project.
PHYSICS & METEOROLOGY (Ph.)

111. Physics (3-3).

General Properties of Matter:

Principles of measurement.

Review of the topics like work and energy; conservative and dissipative forces. Conservation of energy and momentum; Elastic and inelastic collisions; Circular motion, simple harmonic motion etc. Graphical representation of S.H.M. Elastic constants and their measurements. Surface tension, angle of contact, simple cases of surface tension and its measurement.

Acoustics:


Heat and thermal properties of matter:

Expansion of solid, liquid and gases; specific heat of gases, liquid and solids; equation of state (results only). First law of thermodynamics, internal energy and external work; isothermal and adiabatic processes. Humidity; Dewpoint. Simple cases of heat flow by conduction, convection and radiation; general properties of radiation, radiation Pyrometers.

Optics:

A short review of Geometrical Optics.

Combination of thin lenses, thick lenses, dispersion.

Illumination, intensity, power, etc. Elements of spectroscopy.

Nature of light.

Electricity and magnetism:

Review of the topics like electric and magnetic fields, potential, equi-potential surface, lines of force etc. Field due to a dipole and a magnet. Force and energy between two dipoles and magnets, electrostatic and magnetic instruments. Ohm's law and Kirchoff's law and their simple applications. Measurement of current, resistance and potential difference.

(For Science Stream)

112. Physics (4-3).

General properties of matter:

Principles of measurement, Mass and Weight, Specific gravity and density, Archimedes' principles, pressure in a fluid—measurement of pressure, centre of pressure, thrust, Pascal's law; floating bodies, principle of stability; Pumps, barometer. Review of the topics like work and energy, conservative and dissipative forces, virtual work, conservation of energy and momentum, elastic and inelastic collisions, circular motion, simple harmonic motion, etc. Graphical representation of S.H.M.; principle of superposition, combination and resolution of S.H.M.

Acoustics:

Progressive wave, reflection, stationary wave, beats, combination of tones, velocity of sound. Transverse vibration of strings. Measurements of room acoustics.

Heat and thermal properties of matter:

Thermometry. Expansion of solid, liquid and gases. Specific heat of solids, liquids and gases; equation of state (results only). Mechanical equivalent of heat. First law of thermodynamics; internal and external work; isothermal and adiabatic processes. Hygrometry; Change of state; transmission of heat, steam engine, petrol engine. Humidity.
Optics:
Selected topics of geometrical optics, velocity of light, group velocity, Mirage and rainbow. Eye as an optical instrument, production and measurement of spectrum. Kirchhoff's law of emission and absorption and its application. Elements of photography. Defects of the image by a single lens. Combination of thin lenses, thick lenses, dispersion, optical instruments illumination, intensity, power, etc.

Elements of electricity and magnetism:
Review of the topics like electric and magnetic fields, potential, equipotential surface, lines of force etc. Field due to a dipole and a magnet. Force and energy between two dipoles and magnets; Force and energy of a body in a magnetic or electric field; electrostatic and magnetic instruments.
Ohm's law and Kirchhoff's law and their simple applications. Measurement of current, resistance and potential difference. Simple Laboratory experiments (two hours per week) pertaining to subject matter covered.
(For Technical Stream)

113. Physics—(3-2).

Properties of matter:
Surface tension—surface energy, rise of liquid in a capillary tube.
Viscosity of liquids—and Motion of liquid through a tube.

Sound:
Concepts of vibration, forced vibrations and resonance. Waves and their propagation in material media and related topics, musical scale.

Heat:
Review of thermometry and calorimetry.
Coefficient of expansion of solids and coefficient of real and apparent expansion of fluids.
Elements of heat transfer phenomena (conduction, convection and radiation).
Coefficient of humidity & its measurement. 1st and 2nd laws of thermodynamics.

Optics:
Refraction & Reflection at a curved surface, thin lenses and combination of thin lenses, chromatic and spherical aberration and their removal, & description of other defects of images.
Simple optical instrumentsand their magnifying and resolving powers.
Sources of light, measurement of their brightness and intensity of illumination, various units of measurements in photometry, some ideas of about optics of vision and colour. Elementary discussion about science of photography. Elements of wave theory of light (interference, diffraction and polarisation)—(descriptive treatment only).

Electricity and Magnetism:
Review of basic laws of electrostatics and magnetostatics, qualitative ideas about conductors, insulators and magnetic materials.
Concept of magnetic and electric field intensity and induction vectors and potential.
Field of a dipole.
Gauss's theorem and its simple applications.
Phenomena of electro-magnetic induction, self and mutual inductance, growth and decay of current.
Discussion about various systems of units in electricity and magnetism.  
(For Architects)

221. Physics (3-3).

**Thermodynamics:**
Reversible and irreversible process. Carnot's cycle; laws of thermodynamics; absolute scale of temperature; entropy; entropy of perfect gas. Maxwell's relations and simple applications. Discussion of black body radiation.

**Kinetic theory of matter:**
Boltzmann velocity distribution law, Brownian motion, mean free path, transport phenomena. Equation of state. Vacuum pumps, measurement of low pressure.

**Electricity and Magnetism:**

**Wave optics:**
Huygens' principle. Selected topics of interference diffraction and polarisation. Magneto and electro-optical effects.

**General properties of Matter:**
Free, damped and forced oscillations, resonance; Ballistic pendulum, conical pendulum. Rotational motion, moments of inertia, simple gyroscope.
Simple laboratory expts. (2 hrs. per week) pertaining to subject matter.

311. Physics (2-0).

**Atomic Physics:**
Elementary particles, atomic structure; excitation and ionisation; properties of gaseous ions. Discharge in gases; glow discharge; Thermionic emission.

**Quantum Theory of Light:**
Planck's law; photoelectric effect; photoelectric emission; compton effect.

**Atomic Spectra:**
Energy levels; quantum number; elements of spectroscopy; Pauli-Principle and periodic system of elements. X-rays and Crystal structure (Simple description).

**Atomic Nucleus:**
Atomic weight and atomic number; mass defects and binding energy; Isotopes. Natural and artificial radio activity—law of radioactive disintegration; decay constant and half-life, etc. Radioactive series—nuclear structure and nuclear reactions.
Dual aspects of matter and radiation. One dimensional wave equation of matter. Elementary ideas about solid state physics—thermal, electric and magnetic properties of solids.

(For AE, AgE, ChE, CE, EE, Comm & ME)

312. Physics.

Same as Ph—311.

(For Metallurgical and Mining Engineers and Naval Architects)

411. Physics (2-0).

Dielectric properties of matter—dielectric constant, polarisability, dipole relaxation, dielectric loss, dielectric break down and ferroelectricity.
Electrical properties of matter—Electrical conductivity and related phenomena and semiconductors; Surface and Junction effects; Photoconductivity. Superconductivity. (For Electrical and Electrical Comm. Engineers).

413. Architectural Acoustics (2-0).


511. Semiconductor Physics (2-0).

Fermi-Dirac law, Fermi level. Free electron theory of metals. Thermal, electrical and magnetic properties. Schrodinger wave equation and its properties and applications to simple problems. Motion of electrons in a periodic-potential, band theory of metals; effective mass; Brillouin zones; insulators and conductors. Semi-conductors; intrinsic conductivity, impurity conductivity, rectifications, crystal triodes or transistors. (For Electrical Communication Engineers)

521. Solid State and Nuclear Physics (2-0).


522. Meteorology and Aeronomy (2-0).

Meteorological parameters and their measurement. Composition of the atmosphere. Thermodynamic and other physical processes in the atmosphere including radiative and optical phenomena, condensation and precipitation. Mechanics of the atmosphere including weather systems and their motions. General circulation.


697. Physics (2-0).

Selected topics of ultrasonic, Radiography and nuclear Physics
Elements of X-Ray and \( \gamma \)-Ray Radiography.
Ultrasounds and its application.
Introduction to nuclear physics and nuclear power:

- fission, chain reaction, fission bomb;
- fusion, thermo-nuclear reactions, thermo-nuclear bomb, Zeta;
- types of nuclear reactors, nuclear reactor plants.

Radiation protection: blast, gamma flash, heat flash, fallout from bombs; effect of nuclear radiations, their detection and measurement, unit of radiation dosage; protection of ships and personnel from fallout. (For Naval Constructors).
### SCHEDULE—
#### REGULATION

**Schedule of courses and**

Special three-year Bachelor of Technology (B. Tech.)

**A. ENGINEERING**

First year (Common to Civil, Electrical & Mechanical)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for Part-I Examination</th>
<th>1st Term</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam.</th>
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<td>100—0</td>
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<td>Graphics—I</td>
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<td>Mechanics, Strength of</td>
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<td>100—100</td>
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<td>Materials, and Structural</td>
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<td>Mechanics</td>
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<td>GE 16</td>
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<td>ME 13</td>
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<td>ME 14</td>
<td>Manufacturing Science &amp; Practice—I</td>
<td>1—3</td>
<td>50—100</td>
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<td>Properties of Materials—I</td>
<td>2—2</td>
<td>100—50</td>
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<tr>
<td>Met 12</td>
<td>N.C.C. Or Physical Training</td>
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<td>EE 15</td>
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<td>Theory of Machines and Mechanisms—I</td>
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<td>0—3</td>
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<td>CE 18</td>
<td>Surveying</td>
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Duration of papers for end-sessional examinations shall be 3 hours.
### VIII
No. 14

distribution of marks
Degree Courses

**SCIENCE**
Engineering specialisations)

<table>
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<tr>
<th>2nd Term</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. papers</th>
<th>3rd Term</th>
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<td>2 hrs.</td>
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<td>100—100</td>
<td>1</td>
<td>3 hrs.</td>
<td>2—3</td>
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<td>100—100</td>
<td>1</td>
<td>3 hrs.</td>
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<tr>
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<td>3 hrs.</td>
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<tr>
<td>3—3</td>
<td>150—100</td>
<td>1</td>
<td>3 hrs.</td>
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<td>100—0</td>
<td>1</td>
<td>2 hrs.</td>
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<td>2—1</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
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<tr>
<td>2—2</td>
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<td>1</td>
<td>2 hrs.</td>
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<tr>
<td>1—3</td>
<td>50—100</td>
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<td>2 hrs.</td>
<td>1—3</td>
<td>50—100</td>
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<tr>
<td>2—2</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
<td>2—2</td>
<td>100—50</td>
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<tr>
<td>0—2</td>
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<td>20—19</td>
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**Marks.**

0—250 For Civil, Electrical & Mechanical Engineering specialisations.

0—300

0—150 For Civil & Mechanical Engineering specialisations.

150—150 For Electrical Engineering specialisation only.

0—150 For Mechanical Engineering specialisation only.

0—150 For Civil Engineering specialisation only.
### SECOND YEAR

**(i) CIVIL ENGINEERING SPECIALISATION**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for Part II Examination</th>
<th>All Terms</th>
<th>No. of papers for Examination</th>
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<tr>
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<td>Humanities ...</td>
<td>2 0</td>
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<tr>
<td>CE 21</td>
<td>Civil Engineering I ...</td>
<td>4 4</td>
<td>200—100</td>
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<tr>
<td></td>
<td>(Building Construction, Drawing and Surveying and Transportation)</td>
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<tr>
<td>CE 22</td>
<td>Civil Engineering II ...</td>
<td>4 3</td>
<td>200—150</td>
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<tr>
<td></td>
<td>(Irrigation, Water supply and Sewage disposal and Fluid Mechanics—II)</td>
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<tr>
<td>CE 23</td>
<td>Civil Engineering—III ...</td>
<td>4 7</td>
<td>200—200</td>
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<tr>
<td></td>
<td>(Theory of Structures and soil Mechanics, and Principles of Structural Design)</td>
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<td>CE 24</td>
<td>Civil Engineering laboratory ...</td>
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<td>0—100*</td>
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<tr>
<td>Ge 21</td>
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<td>50—50</td>
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<tr>
<td>Ph 22</td>
<td>Properties of Materials—II ...</td>
<td>1 0</td>
<td>50—0</td>
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<tr>
<td>Ma 21</td>
<td>Mathematics—II ...</td>
<td>2 0</td>
<td>100—0</td>
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<td></td>
<td></td>
<td>18 18</td>
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<td>Option</td>
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<td>100—0</td>
<td>1</td>
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<td></td>
<td></td>
<td>20 18</td>
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<td>0—100</td>
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*50 marks in the Second term for educational tour.
(ii) **ELECTRICAL ENGINEERING SPECIALISATION**

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<th>Subjects for Part II Examination</th>
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<td>Comm 21</td>
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<tr>
<td>EE 22</td>
<td>Electrical Circuits and Measuring Instruments</td>
<td>2 1</td>
<td>100—50</td>
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<tr>
<td>EE 23</td>
<td>Electrical Machines</td>
<td>3 1</td>
<td>150—50</td>
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<tr>
<td>EE 24</td>
<td>Power Systems I</td>
<td>2 2</td>
<td>100—100*</td>
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<td>EE 25</td>
<td>Electrical Laboratory I</td>
<td>0 4½</td>
<td>0—150**</td>
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<td>Ma 21</td>
<td>Mathematics II</td>
<td>2 0</td>
<td>100—0</td>
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<tr>
<td>ME 22</td>
<td>Machine Design</td>
<td>1 3</td>
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<td>ME 29</td>
<td>Prime Movers</td>
<td>2 3</td>
<td>100—100</td>
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<td>Ph 21</td>
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<td>2 0</td>
<td>100—0</td>
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<td>100—0</td>
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*50 marks in the first term for practical training during the preceding Summer Vacation and 50 marks for educational tour.
**100 marks in the third term for laboratory tests.
### Mechanical Engineering Specialisation

<table>
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<tr>
<th>Subject No.</th>
<th>Subjects for Part II Examination</th>
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<td>100—0</td>
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<td>Comm</td>
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<td>1½</td>
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<td>3</td>
<td>100—100</td>
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<td>Ma</td>
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<td>2</td>
<td>0</td>
<td>100—0</td>
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<tr>
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<td>Hydraulic Machines</td>
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<td>Heat Power Technology—I</td>
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<td>1½</td>
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*50 marks (25 from each subject) in the second term for educational tour.
### CIVIL ENGINEERING SPECIALISATION

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<th>Subjects for the Final Examination</th>
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<th>Marks</th>
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*Electives:

- CE — 31 Public Health Engineering 4 — 4
- CE — 32 Structural Engineering 4 — 4
- CE — 33 Foundation Engineering 4 — 4
- CE — 34 Hydraulic Engineering 4 — 4
- CE — 36 Transportation Engineering 4 — 4

*Viva voce 0 — 200
Thesis-Project 0 — 300

**50 marks in the first term for professional training during the preceding summer vacation and 50 marks in the second term for educational tour.

(Roads, Tunnels, Airports, Docks and Harbours).
### Electrical Engineering

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<th>All Terms</th>
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<th>Duration of Examination papers</th>
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<td>...</td>
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<tr>
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<td>-</td>
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<td>...</td>
<td>0 4 0—150***</td>
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<td>1 0 50—0</td>
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<td>1 2 hrs.</td>
</tr>
<tr>
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<td>1 2 hrs.</td>
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<td>...</td>
<td>2 0 100—0</td>
<td>1</td>
</tr>
<tr>
<td>18 16</td>
<td></td>
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*50 marks in the First Term for practical Training during the preceding Summer Vacation.
**100 marks in the Third Term for Laboratory Tests.
***50 marks for educational tour.
### (iii) MECHANICAL ENGINEERING SPECIALISATION

<table>
<thead>
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**Electives:**

- ME 38 — Engineering Quality Control. (1-1).
- ME 39 — Applied Fluid Flow, Plasticity and Experimental Stress Analysis. (1-1).

*50 marks (25 from each subject) in the:

I Term for practical training during the preceding summer vacation.

II Term for educational tour.
### Chemical Engineering

#### FIRST

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Curricula for the Second and Third Years shall be the same as for the Fourth and Fifth Years of the five-year integrated course in Chemical Engineering.
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## C. ELECTRONICS & ELECTRICAL

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*50 marks in the first term for practical training during the preceding summer vacation.

**50 marks in the second term for educational tour.
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Comm 37A Radar and Aids to Navigation.  
Comm 37B Antenna and Wave Propagation.  
Comm 37C Network Design.  
Comm 37D Acoustics.  
Comm 37E Servomechanism.  
Comm 37F Electronic Computers.  
Comm 37G Line Communication.

*50 marks in the first term for training during the preceding Summer Vacation.  
@ 50 marks in the second term for educational tour.
### D. METALLURGICAL

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<td>ChE 12</td>
<td>Fuel Technology ...</td>
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<td>Ge 11</td>
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<td>Mathematics—I ...</td>
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<td>Fluid Mechanics ...</td>
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<td>Manufacturing Practice ...</td>
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<td>Met 13</td>
<td>General Metallurgy ...</td>
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<tr>
<td>Ph 13</td>
<td>Material Science ...</td>
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**Fourth Term**

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<td>ME 18</td>
<td>Applied Mechanics</td>
<td>0 3</td>
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<td>ME 19</td>
<td>Manufacturing Practice</td>
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<td>Applied Electricity</td>
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<td>ChE 13</td>
<td>Fuels and Furnaces</td>
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**Total:**

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## ENGINEERING

### YEAR

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<th>3rd Term Hours per Week</th>
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<p>| 19 20                   | 950–550 | 10 | 20 18 | 1000–500 | 10 |</p>
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<td>Physical Metallurgy II</td>
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<td>*Elective (any one)</td>
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*Elective subjects:
- Met 39A Advanced Metallurgy of Alloy Steel.
- Met 39B Furnace Technology.
- Met 39C Advanced Foundry Metallurgy.
### DISTRIBUTION OF MARKS
(for each Examination)

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*Viva-voce* 200

*Thesis/Project* 300
SCHEDULE IX
REGULATION No. 15
(For 3-Year Special B.Tech. Degree Courses)

CHEMICAL ENGINEERING (Ch. E)


Units and dimensions employed in Chemical Engineering calculations. Introduction to dimensional analysis. Material balance for Chemical Engineering processes, Vapour pressure, Humidity, Saturation, Solubility and Absorption, Thermophysics and Thermochemistry, Fuels and combustion. Chemical, Metallurgical, and petroleum process. Sessional work based on the above.

Drawing of Chemical Engineering Equipments.


Classification of fuels, Chemical composition, calorific values and general uses.


Liquid fuels, petroleum and its characteristics, petroleum Processing, Coal Tar Byeproducts, Shale oil.


(For Metallurgical Engineers)

13. Fuels and Furnaces (0-3). Fourth Term.


(For Chemical and Metallurgical engineers).

28. Mineral Dressing (2-2)


(For Metallurgical Engineers)

CIVIL ENGINEERING (CE)

11. Drawing, Design & Graphics I (2-3). First Term only.

I.S. Code of Practice of General Engineering Drawing ; Pictorial views.

12. Structural Mechanics (3-3). Third Term only.

Moving loads and influence lines ; Statically Indeterminate Beams ; Strain Energy methods ; Stability of Equilibrium and Buckling of columns.

Moving loads and influence lines ; Statically Indeterminate Beams ; Strain Energy methods ; Stability of Equilibrium and Buckling of columns.


Fundamentals of mechanics ; Equilibrium of Force systems and engineering application ; Principle of virtual work.
15. Applied Mechanics (2-0).

Same course as CE-14 with reduced number of tutorial and laboratory hours.
(For Electronics & Elec. Comm. Engineers).

16. Fluid Mechanics I (2-1). Third Term only.

Dimensional Analysis and Laws of similitude; Pipe flow and friction coefficient; Flow meters and flow measurement.

17. Drawing (0-9). Fourth Term.

Scales and mathematical curves, projection of points, lines, planes and solids, auxiliary projections, principles of isometric projections.
(For Chemical, Communication and Metallurgical Engineers and Engineering Scientists).

18. Surveying (0-6). Fourth Term.

Principles and Practice of Chain and Compass surveying.

21. Civil Engineering I (4-4).

(i) Building construction, Drawing and Surveying:

Safe Bearing Capacity of Soils; Foundations and footings; Brick work-brick making, classification and Brick laying; Stone masonry; Damp proof courses; Timbering in trenches; Openings in Brick work; Concrete-lime concrete, cement concrete; Formwork; Timber-curing, classification, timber construction; Floor and roof constructions; Design of simple reinforced concrete structures.

Drawing of Brick Bonds; Simple spread foundation, Details of doors and windows, Timber and steel roof trusses, Details of R.C.Lintels and roof slabs, Simple residential building and estimating.

Plane table surveying and levelling; Theodolite Traversing; Tacheometry; Curves—circular and transition; Base line measurement and triangulation; Trigonometrical levelling; elements of field Astronomy—determination of azimuth, latitude, longitude and time; Principles of aerial surveying.

(ii) Transportation.

Roads—Location, ruling curves and gradients, I.R.C. Standards, minimum and overtaking sight distances; Typical sections of highways in plain and hilly areas; Properties of highway materials; Construction and maintenance of the different types of flexible and rigid pavements.

Railways—Construction and maintenance of railway track; Super elevation; Theory of points and crossings; Curve compensation; Signalling and safety devices.

22. Civil Engineering II (4-3).

(i) Irrigation, Water Supply and Sewage disposal:

Elements of hydrology—Well and flow irrigation, Diversion and storage works; Canal systems; Falls and Cross-drainage works; Water logging and salt efflorescence.

Water supply systems—Estimate of water requirement; Sources and collection; Distribution; Examination of water; Standards of quality; objects and methods of treatment; purification processes; House water supply, Rural water supply.
Drainage systems—Estimate of waste water quantities; Flow in sewers and appurtenances; Collection, examination of waste water; purification process; Standards of quality; House drainage; Small scale sewage treatment plant; Rural sanitation.

(ii) Fluid Mechanics II:

Open channel flow—Steady uniform and steady non-uniform flow, hydraulic jump, unsteady flow, noise and water hammer, cavitation.

Special problems of free surface flow—surges and flood waves in channels, elementary mechanics of surface waves, mechanics of scour and sediment transportation.

Hydraulic machinery—Turbines and pumps, theory of flow, performance characteristics.

23. Civil Engineering III (4-7).

(i) Theory of Structures:

Moving loads and influence lines, slopes and deflections; Continuous beams and other indeterminate forms; Suspension bridges; Arches.

(ii) Soil Mechanics:


(iii) Principles of Structural design:

Steel—Design of riveted and bolted points, welded connections, Design of columns, Roof trusses and plate girders.

Reinforced concrete—Simple beams and slabs, Short columns. Footings, Retaining walls and staircases.

24. Civil Engineering Laboratories (0-2).

Experimental work in Soil Mechanics Laboratory, Public health engineering laboratory and models laboratory.

26. Engineering drawing (0-3).

Graphic statics—advanced; Building and structural drawing—elementary and advanced; Screw-threads, Drawing of complete machine parts, Assembly drawing and details, Tracing and blue printing.

(For Metallurgical Engineers).

31. Public Health Engineering (4-4).

Transmission of water; Physical and chemical properties of water; Kinetics of aerobic and anaerobic decomposition; Sedimentation and flotation; Chemical treatment of water; Filtration; Biological purification processes; Sludge treatment and disposal; Control of living organisms; Taste and odour; Natural purification of water; Principles of ventilation, lighting and acoustics of buildings; Refuse collection and disposal; Sanitation problems.

32. Structural Engineering (4-4).

Deflection of trussed beams; continuous trusses and secondary stresses.

Analysis of multistoreyed buildings and continuous girders, Frames with variable moment of inertia; Cables, suspension systems and space frames; Continuous and rigid frame steel bridges; Semi-rigid connections.

Design of R.C. columns subject to direct and bending stresses; Rectangular and circular water towers; Flat slab construction; Shell construction; Principles of prestressed concrete connection, common methods.
Brief introduction to analysis of plates and shells; Buckling behaviour and response of structures to dynamic loading.

33. Foundation Engineering (4-4).

Plastic equilibrium of soils, Stresses in soils, theories of foundation failure; Principles of foundation design; Bearing capacity and settlement analysis; Soil sampling; Principles of foundation action; Spread footings; Mats; Pier and pile foundations; Cofferdams and caissons.

34. Hydraulic Engineering (4-4).

Dams—Principles of design of various types of dams; appurtenant works—spillways, gates, galleries, outlets etc. River diversion; Project planning and selection of type of dams. Water power engineering—planning of hydroelectric developments, estimates of water power from stream; selection of hydraulic turbines; Intakes, conduits and penstocks; Power house structures.

Coastal engineering—Tides and tidal currents; Wave action; Beach erosion; Principles and methods of shore protection; Layout of channels and harbour basins.

35. Design and Project (2-6).

Complete design in steel or R. C. or residential building and industrial or factory building; Silos, Bunkers, Water towers including preparation of working drawings, project reports, quantity estimation and analysis of costs.

Complete design of simple steel or R. C. bridge including costing and quantity estimation. Water supply and drainage scheme and design; Design of a dam project including foundation treatment.

36. Transportation Engineering (Roads, Tunnels, Airports, Docks and Harbours) (4-4).

Classification of roads, estimation of traffic; Geometric standards in the location of highways; Road signs, Traffic control, Road furniture; Structural design of pavements; Tunnels types, construction, ventilation and lighting; Precaution for safety.

General principles involved in the location of Civil and military airports, International standards in the design of airports.

Physical geography in relation to docks and harbours, coastal changes and effect of artificial interference, Tidal phenomena, Wave action, Choice of site; Break-waters and moles; Wet, dry and floating docks; Locks, Construction of harbour structures; River and canal navigation.

37. Laboratories (0-2).

Experimental work in structural laboratory (including models laboratory) Soils laboratory (including Highway laboratory) and Hydraulic laboratory (including Hydraulic machine laboratory).

38. Construction (2-0).


ELECTRICAL ENGINEERING (EE)

11. Applied Electricity I (3-3).

Electric and magnetic field concepts and system parameter calculations. Formulation of equilibrium equations for simple a.c. and d.c. networks and evaluation of transient and steady-state behaviour. Vector loci and circle diagrams. Network theorems and application to single and three-phase circuits.
12. Electrical Technology (2-2).

Introductory study of magnetic and electric fields and circuits. Direct and alternating current machines. Current, voltage, power and energy meters. Electrical installation of buildings. Elements of generation, transmission and distribution.

(For Engineering Science students).

13. Applied Electricity (3-3).


(For Electronics & Electrical Communication Engineers).


Detailed study of the theory and performance of d.c. machines. Special types of d.c. machines. Storage batteries.

(For Electrical Engineering specialisation of Engineering Science course).

15. Applied Electricity—IB (0-3). Fourth Term.

Electrical Workshop and Laboratory.

(For Chemical and Metallurgical Engineers and Civil and Mechanical Engineering specialisations of the Engineering Science course).


(For Mechanical Engineering Specialisation).

22. Electrical Circuits and Measuring Instruments (2-1).


23. Electrical Machines (3-1).


25. Electrical Laboratory I (0-4½).
Experiments covering EE 22, 23 and 24.


(For Electronics & Electrical Communication Engineers).

31. Instrumentation and Control (3-1).

32. Machines and System Components (2-1).

Construcational details of electrical machines and transformers. Insulation, ventilation and cooling. Evaluation of machine parameters.

34. Power Systems II (2-4).


35. Electrical Laboratory II (0-4½).
Experiments covering EE 31, 32 and 34.

36. Project (0-4).
Specification and design of typical amachines and transformers. Project assignments on automatic control schemes.
ELECTRONICS AND ELECTRICAL COMMUNICATION ENGINEERING (COMM).

11. Electronics I (1-0).

Vacuum tubes and transistors—equivalent circuits, amplifiers, oscillators and rectifiers. Electronic instruments.

(For Engineering Scientists).


Vacuum tubes and transistors—equivalent circuits, amplifiers, oscillators and rectifiers. Electronic instruments, Industrial applications.

(For Chemical and Metallurgical Engineers).

13. Electrical and Electronic Circuits (4-3).

A.C. circuits; Resonance; Network theorems. Loop and node analysis; impedance transformation. Coupled circuits. Polyphase circuits, Symmetrical components. Junction diode and transistors; equivalent circuits; Motion of electron. Vacuum tube, Frequency characteristic of basic amplifiers; AF power amplifier; CRO.

14. Communication Engineering Laboratory (0-6). Fourth Term.

Electronic components, soldering and layout. Simple experiments on amplifiers, oscillators and rectifiers. Building up and testing of experimental models.


Resonance; coupled circuits; filters; power supplies. AF and RF voltage and power amplifiers; Oscillators; Modulation and demodulation, mixers. Magnetic and dielectric amplifiers.

(For Electrical Engineers)

22. Electronics II (2-1½).

Same as Comm. 21.

(For Mechanical Engineers).

23. Mathematical methods in Electronic Engineering (2-1).

Matrices and determinants; Complex variable; Special functions; Vector calculus Tensor Analysis; Wave equations; Transformation calculus including Fourier transform. Elements of probability theory.

24. Networks and Transmission lines (3-1½).

Loop and node analysis. Two terminal and Four terminal network parameters; Equalisers and Filters. Fields and power flow in transmission lines. Wave equation. Constants of a transmission lines. AF and RF transmission lines.

25. Electronic Circuits (3-6).

Amplifiers—single and multistage, feedback, operational and tuned. RF and UHF Oscillators, and mixers. Pulse circuits, multivibrators, blocking oscillators, time base generators and counters; Logic circuits. Modulation and demodulation.

26. Industrial Electronics (2-1½).

Power rectifiers and supplies. Gas tubes; Phototubes; Magnetic and Servo amplifiers. Induction and dielectric heating. Voltage stabilisers; Transducers and instrumentation. Control Systems.

27. Drawing and Workshop Practice (1-3).

Electronic circuit drawing; Component fabrication and assembly; Electronic Workshop—Special methods; treatment of materials, printed circuits, panel fabrication.

Pulse circuits, multivibrators, time base generators, and counters. Electronic instruments; transducers and instrumentation. Electronic control; RF heating. Elements of analogue and Digital computer.

(For Electrical Engineers).

32. Network Theory (2-1).


33. EM waves and Radiation Systems (3-1½).

Maxwell’s equation. Static and time varying fields. Wave equation, Plane waves, waveguides, resonators. Radiation; Typical Antennas, measurements. Ground wave propagation, propagation through ionosphere and troposphere.

34. Radio Engineering (2-3).

Generation and detection of AM, SSB, FM and PM Signals. Noise, Pulse modulation, Microwave generators; Power amplifiers—h.f., TWT and klystron. Electro-acoustic-transducers; recording and reproduction of sound; Reverberation and room acoustics; Ultrasonics.

35. Line and Radio Communication Engineering (3-1½).

Principles of telegraphy and telephony. VF and Carrier systems. Communication theory; RF communication systems. Television. UHF and Microwave techniques. Microwave communication systems; Radar including Aids to Navigation.

37A. Radar and Aids to Navigation (2-1½).

Long distance aids to Navigation, Radio Compass, direction finders. Middle and short distance navigation aids. Radar equation, range, resolution, accuracy, and data presentation; Rader receiver, different types of Radar.

37B. Antenna and wave Propagation (2-1½).

Dipole and linear antenna. Antenna in the long, medium, short wave, and VHF ranges. Microwave antenna. Ground wave propagation; propagation of waves through ionosphere and troposphere.

37C. Network Design (2-1½).

Image parameter and Insertion loss filters; Equalisers; Delay lines; Amplifier networks; Feedback amplifiers; Pulse amplifiers. Active filters.

37D. Acoustics (2-1½).


37E. Servomechanism (2-1½).


37F. Electronic Computers (2-1½).

37G. Line Communication (2-1).  

GEOLGY (Ge)  

11. Geology for Metallurgists (2-2).  

Definition of minerals and crystals and scope of the science of crystallography.

Introduction to the morphology of crystals—face, edge, interfacial angle, forms, Axis—plane—centre of symmetry, crystallographic axes, parameters and indices, divisions into systems.

Systematic description of cubic, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic systems.

Twinning, isomorphism.

Distribution of rocks in the crust of the Earth—Igneous, sedimentary and metamorphic rocks—origin of these above rock types.

Minerals—Rock forming and economic minerals.

Ore—Ore minerals, gangue minerals, simple and complex ores. Non-metallic minerals, mineral fuels.

Processes of formation of mineral deposits. Examples of mineral deposits formed by the different processes.

Textures and structures of ore deposits.

Important mineral deposits in India: Gold, Copper, Aluminium, Iron, Magnanese, Coal, Mica, Chromium, Lead-zinc, Silver, Asbestos, Refractory minerals, Minerals used as flux.

Important geological formations in India, with their associated economic minerals of importance to metallurgists.

Development of mineral industry in the I, II & III five year plans. Elementary idea about prospecting of ores and minerals.

Laboratory:
Identification of the different crystals belonging to different systems with their systematic description.

Description and identification of rock-forming mineral. Description and identification of ore-forming minerals. Introduction to the study of geologic maps and sections.


(For Civil Engineers).

HUMANITIES AND SOCIAL SCIENCES (Hu)  

11. Economics / English (2-0).

Economics


5. Organisation of Production—Division of Labour—use of machinery—Location—Economic, Social and Strategic Considerations in Industrial Location.


7. Scale of Production—Economies and Diseconomies of Large and Small Scale Production—External and internal economies—Laws of Return—Diminishing, Increasing and Constant Returns—scale of production—Economies of increased dimensions and linked process.

8. Size of a unit—Factors determining size—optimum size.

9. Integration—Motives of Integration—Methods of Integration—Direction of Growth—Integration and Social interest.

10. Value, Depreciation, Depletion and allied problems.


12. Factor pricing—wage determination.


14. Banking, Central, Commercial, and investment.


English

The object of the course in English is to teach students how to express their ideas in good, simple and correct English and to help them develop a taste for literature. The students will be taught suitable English texts.

21. Psychology & Economics of Industrial Labour (2-0).

The course gives the basic ideas about human behaviour which forms the basis for the application of psychological factors underlying human efficiency in industry.

Psychology


2. Industrial Psychology—General principles of group behaviour study of human factor in industry. Human and social problems and industrialisation.

Economics of Industrial Labour

1. Industrial Labour in India—Its Distribution.

2. Efficiency of Labour—Responsibility of Employers.

3. Recruitment, Training etc.

5. Scientific System of Wage Payment—Payment by results.


10. Industrial Welfare.


12. Labour Administration in India.

31. Industrial Psychology and English (2-0).

*Industrial Psychology*

Industrial fatigue and monotony: causation and remedies.

Personnel selection: Interviewing and psychological tests.

Industrial training: its benefits and principles.

Merit-rating.

Wage and Incentives.

Maladjustment—absenteeism and labour turnover—maladjusted worker.

Human relations in industry—its principles and practices in relation to morale and productivity—industrial conflict. Leadership and supervision in Industry.

*English:*

The object of the course is to teach students how to express their ideas in good, simple and correct English and to help them develop a taste for literature and also to help them acquire proficiency in report writing. Suitable text books will be used.

32. Problems of Philosophy (1-0).

Students will be broadly acquainted with the main philosophical problems that have engaged the attention of thinkers at all times. In course of the discussion of these problems, reference will be made to both thinkers and systems from the East and the West.


The problem of Appearance and Reality in Indian Philosophy—the Upanishads, Buddhism, Nyaya, Samkhya and Vedanta.


5. Types of Modern Indian Philosophy—Practical Vedanta of Vivekananda, Personalism of Tagore, Ethical Idealism of Gandhi, Integral Idealism of Aurobindo.

Infinite series, convergence tests; absolute and conditional convergence, uniform convergence, differentiation and integration of a series, Taylor's series, Maclaurin's series, Fourier series, solution of ordinary differential equations with constant coefficients; partial differentiation. Taylor series, Maxima and Minima of two variables.

Basic ideas of three dimensional geometry; straight lines; general conicoid with special reference to sphere, ellipsoid and cone; multiple integration and line integration.

Vector analysis; differentiation of a vector; gradient, divergence, curl and orthogonal curvilinear co-ordinates; Stokes' theorem, Green's theorem; Laplacian operator; use of the vectors in fluid mechanics, heat flow, and electricity and magnetism.

12. Mechanics (3-3). First Term.


(For Engineering Scientists).


Fluid Statics: Properties of fluids, pressure theorems, laws of equilibrium of floatation.

Fluid Dynamics: laws of fluid motion, Bernulli's equation, vertex motion.

Viscous fluids: Navier-stokes equations, geometrical and dynamical similarity, Boundary layers; Turbulence.


Matrix algebra, method of inversion of a matrix; characteristic equation. Cayley Hamilton theorem, Eigen values, Sylvester's theorem; application of matrix algebra.

Complex variable, general function of a complex variable, derivative and Cauchy-Riemann conditions, line integral of a complex function, Cauchy's integral formula, Taylor's series, Laurent series, Cauchy's Residue theorem, conformal transformation and its applications in hydrodynamics and electorstatics.

Partial differential equation—parabolic, elliptic and hyperbolic, discussion of the boundary and initial conditions required for the unique determination of their solution, examples; Vibration of strings; vibration of a rectangular and circular membrane. Two dimensional steady flow of heat, one dimensional unsteady flow of heat; calculus of variations; Hamilton's principle and Lagrange equation solution of transcendental and polynomial equation; Newton and Raphson method; interpolation and extrapolation formulae for forward, backward and central differences, numerical solution of ordinary differential equation.

(For Engineering Scientists).


(For Engineering Scientists).

MECHANICAL ENGINEERING (ME)


Introduction to mechanics of materials; members under axial loads, thermal stresses, thin cylinders and indeterminate problems of axial loads. Elements of principal stresses. Bending moment and shear force diagrams. Stresses and deflections of straight uniform beams. Torsion of circular bars.

(For Engineering Scientists).

13. Heat Technology (2-1).

Engineering system of metric units.


Introduction to steam power generating equipment.

Properties of gases and gaseous mixtures.

Ideal thermodynamic cycles for internal combustion engines.

Introduction to internal combustion engines and gas turbines.

(For Engineering Scientists and Chemical Engineers).


Manufacturing processes: foundry, welding, machining; hot and cold working. Metrology.

A practical course on the above.

(For Engineering Scientists and Communication Engineers).


(For Communication Engineers)


Principles and design of castings, pin joints, riveted and welded joints, press fits, screwed fastenings, thin cylinders, beams, shafts, couplings, keys, springs, bearings and members subjected to direct and eccentric thrust loads.

(For Chemical, Communication and Metallurgical Engineers)

17. Manufacturing Practice (0-3).

Practical course as in 14.

(For Chemical and Metallurgical Engineers).
Practical work in Material Testing Laboratory and Instrumentation and Control Laboratory.
(For Engineering Scientists, and Chemical, Communication and Metallurgical Engineers)

Analysis and kinematics of plane mechanisms.
Mechanisms for intermittent motion.
Inertia forces in machine parts. Piston effort and crank effort diagrams; bearing loads.
Introduction to the theory of lubrication and bearings.

19. Manufacturing Practice (0-12). Fourth Term.
Practical work in machine shop, press shop, welding shop and foundry to study the characteristics of machine tools, equipment, accessories, cutting tools and processes.
(For Engineering Scientists, and Chemical, Communication and Metallurgical Engineers)

Dynamic action of moving fluids.
Construction, operation and performance of impulse and reaction turbines: Pelton wheel, Francis turbine, Kaplan turbine and tubular turbine.
Dimensional analysis and principle of similitude applied to turbines. Specific speed of turbines.
Construction, operation and performance of positive displacement pumps: reciprocating pumps and rotary pumps.
Construction, operation and performance of rotodynamic pumps: centrifugal, mixed flow and axial flow pumps.
Dimensional analysis and principle of similitude applied to rotodynamic pumps. Specific speed of pumps.
Construction and operation of fluid coupling, torque converter and hydraulic dynamometer.
Cavitation in hydraulic machines.
Hydrostatic machines: accumulators, intensifiers, jacks, lifts and presses.
Oil hydraulic systems: oil pressure governors and control mechanisms; oil pressure circuits for machine tools.

General manufacturing considerations of machine parts.
Design of machine parts subjected to friction, combined loads, dynamic loads and stress concentration.
Design of space mechanisms, flywheels, high speed rotors, thick cylinders, journal bearings and roller bearings.
Design of complete units of machines like drives, clutches, brakes and gear boxes.
(For Electrical and Mechanical Engineers)


24. Manufacturing Science and Practice-II (1-3).


25. Theory of Machines and Mechanisms-II (2-1).


Vibration of single degree of freedom systems. Transverse and torsional vibrations of shafts and rotors. Critical speeds.


Plain stress and strain analysis and strain rosettes; problems of combined bending, twisting and axial loading.

Statically indeterminate beams. Unsymmetrical bending of beams; shear flow in beams. Bending of curved beams; circumferential and radial stresses.

Thick walled cylinders and compound cylinders.

Rotating discs of uniform thickness. Strain energy under different kinds of loading. Energy methods for statically determinate and indeterminate problems.


Experiments on rolling, yield point and ageing in metals; cold working of metals and alloys; quenching severity; hardenability; heat treatment of various steels; case carburizing.

Study of melting processes for cast irons, copper base and aluminium base alloys.

29. Prime Movers (2-3).

Reciprocating and rotary type internal combustion engines.

Water power engineering. Steam power generating equipment.

(For Electrical Engineers)

31. Industrial Management (2-0).

Development of production system and forms of ownership.

Evolution of management science.

Decision making for production system through economic, graphical, statistical and mathematical tools.

Design, operation and control of production systems covering product, organisation, work study, plant location, plant selection and layout, plant buildings, production planning and control, inventory control, quality control, plant maintenance, job evaluation, merit rating, wages and incentives. Cost control including budgetary control and depreciation studies.

(For Electrical, Communication, Mechanical and Metallurgical Engineers)
32. Metal Processing Laboratory (0-3)
A course of demonstration and experimetal investigation in the following:
- Metal cutting; study of cutting forces, temperature, wear and surface finish.
- Metal forming; sheet metal working, forging and rolling.
- Machine tool testing.

33. Heat Power Technology-II (2-4).
- Elements of gas dynamics. One dimensional flow. Aerofoil theory.

34. Instrumentation and Controls (2-1).
- Mechanical transients. Instruments and instrumentation for measurement of mechanical quantities. Accuracy, precision, error and calibration. Introduction to dynamics of automatic controls.

35. Design Project (1-5).
- A general design course based on topics covered in the earlier courses on drawing and design involving detailed design calculations, economy analysis and preparation of working drawings of complete machines such as water turbines, pumps, jacks, pulley blocks, winches, cranes, conveyors, presses and simple machine tools.

36. Production Engineering Project (1-5).
- Design of production tooling; jigs and fixtures, cams and layout for turret lathes and single spindle automatics. Plastic working tools. Limit gauges. Introduction to the design of a production system.

- A course of project relating to the above.

37. Mechanics of Solids-II (2-1).
- Columns and beam-columns. Elements of beams-on-elastic-foundation.
- Bending of thin circular plates.
- Elements of three dimensional stresses. Theories of elastic failure.
- Elements of theory of elasticity. Two dimensional problems in rectangular and polar co-ordinates.
- Tension of non-circular sections; analogies.

38. Engineering Quality Control (Elective) (1-1).
- Control charts:—x-R charts, p-charts, c-charts, some special control charts.
- Acceptance sampling:—single, double and multiple sampling plans. Elements of reliability engineering.

39. Applied Fluid Flow, Plasticity and Experimental Stress Analysis (Elective) (1-1).
- Unsteady flow in one dimension; steady flow in two dimensions.
- General analytical relations for viscous flow.
- Theory of hydrodynamic lubrication.
- Elements of plasticity and experimental stress analysis.
11. Elements of Metallurgy (1-0).

Introduction: Indian mineral resources and metallurgical industries, location of ore bodies and extraction plants, economic importance of metallurgical industries.

Extractive Metallurgy: Preparation of the ore, elements of ore-dressing and ore beneficiation, principles involved in the different processes used in extraction, roasting, reducing, smelting, refining; simple flowsheets for Fe, Steel, Cu, Al, Zn and Mg. Familiarising the students with some typical names: checker works, tapping and tap holes, pitside, ingot and ingot molds, soaking pit, reheating furnaces, size of a rolling mill.


(For Chemical Engineers)


Introductory course for SBT students in Engineering Science.

Space lattice, atomic arrangements in different space lattices, miller indices, crystal structure of some common metals. Solidification of some molten metals—dendritic freezing—structure of cast metals—grain refinement techniques. Study of binary equilibrium diagrams—types of solid solutions—property changes on alloying—study of some important binary systems like Fe-C, Cu-Zn, Cu-Sn, Cu-Ni, Al-Cu etc. Segregation—cored dendritic structures homogenizing anneal. Hume Rothery rules for formation of binary alloys. Elastic and plastic behaviour of single crystal of metals—stress-strain diagram, critical resolved shear stress for slipping and twinning, plastic deformation of polycrystalline metals, fiber texture and its importance; annealing of cold worked metals. Fundamental principles of heat-treatment of steels, annealing, normalising, hardening, tempering, T-T-T diagram, quenching media, microstructures and properties developed in different heat treatments.

(For Engineering Scientists)


Introduction: Indian mineral resources and metallurgical industries, location of ore bodies and extraction plants, economic importance or metallurgical industries.

Extractive metallurgy: Preparation of the ore, elements of ore-dressing and ore beneficiation, principles involved in the different processes used in extraction, roasting, reducing, smelting, refining, simple flowsheets for Fe, Steel, Cu, Al, Zn and Mg. Familiarising the students with some typical names: checker works, tapping and tap holes, pitside, ingot and ingot molds, soaking pit, reheating furnaces, size of a rolling mill.

Physical Metallurgy (General): Metallic bonds, different kinds of metallic crystals, solid solutions, substitutional and interstitial types. Grain formation in crystals, chill castings nucleation and growth. Electrical and magnetic properties of metals. Elastic and plastic properties of single and polycrystalline solids, cold and hot working, grain-refinement. Binary alloys equilibrium diagrams, complete solid solubility, partial solubility, complete immiscibility, intermetallic compounds, thermal analysis.

21. Refractories (1-0), First and Third terms, and (0-2) Second Term.

Refractories—different types, physico-chemical properties, resistance to erosion, high temperature, temperature variation, molten metal and slag, expansion, contraction, specific heat, porosity, permeability, thermal and electrical conductivity, preparation of refractory materials, their uses in the manufacture of firebricks, silica bricks, etc., refractory materials used in different types of metallurgical furnaces.

22. Extraction Metallurgy of Iron and Steel-I (2-1).

World production of Iron & Steel—India’s share, role of Iron & Steel industry in the industrialisation of a country, raw material reserves—location and characteristics, preparation and beneficiation of raw materials, Iron blast furnace—general features and construction, smelting of ores in a blast furnace, critical appraisal of blast furnace reactions from the point of view of thermodynamics and kinetics of the process, charge and heat balance, preheating of blast, stoves and their operation. Blast furnace products, pig iron—different grades, slags—characteristics of indian pig iron and slags. Top gas—cleaning—ancillary equipment. Charge distribution at the top of the furnace—operating troubles associated with improper distribution of charge. Modern trends in blast furnace practice—oxygen enrichment, humidification and refrigeration of blast, fuel injection, high top pressure operation, unconventional methos of iron production, rotary kiln, low shaft furnaces. Manufacture of ferromanganese in blast furnace, production of other ferroalloys. Elements of blast furnace design.

23. Foundry Metallurgy (2-3).

Pattern making, molding processes and molding materials, molding and coreblowing machines, molding sands and clays, testing of sands, coremaking and testing of core sands, solidification of metals, pouring and feeding of castings; metallurgy of gray iron—inoculation of gray irons, heat treatment, alloy gray irons. Malleable iron—metallurgy—production techniques. Nodular iron—manufacture, properties, heat treatment and uses; melting of cast irons in cupola, air furnaces, electric arc furnaces, details of cupola operation and control. Gases in non-ferrous metals and degasification, melting furnaces for non-ferrous metals, melting techniques of some common non-ferrous metals and alloys.


Atomic structure of metals and nature of metallic bonds, crystal structure of metals, indices for planes and directions, polymorphism, grain formation and importance of grain boundaries, thermodynamical considerations of liquid-solid, solid-solid transformations. Solid solutions, types, alloys, factors influencing solubility, thermodynamical conditions of equilibrium in alloys, mode of freezing of alloys, structure of alloys, solid state transformations, atomic migration in the solid state, diffusion, homogenisation, precipitation from supersaturated solutions, order-disorder changes, ternary diagrams—construction and interpretation—application to important industrial alloys. Metallurgical microscope and metallograph, pyrometry—principles and different types of pyrometres, their uses.

25. Mechanical Metallurgy—I (2-3).

Deformation and strength of single crystals and polycrystalline metals, theory of dislocations, Frank-Read sources, slip and twinning in FCC, BCC, HCP crystals, work hardening, yield point and precipitation hardening, Different methods of testing, scope, purpose, significance of tests, destructive and non-destructive testing.


Importance and scope of non-ferrous metallurgy, non-ferrous metallurgy in India, —present and future, study of the different processes of extraction of non-ferrous metals—(a) pyrometallurgy, (b) hydrometallurgy, (c) electrometallurgy. General theoretical considerations—free energy of formation, freeenergy-temperature chart, activity and chemical potential, correlation of mode of occurrence, reactivity, and the electrode potential series, study of unit processes and its importance in pyrometallurgy, roasting, sintering, fluidised bed roasting, direct and indirect smelting, smelting furnaces, slagging, converting, refining techniques, liquation, distillation, sublimation, catalytic distillation, Mond’s process, metals to be studied,—Cu, Pb, Zn, Al, Ni, Sn, Mn, Ag, Au and refractory metals. Metallurgical calculations related to different processes, chief physical, mechanical, chemical properties as well as the uses of the above metals and alloys. Chlorine metallurgy, reclamation of secondary metals.
27. Metallurgical Thermodynamics and Chemical Kinetics (2-1).

Laws of thermodynamics, Maxwell relations—applications, thermal capacity of gases and solids, Hess’s law, use of standard tables, free energy and thermodynamic potential, condition of equilibrium, chemical equilibrium, equilibrium constants of homogeneous and heterogeneous systems, use of standard tables of thermodynamic functions. Solutions, dilute solutions, derivation of Raoul’s law, deviations, concentrated solutions, concept of activity, activity coefficient, partial molar free energies, choice of standard state, electrolytic solutions, electrode potential, chemical and electrical energy, reference electrode, polarisation over-voltage, electrodeposition of metals and alloys. Phase rule—application to systems, adsorption and absorption, adsorption on surfaces, Gibb’s equation, chemical kinetics, importance of the rate of nucleation, concept of activated state, order of reaction, applications.


Elements of dislocation theory and plastic working of metals yield point, strain-ageing and other related phenomena. Review of theories of rolling, calculation of rolling load and torque, applications. Hardenability, measurement, calculation from composition, quenching severity of cooling media, applications to heat treatment problems.

31. Extractive Metallurgy of Iron and Steel—II (2-1).


32. Electrometallurgy and Corrosion (1-1).

Principle of extraction of metals and electroplating of metals and alloys, principle guiding the choice of different electrolytic baths, complexing and addition agents for electroplating baths, their effect on physical properties of electrodeposits, flow sheet of electrolytic extraction and refining of the following metals—Ca, Mg, Al, Cu, Zn, Ni, Pb, Mn, Ag, Au. Electroplating of Cu, Zn, Cd, Ni, Cr and alloys. Electrothermal process for reducing iron from its ore. Theories of corrosion, general principle of corrosion control, methods of corrosion prevention, inhibitors—their properties and functions. Oxidation of metals and alloys, principle behind development of high temperature oxidation resisting materials. Corrosion testing, metal finishing, surface treatments.

33. Mechanical Metallurgy—II (1-0).

Working of metals, stress conditions governing the flow of metals in hot and cold working, work of deformation, characteristics and elements of the theories of various shaping operations—forging, rolling, extrusion, drawing; relationship between the properties of metal and shaping processes. Metallurgical defects and difficulties encountered in metal forming, joining methods, welding, brazing and soldering.

34. Physical Metallurgy—II (2-3).

Free-energy and composition diagrams to illustrate phase transformations, kinetics of the process, driving force, application to Fe-C system, pearlitic, bainitic and martensitic transformations, isothermal transformation in steel, its applications, grain size, grain growth, overheated and burnt structure of steel. Hardening of steel, hardenability determination, uses and limitations, tempering of steels. Special methods of heat treatment of steels, modern methods to strengthen the steel by heat treatment and plastic straining. Heat treatment of important non-ferrous alloys, theories of age-hardening. Use of controlled atmosphere, case and surface hardening of steel.

35. Extractive Metallurgy Laboratory (0-3).

Experiments are designed to illustrate the principles involved in the extraction of metals—thermal decomposition of carbonates, oxides, sulphides etc., reduction oxides, C—CO—CO,
reaction, chloridation metallurgy, matte-metal reaction, electrometallurgy experiments. The students are required to study the thermodynamics and kinetics of the reactions.

36. Applied X-Rays and Metal Physics (2-3).


Industrial Radiography: Operation of X-Ray industrial unit—limitations and precautions. Use of Radiography and radiography with radioactive cobalt, comparison between their fields of applications.


Materials for heavy structures, tools, materials for electrical industries—magnets, resistance elements, electrical contacts etc., powder metallurgy.

38. Seminar (Works visit, vocational training etc.) (0-1).

39. Project (0-6).

39A. Advanced Metallurgy of Alloy Steel (2-2).

Detailed study of important low, medium, high alloy steel manufacture, fabrication, heat treatment, constitution, metallurgy, selection and application. Austenitic transformation by nucleation, growth and other mechanisms, application of stress to austenitic steels and their effects on Ms, hardenability, and its determination.

39B. Furnace Technology (2-2).


39C. Advanced Foundry Metallurgy (2-2).

Advanced study of the topics covered under Met 23.


Physical and extraction metallurgy of metals and alloys used in Atomic Energy generation, niobium, plutonium, thorium, uranium, etc., discussion of the metallurgical processes of fabrication and handling techniques of these metals and their alloys, metallurgy of liquid metals and radiation damage.

PHYSICS AND METEOROLOGY—(Ph)


Basic concepts of fundamental physical quantities; structure of atom, brief discussion of quantum number and Pauli principle; atomic aggregates—elementary discussion of statistical mechanics; nature of chemical bonds; crystal lattice and lattice energy; role of imperfections
in solids; structure and essential physical properties of some common materials e.g., metals, glass, high-polymers etc.; atomic theory of elasticity; lattice vibration and elastic waves; thermal properties of solids; theory of sp. heat, elements of emission and absorption spectra including X-ray, optical properties of solids.

(For Engineering Scientists).

12. Physics—(2-1).

Elements of atomic physics; Spectroscopy and nuclear physics.

Introduction to statistical mechanics and quantum mechanics.

X-Rays and electron diffraction and structure of matter.

(For Communication Engineers).


Atomic structure of matter—nuclei and electrons, electronic configuration of elements; atomic aggregates, nature of chemical bonds, different kinds of crystal structure; absorption and emission spectra including X-rays; X-ray diffraction and its application; mechanical properties of solids—elasticity and plasticity, role of imperfections in solids; dual aspect of matter and radiation, matter waves, quantization; free electron theory of metals, energy bands in solids, electrical conduction in metals and semiconductors; electrical properties of metals, semiconductors and dielectrics; brief review of surface properties of defect solids; selected topics in Physics—diffusion, paramagnetic resonance, ultrasonics etc.

(For Metallurgical Engineers)


Same as Ph 13 for Chemical Engineers.


Selected topics in physics having application in the study of materials, ultrasonics, interferometry, radio-activity and tracer technique, X-ray diffraction and radiography, electron diffraction and electron microscopy etc.; discussion of the nature of radiation and matter—quantum theory of radiation, dual aspect of matter and matter waves; Schrodinger equation.

(For Electrical Engineers).


Same as Ph. 21 for Civil Engineers with reduced number of hours.

23. Material Science—(3-0).

Bonding forces; crystal structure, elastic and thermal properties; free electron theory of metals; band theory of solids. Electrical, magnetic and optical properties of solids. Selected topics of solid state physics.

(For Communication Engineers)

31. Properties of materials—III (1-1).

A brief discussion of energy-bands of solids and their relation to physical properties; electrical and magnetic properties of conductors and semiconductors; selected topics in physics—dielectrics, radiation damage etc.

(For Civil Engineers).

32. Semiconductors and Plasma Physics—(2-0).

Intrinsic and impurity semiconductors, junctions, rectification, transistors. Photoelectric, galvanomagnetic, thermoelectric and acoustoelectric devices—their fabrication. Quantum Electronics, elements of plasma physics and their important applications.

(For Communication Engineers).
33. Solid State and Nuclear Physics (2-0).


(For Electrical Engineers).

SCHEDULE X

REGULATION NO. 16

Optional Subjects

(For Undergraduate Students)

A student may study, in the fourth and fifth sessions of the five-year, five-and-a-half-year and six-year B.Tech. degree courses, and five-and-a-half-year B.Arch. degree course, and in the second and third sessions of the Special three-year courses for the B.Tech. degree, an optional subject of his choice in consultation with his Department. A list of optional subjects is given in this Schedule. The departments will announce at the close of each academic session the optional subjects to be offered from out of the list during the following academic session.

All subjects under this Schedule carry a load of (2-0).

AgE. A 41. Horticulture.

A course on flower and vegetable gardening, including ornamental plants suitable for avenues and gardens in India. Techniques for their successful culture: methods of raising seedlings and vegetative propagation of plants like cutting, grafting, etc.: making beds, pits and layout of gardens; manuring and watering. Structure and functions of plant organs. Methods of breeding. Plant disease control. Storage of seeds and bulbs.

AgE. A 42. Soil Conservation.

Soil formation and classification, physical properties, soil fertility, causes of soil damage and depletion, erosion by water runoff and wind. Benefits of soil conservation, land use concept, vegetative and mechanical controls, terracing, contour practices, control of small water courses, and role of vegetation in conservation, pastures and forest. Water conservation, ponds, tanks, small earth dams, ground water recharging, drainage, irrigation, up stream flood control, conservation planning, and soil conservation organizations.

AgE. A 43. Irrigation and Drainage.


AgE. A 44. Farm Machinery.

The role of machinery and equipment in agriculture. Agricultural output by hand vs. mechanical methods. Tillage machinery, ploughs, harrows, disks and rollers; seeding machinery, cultivators, harvesters and threshers. Special machinery for preparing fodder, grinding, fertilizer distribution, earth moving, and dairy farming. Selection, care and maintenance of machinery. Calculation of machinery capacity and costs.


Ch. A 41. Soil Chemistry.


Ch. A 42. Advanced Nuclear Chemistry.

Detailed study of measurements of radioactivity and radiations, health physics, more detailed study of techniques for investigating radio nuclides, further study in use of tracers in scientific and industrial problems, radiocarbon as tracer, geo-and cosmo-chronology.

Nature and theories of nuclear reactions—energetics—cross section—nuclear spins and moments—reaction at very high energies—Fission—theories of fission—spontaneous fission—nuclear states—nature of different radioactive processes—artificial radioactivity—new elements and their properties.

Nuclear reactors—elementary theory of reactors—types of reactors and their use—use of nuclear energy in war and peace—nuclear energy in India—energy production in stars—Genesis of elements.


(Except for Mechanical and Mining Engineers).


Liquid Fuels: Classification. Petroleum refinery operations, properties of petroleum products. Synthetic liquid fuels.


The course covers a unified physical treatment of processes with particular emphasis on the formulation and solution of typical boundary value problems, associated with energy, mass & momentum transport.


Introduction to Chemical Engineering and Elementary treatment of Unit Operations. Chemical machineries involved in fluid flow, heat transfer, evaporation, distillation, gas absorption, drying, filtration, size reduction and separation, extraction etc.

CE. A 41. Theory of Structures.


CE. A 42. Surveying.

Curves (plain and transition), Geodetic Surveying, base line measurements and triangulation, precise and trigonometrical levelling, field of astronomy. Determination of azimuth and altitude and meridian.

Properties of resonant circuits; four terminal network; filters and attenuators; amplifiers—class A, class B, class C; simple A, F. and R. F. amplifiers, feedback in amplifiers; oscillators; principles of modulation and demodulation; single phase rectifiers; electronic measurements; photocell; gas tubes and their simple applications; elements of electronics in industry.


Basis and essentials of French language: graduated course to cover pronunciation and elements of grammar, reading of varied matter, literary and scientific, to lay the foundation and vocabulary for facilitating further independent reading of scientific journals and writings. Practice in hearing and speaking French may be supplemented by audio-visual devices, (French records, pictures, etc.).

Hu. A 42. Elementary German.

Basis and essentials of German language: graduated course to cover pronunciation and elements of grammar, reading of varied matter, literary and scientific, to lay the foundation and vocabulary for facilitating further independent reading of scientific journals and writings. Practice in hearing and speaking German may be supplemented by audio-visual devices, (German records, pictures, etc.).

HU. A 43. Elementary Russian.

Basis and essentials of Russian language: graduated course to cover pronunciation and elements of grammar, reading of varied matter, literary and scientific, to lay the foundation and vocabulary for facilitating further independent reading of scientific journals and writings. Practice in hearing and speaking Russian may be supplemented by audio-visual devices, (Russian records, pictures, etc.).


This course is intended to give instruction in the reading, writing, and speaking of simple Hindi, so that non-Hindi knowing people might have a working knowledge of Hindi.


Section I—

1. Nature of an underdeveloped economy.

2. Keynesian Model and its extension with special reference to problems of underdeveloped countries.

(a) Theory of Employment—Classical Model—Keynesian Model—Model of ‘Economic Growth’ and employment problems under conditions of growth—specific employment problems of India.

(b) Consumption Functions—Keynes’ Formulation of consumption Function—Its extension—consumption function and economic development—Multiplier—its operation in underdeveloped countries.

(c) Investment Functions—Keynes’ Formulation of investment Function—its extension.

(d) Rate of interest—rate of interest and investment—rate of interest and employment. Section II—


This course is offered to students who have done their elementary course either at the Institute or elsewhere. Suitable text books will be used and more advanced exercises in writing
and speaking the French language will be given. The aim of this course is to enable students to read and translate with ease and precision more advanced scientific journals and technical articles.

**Hu. A 52. Advanced German.**

This course is offered to students who have done their elementary course either at the Institute or elsewhere. Suitable text books will be used and more advanced exercises in writing and speaking the German language will be given. The aim of this course is to enable students to read and translate with ease and precision more advanced scientific journals and technical articles.

**Hu. A 53. Advanced Russian**

This course is offered to students who have done their elementary course either at the Institute or elsewhere. Suitable text books will be used and more advanced exercises in writing and speaking the Russian language will be given. The aim of this course is to enable students to read and translate with ease and precision more advanced scientific journals and technical articles.

**Hu. A 54. Advanced Hindi.**

This course is intended to supplement the Elementary Hindi course and would be offered to non-Hindi speaking students who have done their elementary courses, either at the Institute or elsewhere. Suitable texts from the works of Tulsidas, Bharatendu Harischandra, Premchand, Nirala, Sumitranandan Pant etc., would be used and advanced exercises in writing and speaking the Hindi language will be given. Special emphasis will be laid on the essentials of Hindi grammar and composition and difficult vocabulary so that students may be able to read, speak, understand and translate with ease and precision literary, political and scientific articles.

**Hu. A 56. Representative Men and Modern Age.**

The purpose of this course is to acquaint the students with some leading personalities who have made significant contributions in the last one hundred and fifty years to the task of nation-building, to systems of ideas and to the general cause of humanism. This will help the students to evaluate some outstanding men and movements in recent history with special reference to India.


**HU. A 58. Special Area Studies in Psychology.**

(i) Small group study, and (ii) Public opinion and mass communication.

This course is designed to acquaint students with the investigations on the effects of group on individual performance and influences operating upon his attitude and through group processes and methods of mass media of communication.


Mass media of communication—their role in changing public opinion.

**Ma. A 41. Higher Mathematics.**

Functions of a Complex variable : Elementary functions and their properties ; integration of complex functions ; Cauchy's Residue Theorem, Conformal Mapping. Matrices :
Definition, Sum, product and transpose. Application to linear equations. Partitioned matrices
in circuit problems. Operational calculus; Fourier-Mellin transform and their essential
properties. Applications to ordinary and partial differential equations. Special Functions;
Gamma, Beta, Legendre and Bessel’s functions. Probability : Element of probability, theory
of errors ; Normal, Binomial and Poisson distribution.

Ma. A 42. Statistics I.

Probability : Occupancy and ordering problems, Addition and Multiplication
theorems of probability, conditional probability, Binomial, Poisson and Normal distributions,
Mathematical expectation, law of large numbers.

Statistics : Frequency distribution, moments and cumulants, correlation, regression
and prediction, sampling distributions, tests of significance, analysis of variance and covari-
ance, elements of sample surveys, preparation of statistical reports, time series analysis and
interpretation of index numbers, concept of quality control in industry, sampling inspection
schemes.

Ma. A 43. Statistics I.

Graphical and tabular representation of data. Theorems on probability and standard
distributions, elements of sample surveys, preparation of statistical reports, time series analysis,
construction and use of index numbers.

Census and surveys, vital statistics and demography, methods of population projection.
Estimation of parameter and tests of hypotheses. (For Architects).

Ma. A 44. Statistics I.

Probability and some standard probability distributions, empirical frequency distribution,
‘Control’ in experimentation, randomness, replication and local control in experimental designs,
some common designs and associated analysis of variation, missing plot techniques, partial
and multiple correlation and regression, analysis of counted data and non-parametric tests.

(For Agricultural Engineers).

Ma. A 52. Statistics II.

Theory of Inference : Estimation of Parameters by Maximum Likelihood and other
methods, tests of Statistical Hypotheses, Non-Parametric-Tests, Analysis of variance. Multiple
Regression and Correlation analysis. Design of Industrial Experiments. Probit analysis.
Research. Monte Carlo Methods. Industrial Quality control : Control Charts, Single and
Double Sampling Inspection Plans, Sampling Inspection by variables, Sequential Sampling
Plans.


General theory of perfect fluids, Bernoulli’s equation, Theory of potential motion,
Conformal transformation, Discontinuous motion. Flow and Circulation theorems. Vortex
motion. Gravity waves and related Hydraulic problems. Simple cases of motion in three-
dimensions. Poiseuille flow. Boundary Layer theory.

Ma. A 56 Theory of Elasticity.

Analysis of stress and strain in two and three dimensions. Problems in plane stress
and strain using Airy’s stress function. Pure bending, torsion and flexure of cylindrical rod.

ME. A 41. Elements of Production Technology-I.

Machines and methods in manufacture : foundry engineering, machining and machine
tools. Metrology. Plastic working of metals (cold and hot).

Welding engineering.

Auxiliary engineering processes.

(For Civil, Metallurgical and Mining Engineers)
ME. A 43. Prime Movers.
Reciprocating and rotary type internal combustion engines.
Water power engineering. Steam power generating equipment.
   (For Civil and Communication Engineers)

ME. A 51. Elements of Production Technology-II.
(Pre-requisite ME. A 41).
Advanced study in manufacturing processes: jigs, fixtures, tools, gauges and dies.
Economics of manufacture.

ME. A 52. Elements of Industrial Engineering.
General description of a production system: ownership, major functions and management.
Decision making for production systems: problem areas and tools.
Design and operation of production systems: product, plant location, plant layout, work study and organisation. Control of production systems: production planning and control, inventory control, wages and incentives and cost control.
   (For Agricultural and Civil Engineers and Naval Architects)

ME. A 54. Applied Elasticity.
Introduction to the theory of elasticity approach to stress problems as against the strength of materials approach.
Stress measurements by strain gauge, photoelastic and brittle coating methods.
   (Except for Civil and Mechanical Engineers)

ME. A 55. Elements of Instruments and Controls
Theory of measurements, calibration and instrumentation. Instruments:—flow meters, thermometers, pyrometers, pressure indicators and recorders, strain gauges, deflectometers, speedometers, accelerometers and vibration instruments. Mechanical integrators and analysers. Control performances:—mechanical, hydraulic and pneumatic controls, automatic controls and speed regulators.
   (For Agricultural, Civil and Mining Engineers and Naval Architects)

Met. A 41. Metallurgy I.
Iron and steel making, pitside practice, ingot defects and their remedy. Steel—low and medium alloy steels as are used in industry, their heat treatment. Important carbon and alloy tool steels: uses and heat treatment. Aluminium and its alloys, uses, heat treatment and properties.

Met. A 51. Metallurgy. II.
Plastic working of steel: hot and cold rolling, extrusion, drawing, etc. Advanced heat treatment of steel and non-ferrous engineering alloys.

Ph. A 41. Nuclear Physics.
Ph. A 42. Thermodynamics and Statistical Mechanics.

Ph. A 43. Elements of Quantum Mechanics.
Lagrangian and Hamiltonian mechanics. Hamilton-Jacobi's equation. Lorentz transformation. Lorentz contraction and time-dilatation. Elements of relativistic mechanics and mass energy relation.


Elements of quantum theory of radiation: transition probabilities.

Ph. A 44. Applied X-rays.


Ph. A 46. High Vacuum Technique.
Fundamental considerations in vacuum technique: Equation of state; molecular velocities; transport phenomenon; vacuum impedance, conductance and speed; flow through short and long apertures; duct and barriers; pumping speeds of pumps and traps.

Elements of the vacuum systems: Different types of pumps and their speeds; oil migration problems; refrigerants; charcoal traps; getters; ultra high vacuum.

Vacuum measurements, materials and equipment: Vacuum gauges; vacuum tanks, seals and gaskets, insulated seals, valves, protective devices.

Leak detections, instruments and techniques: Spart coils; discharge tubes, rate of rise measurements, soap film method; sealing substance outside and change of pressure; commercial leak detectors; technique of detecting leaks.

Technical applications: Sputtering, evaporation, etc. Properties of materials deposited in high vacuum.


Fourier analysis of plane waves. Group, phase and signal velocities.

Cylindrical and spherical waves.

Wave sources, retarded potentials, linear oscillator. Directional arrays. Guided waves.

Electron-Optics: Electrostatic and electromagnetic lenses; field plotting and ray tracing; focal lengths, aberrations. Application of electron optics.
PART III

REGULATIONS

Schedule of Courses, and Subjects of instruction for 3-year B.Sc. (Hons.) degree courses, and 2-year M.Sc. degree courses in Chemistry, Mathematics and Physics, and 5-year integrated B.Sc./M.Sc. degree courses in Applied Geology and Exploration Geophysics
SCHEDULE XI
REGULATION NO. 17

Admission to the First Year class of the Three-Year B.Sc. (Honours) Degree Course.

(a) Minimum Educational Qualifications.

Admission to the First Year class of the Three-Year B.Sc. (Hons.) Degree courses in Chemistry, in Mathematics and in Physics shall be open to any person who has passed or is expected to pass before the first July of the year of admission any one of the following examinations:

(i) Higher Secondary Examination of a recognised University or any of the recognised Boards of Secondary Education in the Science stream with Chemistry, Mathematics and Physics as elective subjects.

(ii) Pre-University or Pre-Degree or University Entrance Examination of a recognised University or Board with Chemistry, Mathematics and Physics after passing the Matriculation or School Final or S.S.L.C. or High School or equivalent examination conducted by a recognised University or Board;

(iii) Senior Cambridge or Indian School Certificate Examination with Elementary Mathematics and Additional Mathematics, Physics, and Chemistry as separate subjects;

(iv) General Certificate Examination ('0' level) with Chemistry, Mathematics and Physics as separate subjects;

(v) First Year Examination of the two-year Inter-Science or F.Sc. course of a recognised University or Board or Institute affiliated to a recognised University or Board with Chemistry, Mathematics and Physics as separate subjects;

(vi) Jamia Higher Secondary (Three-Year course after VIII standard) with Chemistry, Mathematics and Physics as separate subjects;

(vii) First Year Examination of the two-year course of the Joint Services Wing of the National Defence Academy with Chemistry, Mathematics and Physics as separate subjects, and


(b) Age limit.

To be eligible for admission to the First Year Class a candidate shall, on the 1st October of the year of admission, have completed 16 years of age.

(c) Standard of Physical Fitness.

A candidate seeking admission to the First Year Class must fulfil the prescribed standard of physical fitness as given below:

Height .... .... .... 1.5 m.
Weight .... .... .... 41 kg.
Chest Measurement .... .... 69 cm. (with satisfactory limit of expansion and contraction).
Heart & Lungs .... .... There should be no abnormality.
Vision .... .... Better eye Worse eye
   6/9 or 6/9 ) Corrected
   6/6 6/12 ) with glass.
Hearing .... .... Eyes shall be free from congenital or other diseases.
   Normal.
Good general health and build. Hernia, Hydrocele, Varicocele, Piles... Presence of any of these is a temporary disqualification to be rectified at his own expense before joining.

Opinion of the Institute Medical Officer shall be final and there shall be no appeal.

**SCHEDULE XII**

**REGULATION NO. 18**

Method of admission to the First Year Class of the Three-Year B.Sc. (Honours) Degree Course.

1. Admission to the First Year Class of the Three-Year B.Sc. (Hons.) Degree course shall be made on the basis of the performance of the candidates in the qualifying examination as prescribed in Regulation No. 17 and on their being found medically fit by the Institute Medical Officer.

2. Applications received by the Institute in response to advertisement shall be considered by an Admission Committee set up by the Senate for the purpose and selections be made on the basis of the standard as may be decided by the Senate from time to time.

**SCHEDULE XIII**

**REGULATION NO. 19**

Three-Year B.Sc. (Hons.) Degree Course and its duration.

1. The Institute shall provide Undergraduate courses leading to the Degree of Bachelor of Science (B.Sc.) with Honours in Chemistry, in Mathematics, and in Physics and in any other subject as the Senate may decide from time to time taking into consideration the accommodation and staff position and other facilities available.

2. The curriculum for the Degree of Bachelor of Science in the Subjects mentioned in para 1 shall extend over not less than three academic sessions each consisting of three terms.

**SCHEDULE XIV**

**REGULATION NO. 20**

Graduation Requirement—Three-Year B.Sc. (Hons.) Degree Course.

1. Every student for the Bachelor’s Degree must, before entering on the curriculum, have complied with the admission requirements.

2. A student shall not be permitted to proceed to the next higher class unless he has fulfilled to the satisfaction of the Senate all requirements in respect of attendance and study and has passed the prescribed examinations.

3. A student shall not be permitted to take any of the examinations unless (i) he has been regular in attendance (a student shall be expected to be regular in attendance in all lectures, tutorials, laboratories, guided studies, drawing office, field work and workshop classes), and (ii) he has satisfied all class teachers that he has conducted himself well within and outside the class rooms and that he has been regular, diligent and methodical in studies and has independently and satisfactorily performed the home and sessional assignment and has regularly submitted these for teachers’ scrutiny.
4. During the three years of study it shall be obligatory for all men students to participate in one of the units of the National Cadet Corps; and for the women students and for those men students, who may not be up to the standard of physical fitness required in the National Cadet Corps, it shall be obligatory to participate in physical training.

5. Subjects of each examination shall be as given in Schedule XV. In each subject of examination there shall be written paper or papers and/or sessional assignments as prescribed in the Regulations. The sessional assignments may comprise tutorials, guided studies, laboratory and field work, workshop practice and drawing office work.

6. The marks allotted to each subject in the terminal as well as in the End-Sessional examinations shall be as prescribed in Schedule XV.

7. The Senate shall determine in respect of each subject of study the scope of the course and the relative proportion in each course of lectures and/or practical or laboratory work. The Senate shall also determine in respect of the several examinations leading to the Degree, the conditions for admission and the standard of examinations.

8. Special Senate instructions specifying the standard of examination shall be kept with the Registry to be made available only to the Senate and the Board of Examiners.

9. A student, who, does not comply with all the provisions of the Ordinances and Regulations for an Honours degree but has, in the opinion of the Senate, shown sufficient merit in his studies and examination may, on the special recommendation of the Senate, be admitted by the Board of Governors to the ordinary degree, the diploma being suitably inscribed to that effect.

10. A student shall be required to qualify in the first, Second and the Final Examinations within a maximum period of 4 years of study at the Institute.

11. If a student fails in an examination and is permitted to repeat the course his marks shall be as may be secured by him when he repeats the course.

12. The Senate shall be competent on the recommendation of the Board of Examiners to deviate from the prescribed Ordinances and Regulations relating to the examination and consider the special cases of candidates not covered by the Ordinances and Regulations subject to approval of the Board of Governors.

13. Subject to the provisions of the Ordinances and Regulations the Degree of Bachelor of Science shall be conferred on students who have followed the prescribed curricula for not less than three academic sessions studying subjects set forth in the Regulations (Schedule XV) and who have reached the Honours standard in the Examinations in one of the following branches:

(i) Chemistry; (ii) Mathematics; (iii) Physics.

14. There shall be three complete examinations for the Degree of Bachelor of Science (B.Sc.) viz., (i) the First Examination, (ii) the Second Examination, and (iii) the Final Examination.

15. For each examination a Board of Examiners shall be constituted by the Senate and the Board of Examiners shall comprise the teachers in the subjects of examination and the additional examiner or examiners and other experts.

16. No student may present himself for examination in any subject until he has duly completed the prescribed course of instruction to the satisfaction of the teachers concerned.

17. The First Examination

(i) The First Examination shall be taken in three sections consisting of two Terminal examinations each covering the term's work and an End-sessional examination covering the entire course of the First Examination.

(ii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments and in the practical examination.
(iii) A student shall be deemed to have passed the First Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, in the practical examination and in the aggregate.

18. The Second Examination

(i) No student may present himself for examination in any subject of the Second examination until he has passed the whole of the First Examination except those who have been granted admission direct to the Second year class and exempted from the First examination.

(ii) The Second Examination shall consist of two Terminal examinations each covering the term's work and an End-sessional examination covering the entire course of the Second examination.

(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the practical examination.

(iv) A student shall be deemed to have passed the Second Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, in the practical examination and in the aggregate.

19. The Final Examination

(i) No student may present himself in any subject of the Final examination until he has passed the whole of the Second Examination.

(ii) The Final examination shall be taken in four sections comprising two Terminal examinations each covering the term's work and an End-sessional examination and a viva-voce examination.

(iii) No student may present himself for examination in any subject of the End-sessional examination and in the viva-voce examination unless he has secured on the total of the two Terminal examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the practical examination.

(iv) The End-sessional examination shall cover the entire course prescribed for the Final examination.

(v) A student shall be deemed to have passed the Final B.Sc. Examination if he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, in the practical examination, in the viva-voce examination and in the aggregate.

20. The Maximum marks

The maximum marks for the First, Second and the Final examinations shall be the total of the maximum marks prescribed for the obligatory subjects of the respective End-sessional Examination plus fifty per cent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examination.

21. The Weighted Maximum Marks

(i) The weighted maximum marks for the First and the Second Examinations shall be the maximum marks of the First and the Second Examinations respectively.

(ii) The weighted maximum marks for the Final Examination shall be the maximum marks of the Final Examination plus fifty per cent of the weighted maximum marks of the First and the Second examinations.

22. A student passing in all the three examinations for the Degree of Bachelor of Science (B.Sc.) shall be declared to have passed with Honours in the appropriate branch on the basis of his overall performance in all the three examinations.
23. The students found eligible for the Honours Degree shall, in each branch, be classified in two groups to be denominated respectively First and Second Class on the basis of the weighted total marks they secure out of the prescribed weighted maximum marks of the Final examination. The names of the candidates in the First Class shall be arranged in order of merit and those in the Second Class in the alphabetical order.

24. The students satisfying all the conditions prescribed and having passed the prescribed examinations shall be entitled to receive the Degree of Bachelor of Science (B.Sc.) with Honours in the appropriate branch of study.

25. A student who has been admitted at a stage higher than the first year class may be allowed to graduate with First or Second Class Honours on the results of the complete examinations which he takes to the satisfaction of the Board of Examiners, on a criterion to be determined by the Senate. He will not, however, be ranked.

26. For the degree of Bachelor of Science with Honours in any branch as set forth above the graduate shall receive a Diploma wherein shall be set forth the branch of study in which he has obtained Honours and the Class in which he has been placed.
# Schedule XV

## Regulation No. 21

### Schedule of Courses and Distribution of Marks

*Three-Year B.Sc. (Hons.) degree courses in Chemistry, Mathematics and Physics*

**First Year (Common for all courses)**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the First Examination</th>
<th>First and Second Terms</th>
<th>No. of papers for exam.</th>
<th>Duration of exam. papers</th>
<th>Third Term</th>
<th>No. of papers for exam.</th>
<th>Duration of exam. papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu 101</td>
<td>English</td>
<td></td>
<td>2</td>
<td>1</td>
<td>2 hrs.</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Hu 103</td>
<td>Principles of Government</td>
<td></td>
<td>1</td>
<td>0</td>
<td>2 hrs.</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ch 101</td>
<td>Chemistry</td>
<td></td>
<td>4</td>
<td>1</td>
<td>3 hrs.</td>
<td>6</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ch 102</td>
<td>Chemistry Lab. I</td>
<td></td>
<td>0</td>
<td>5</td>
<td>2 hrs.</td>
<td>4</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ma 101</td>
<td>Mathematics I</td>
<td></td>
<td>6</td>
<td>2</td>
<td>3 hrs.</td>
<td>6</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ph 101</td>
<td>Physics I</td>
<td></td>
<td>4</td>
<td>1</td>
<td>2 hrs.</td>
<td>4</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ph 102</td>
<td>Physics Lab. II</td>
<td></td>
<td>0</td>
<td>5</td>
<td>2 hrs.</td>
<td>0</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>†ME 101</td>
<td>Workshop and Drawing</td>
<td></td>
<td>0</td>
<td>3</td>
<td>0-100</td>
<td>0</td>
<td>0-100</td>
</tr>
<tr>
<td>GE 101</td>
<td>NCC or Physical Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>21</td>
<td>850-650</td>
<td>8</td>
<td>17 21 850-650</td>
</tr>
</tbody>
</table>

†ME 101 First and Second Terms.
GE 101 Third Term.

Duration of papers for end-sessional examinations shall be 3 hours.
## SECOND YEAR
(Common for all courses)

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Second Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam, paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu 201</td>
<td>English</td>
<td>Hours per Week</td>
<td>Marks</td>
<td>1</td>
</tr>
<tr>
<td>Hu 202</td>
<td>Logic</td>
<td>1 0</td>
<td>50—0</td>
<td>1</td>
</tr>
<tr>
<td>Ch 201</td>
<td>Chemistry II</td>
<td>6 0</td>
<td>300—0</td>
<td>2</td>
</tr>
<tr>
<td>Ch 202</td>
<td>Chemistry Lab. II</td>
<td>0 6</td>
<td>0—125</td>
<td>--</td>
</tr>
<tr>
<td>Ma 201</td>
<td>Mathematics II</td>
<td>6 2</td>
<td>300—100</td>
<td>2</td>
</tr>
<tr>
<td>Ph 201</td>
<td>Physics II</td>
<td>6 0</td>
<td>300—0</td>
<td>2</td>
</tr>
<tr>
<td>Ph 202</td>
<td>Physics Lab. II</td>
<td>0 6</td>
<td>0—125</td>
<td>--</td>
</tr>
<tr>
<td>NCC or Physical Training</td>
<td></td>
<td>0 3</td>
<td>0—100</td>
<td>--</td>
</tr>
</tbody>
</table>

20 18 1000—500 8
### THIRD YEAR

(i) **For Chemistry Honours Course Students**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 303</td>
<td>Physical Chemistry</td>
<td>3 0 150—0</td>
<td>1</td>
<td>3 hrs.</td>
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<tr>
<td>Ch 304</td>
<td>Organic Chemistry</td>
<td>3 0 150—0</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ch 305</td>
<td>Inorganic Chemistry</td>
<td>3 0 150—0</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ch 306</td>
<td>Industrial Chemistry</td>
<td>3 0 150—0</td>
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<tr>
<td>Ch 307</td>
<td>General and Analytical Chemistry</td>
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<td>3 hrs.</td>
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<td>Ch 308</td>
<td>Chemistry—Lab.—III</td>
<td>0 15 0—450</td>
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<tr>
<td>Elective (any one of the subjects for Mathematics or Physics Honours Course)</td>
<td>3 0 150—0</td>
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<td>3 hrs.</td>
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<tr>
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<tr>
<td>NCC or Physical Training</td>
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<td></td>
<td>18 17 900—600</td>
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### THIRD YEAR

**For Mathematics Honours Course Students**

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<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers</th>
<th>Duration of Exam. papers</th>
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<tbody>
<tr>
<td><strong>Ma 303</strong></td>
<td>Analysis</td>
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<td>Marks</td>
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<tr>
<td><strong>Ma 304</strong></td>
<td>Modern Algebra and Pure Geometry</td>
<td>3 0</td>
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<tr>
<td><strong>Ma 305</strong></td>
<td>Probability, Statistics and Computation</td>
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<tr>
<td><strong>Ma 306</strong></td>
<td>Astronomy and Rigid Dynamics</td>
<td>3 0</td>
<td>150 — 0</td>
<td>1</td>
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<tr>
<td><strong>Ma 307</strong></td>
<td>Statics and Hydrostatics</td>
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<td>150 — 0</td>
<td>1</td>
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<tr>
<td><strong>Ma 308</strong></td>
<td>Special Functions and Differential Equations</td>
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<td>150 — 0</td>
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<td><strong>Ma 309</strong></td>
<td>Mathematical Computation—Practical and Sessional</td>
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<td>Elective (any one of the subjects for Chemistry or Physics Honours course)</td>
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### (iii) For Physics Honours Course Students

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<th>Subject No.</th>
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<tr>
<td>Ph 303</td>
<td>Mechanics and Properties of Matter</td>
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<td>Ph 304</td>
<td>Heat and Thermodynamics</td>
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<td>150—0</td>
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<td>Ph 305</td>
<td>Physical Optics</td>
<td>3 0</td>
<td>150—0</td>
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<td>Ph 306</td>
<td>Electricity and Magnetism</td>
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<td>150—0</td>
<td>1</td>
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<td>Ph 307</td>
<td>Atomic Physics</td>
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<td>150—0</td>
<td>1</td>
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<tr>
<td>Ph 308</td>
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<td>Ma 310</td>
<td>Mathematics III</td>
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Viva voce

NCG or Physical Training

<table>
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<th>Hours per Week</th>
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<tr>
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<td>18</td>
<td>17</td>
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### DISTRIBUTION OF MARKS
(For each Examination)

#### Three-Year B.Sc. (Honours) Degree Courses

<table>
<thead>
<tr>
<th>Examination</th>
<th>First Term Marks</th>
<th>Second Term Marks</th>
<th>End-Sessional Marks</th>
<th>Maximum Marks</th>
<th>Weighted Maximum Marks</th>
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<td>Final</td>
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<td>1,500</td>
<td>1,500</td>
<td>3,000</td>
<td>6,000</td>
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SCHEDULE XVI

REGULATION No. 22

Subjects of Instructions for Three-Year Bachelor of Science (B.Sc.) (Honours) degree course

CHEMISTRY (Ch)

101. Chemistry—I (4-1).

(A) PHYSICAL CHEMISTRY

Gaseous state: Ideal gas laws and the molar gas constant, kinetic theory of gases, specific heats of gases, deviations from ideal behaviour. Van der waals equation, molecular weight and thermal dissociation, critical phenomena, continuity of state, liquefaction of gases.

Solution: Definition of terms, characteristic features of different types of solutions including distillation of binary liquid mixtures, extraction, solubility curves and fractional crystallisation.

Colligative properties of dilute solution: Osmotic pressure, lowering of vapour pressure, elevation of boiling point and depression of freezing point, experimental determination of molecular weights of solutes, abnormal colligative properties.

Electrochemistry: Arrhenius’s theory of electrolytic dissociation, degree of dissociation and Vant Hoff’s factor, Faraday’s laws of electrolysis and some important electrolytic processes.

Chemical equilibrium: Reversible reactions, Law of mass action and chemical equilibrium in homogeneous and heterogeneous systems, Le Chatelier’s principle and its applications.

Elements of thermodynamics & thermochemistry: First law of thermodynamics, internal energy, heat content and heat capacity, heat of reactions, heat of solution, heat of neutralisation, Hess’s law of constant heat summation, heat of reaction at constant pressure and constant volume, effect of temperature on heat of reaction (Kirchhoff’s law).

(B) ORGANIC CHEMISTRY

Introduction to organic chemistry. Purification of organic compounds (solids and liquids).

Qualitative and quantitative analysis of organic compounds. Determination of molecular weight, empirical and molecular formula of organic compounds.

Constitution and classification of organic compounds. Functional groups and homologous series. Nomenclature. Distinction between aliphatic and aromatic compounds.


Organic compounds containing only one functional group: General methods of preparation, constitution and properties of aliphatic alcohols, ethers, aldehydes, Ketones, carboxylic acids (fatty acids), and esters. Studies of simple individual members in each class.

(C) INORGANIC CHEMISTRY

Hydrogen; Water; hydrogen peroxide and ozone.

Inert gases (excluding details of separation).

Study of the chemistry of the following elements and their compounds on the basis of the periodic classification (Metallurgical and industrial processes, the true peroxides and the true peracids are to be excluded).
Elements of groups IA, IB, IIA and IIB (excluding francium and radium), the halogens, oxygen, sulphur (excluding thionic acids).

(D) GENERAL CHEMISTRY

Elementary idea of the nuclear atom and fundamental particles; cathode ray, electron and the ratio e/m (experimental method for its determination is excluded) X-ray, radioactive rays, electronic charge, indentification of the particle and the nuclear atom, atomic number, Moseley's work (elementary concepts only), isotopes and isobars, Mendeleef and Bohr's periodic table; group displacement law.

Electrovalency, covalency, metallic bond, Van der Waals bond, coordination bond, partial ionic character of covalent bond, molecular dipole, electronegativity of elements, octet rule and deviation from the octet rule, elements of Werner's coordination theory; double and complex salts; ionic hydration.

The electron, Faraday's laws and Avogadro number, electronic theory of oxidation and reduction, relation between the equivalent weight and electrons both in acid-base and oxidation-reduction, chemical calculations.

Volumetric and gravimetric compositions of $H_2O$, $NH_3$, $N_2O$, $NO$, $SO_2$, $CO$, $CO_2$, $CH_4$, $C_2H_4$ and $C_4H_4$; chemical calculations involving volume to volume and weight to volume conversions.

Acids, bases and amphoteric oxides—elementary concept of the theory of acids and bases.

Metals and nonmetals—electrochemical series.

102. Chemistry Lab.—I (0-5).

Physical: Determination of the density of a gas, determination of the value of equilibrium constant, determination of the heat of neutralisation of an acid by a base, determination of the solubility of a substance at different temperatures, determination of the boiling points of solvent and solutions, verification of Faraday's laws and determination of equivalent weight of a metal.

Organic: Detection of elements in organic compounds (Nitrogen, halogen, sulphur), determination of melting points and boiling points, crystallisation.

Inorganic: Analysis of mixtures containing not more than three radicals (basic or acidic or both) from the following:

(a) Acid radicals: $CO_3$, $Cl$, $Br$, I, F, $SO_4$, $S_2O_3$, $S$, $NO_3$, $NO_2$, $PO_4$, $BO_3$, $CrO_4$.

(b) Basic radicals: $Na$, K, $NH_4$, Cu, Ag, Ba, Ca, Sr, Mg, Zn, Cd, Hg, Al, Pb, Sn, Cr, Mn, Fe, Co, Ni, As, Sb, Bi.

201. Chemistry—II (6-0).

(A) PHYSICAL CHEMISTRY

Electrochemistry: Transport number, specific, equivalent and molar conductivity—their determination and variation with temperature and dilution; Kohlrausch's law of ionic mobility, ionic conductance, conductometric titrations of acids and determination of solubility. Ostwald's dilution law, strong and weak electrolytes, effect of common ion, solubility product and its applications to analytical chemistry, ionic product of water, pH, strength of acids and bases, buffer solution, hydrolysis of salts, indicators, E.M.F. of galvanic cells, standard electrode potential and the electrochemical series.

Liquid state: Vapour pressure, surface tension, molecular weights of pure liquids, viscosity, relationship between physical properties and chemical constitution.

Solid state: Allotropy, isomorphism, Dulong and Petit's law.

Chemical kinetics: Molecularity and order of a reaction, expression for the rate constants of reactions of first and second order; temperature coefficient and energy of activation.
Catalysis: Criteria of catalysis, homogeneous, heterogeneous and autocatalysis; elementary theory of catalysis, promoters and poisons.

Phase rule and its applications to one and two component systems.

Colloid: Definition, classification, preparation and purification of colloids, thermal, optical and electrical properties, coagulation, peptisation, protective colloids and gold number.

(B) ORGANIC CHEMISTRY

Organic compounds containing only one functional group: General methods of preparation, constitution and properties of aliphatic acid amides, acid anhydrides, acid chlorides, nitro compounds, amines, nitriles and isonitriles. (Special treatment for the first four members of each group).

Hydrolysis of esters. Introduction to fats, oils and waxes.

Organometallic compounds: Compounds containing magnesium and their uses in organic synthesis.

Organic compounds containing more than one but not more than three functional groups: Methods of preparation, constitution and reactions of derivatives of unsaturated compounds (acrolein, acrylic acid); polyhydric alcohols (ethylene glycol, ethylene oxide, glycerol); di- and tribasic acids (oxalic, malonic, succinic, citric acids); hydroxy acids (lactic and tartaric acids), unsaturated acids (maleic and fumaric acids), keto acids (pyruvic and acetocacetic acids); carbonic acid derivative (carbonyl chloride and urea).


Aromatic compounds with functional groups: Preparation, constitution and properties of halogenated compounds (chloro-, bromo-, iodo-benzene, benzylicloride, benzoal chloride); nitro compounds (nitrobenzene, trinitrotoluene, picric acid); phenol, benzene sulphonic acid, benzyl alcohol, benzaldehyde, acetonaphone, benzophenone, salicylaldehyde, benzoic and tolulic acid, benzoic anhydride, benzamide, benzoic ester, phenyl acetic acid, cinnamic acid, salicylic acid, acetylsalicylic acid.


Introduction to Electronic theory in the elucidation of the course of organic reactions. Elementary study of the following reactions; Reformatsky's reaction, Claisen reaction, Michael reaction, Reimer-Tiemann reaction, Cannizzaro's reaction, Perkin's reaction.

(C) INORGANIC CHEMISTRY

Metallurgy, uses and common alloys of Na, K, Cu, Ag, Au, Mg, Ca, Sr, Ba, Zn, Cd, Hg, Al, Sn, Pb, As, Sb, Bi, Fe, Ni.

Elementary ideas on the production of the following:

Cements and mortars, superphosphate, ceramics, glass, nitrogenous fertilizers, lead and chrome pigments, lithopone, rouge, ferrocyanide, ferricyanide, Prussian blue, nitroprusside.

Manufacture of steel; alloy steels and their uses.

Study of the chemistry of the following elements and their principal compounds.
B (nitrogen, hydrogen derivatives to be omitted; diborane is included), Al, C, Si, Sn, Pb, In, P, As, Sb, Bi, Cr, Mn, Fe, Co, Ni.

(As far as practicable, periodic classification should be the basis for the study of the properties of these elements and their compounds).

202. Chemistry Lab—II (0-6).

(A) PHYSICAL CHEMISTRY

(a) Determination of the equivalent conductance of an electrolyte at different concentration, (b) Determination of viscosity and surface tension of liquids, (c) Determination of transition temperatures of solids (d) Properties of colloids.

(B) ORGANIC CHEMISTRY

(a) Tests and reaction of known compounds: Methyl alcohol, ethyl alcohol, glycerine, benzy1 alcohol, chloroform, acetaldehyde, benzaldehyde, acetone, acetonaphene, glucose, lactose, sucrose, starch, formic acid, acetic acid, succinic acid, citric acid, tartaric acid, benzoic acid, salicylic acid, ethyl acetate, phenol, resorcinol, nitrobenzene, aniline, methylamine, dimethyl aniline, pyridine and urea.

(b) Identification of unknown monofunctional organic compounds (Hydroxyl, halo, carboxyl, ester, nitro, amino).

(C) INORGANIC CHEMISTRY

(a) Volumetric: Acidimetry and alkalimetry: determination of hardness of water; estimations of oxalic acid and permanganate, and of ferrous iron (by permanganate and dichromate), estimations of ferric iron by permanganate and dichromate, of thiosulphate by dichromate and copper, of calcium by permanganate, and of silver by thiocynate; estimation of available chlorine in bleaching powder.

(b) Gravimetric: Estimation of barium as barium sulphate, and iron as Fe₃O₄;

(c) Estimation of Cu and Fe or Ca and Fe in a mixture.

303. Physical Chemistry (3-0).

Gasous state: Equations of state for real gases (Van der Waals’, Barthelot’s & Dieterici’s), limiting density, the law of corresponding state, reduced equation of state, collision frequency, mean free path.

Liquid state: Surface tension, viscosity, latent heat, molecular volume, parachor, refraction and optical activity in relation to structure.

Solid state: Elementary idea about crystal structure.

Thermodynamics: First law of thermodynamics, adiabatic and isothermal processes, specific heats of gases, Joule-Thomson effect.

Second law of thermodynamics: reversible and irreversible processes. Carnot’s cycle and its efficiency, entropy and its change in simple processes, work function, free energy, thermodynamic criteria of equilibrium, Gibbs-Helmholtz equation. Clapeyron-Clausius equation. Chemical potential and simple relations between thermodynamic functions.

Chemical equilibrium: Thermodynamic derivation of the law of mass action. Vant Hoff’s reaction isotherm and isochore, free energy and equation constant.

Chemical kinetics: Rate equations for reactions of first, second and third order, determination of the order of a reaction, collision theory of chemical reactions, elementary idea about consecutive reactions and back reactions.

Surface chemistry and catalysis: Types of adsorption, adsorption isotherms (of Freundlich and Langmuir).
Solution: Thermodynamic derivation of Raoult’s law and Van’t Hoff's equation for osmotic pressure of ideal solution, determination of molecular weights of solutes.

Phase equilibria: The equilibria between gas-liquid, liquid-liquid, and liquid-solid (Cases illustrating simple types only).

Electrochemistry: Transport number and its determination, ionic mobility and ionic conductance, applications of conductance measurement in titration, determination of solubility and basicity of acids, elementary idea about the interionic attraction theory, osmotic co-efficient and ionic strength.

Galvanic cells, E.M.F. and free energy, reversible cells and reversible electrodes, standard electrodes, standard electrode potential, oxidation-reduction potential, concentration cells, cells with and without transport, application of e.m.f. measurements in titration, calculation of heat of reaction, equilibrium constant and solubility product.


Colloids, origin of charge and stability of lyophobic solutions, determination of size of colloidal particles, colloidal electrolytes.

304. Organic Chemistry (3-0).


Alicyclic compounds. Baeyer’s Strain Theory. Theory of strainless rings. Large ring compounds.

Resonance and tautomerism. Polyfunctional group of organic compounds (Diketones, hydroxyaldehydes and hydroxyketones, hydroxyacids and lactones, amino acids and lactanes), ketenes, Quaternary ammonium compounds.

Aliphatic and aromatic diazocompounds: Diazomethane, diazoacetic ester. Diazonium salts and related compounds.


Configuration of the monosaccharides, determination of the size of sugar rings. Mutarotation.

Detail studies of aromatic compounds, aromatic nitrose compounds, diamines, di- and polyhydric phenols, quinones and quinols, di-and tricarboxylic acids.

Polynuclear hydrocarbons and their derivatives: Diphenyl, di and triphenylmethane, dibenzyle, stilbene, benzoic,acenaphthene, indene, fluorene, anthracene, phenanthrene. Their preparation, properties, constitution and uses.

Name reactions, condensations, rearrangements:

Dieckmann reaction, Knoevenagel reaction, Stobbe condensation, Mannich reaction, Diels-Alder reaction, Arndt-Eistert reaction, Hofmann degradation, Schmidt reaction, Curtius reaction.

Pinacol-pinacolone rearrangements, Benzidine rearrangements, Semidine rearrangements, Beckmann rearrangements.

Introduction to dye-stuffs. Classification of azodyes.

Introduction to heterocyclic compounds and alkaloids.

305. Inorganic Chemistry (3-0).

Treatment of the topics included in the first and second year courses on a more advanced level. The following additional elements are included:
Ra, Se, Te, U, Pt.

The following topics to be specially considered:

1. Separation of inert gases from their mixture and their chemical characteristics.
2. Oxides and oxyacids of halogens, interhalogens, polyhalides, pseudo-halogens, basic property of iodine.
3. Thionic acids,
4. boron hydrides and boron nitride,
5. silicon hydrides,
6. Mercury-nitrogen compounds,
7. Complex halides and cyanides of zinc, cadmium and mercury,
9. Hydrides, carbides and nitrides (general treatment only).
10. Amides, acid amides and imides of S, P, N and C,
11. Study of the different valent state (both normal and abnormal) compounds (simple and complex) of Cu, Ag, Au, Fe, Co, Ni, Hg, Pt, Cr and Mn.
12. Electrometallurgical processes with special reference to Mg; Al, Zn; electro-refining of elements, electro-plating, metallurgy of copper, zinc, lead, tin and nickel, iron and steel industry.
13. Important alloys (composition and uses only).

306. Industrial Chemistry (3-0).


Fuels—

(a) Solid fuel—(i) Coal—analysis, classification, carbonisation and recovery of coal chemicals (ii) Wood-distillation and its products.

(b) Liquid fuel—(i) Petroleum—distillation, cracking and other unit processes, different petrochemicals. Gasoline and diesel oil—their characterisation.

(ii) Synthetic liquid fuel—Fischer-Tropsch and Bergius processes; power alcohol.

(c) Gaseous fuel—gasification of coal (producer gas and water gas, coal gas), natural gas.

Industrial gases—Oxygen and nitrogen by liquefaction, hydrogen, carbon dioxide, chlorine, hydrocarbon gases like acetylene, ethylene, etc.

Acids and alkalis of industrial importance—(i) Sulphuric acid, nitric acid and hydrochloric acid.

(ii) Caustic industry.

Fixation of nitrogen and related industries—(i) Ammonia, ammonium sulphate, ammonium nitrate, cyanamide and azotobacteria.

(ii) Nitrogenous and other fertilizers.

Electrochemical and electro-thermal industries—(i) A short discussion on applied electrochemistry and its utility in various industries.
(ii) Manufacture of carbides, hydrogen peroxide, and permanganate.

Ceramic industry—Lime, cements, refractories, glass. (Pottery, porcelain and enamels—to be discussed briefly).

Fermentation industry—Ethyl alcohol, acetone, butyl alcohol, lactic acid, acetic acid.

Sugar Industry—Glucose, cane-sugar, dextrine, utilisation of molasses.

Paper industry—mechanical and chemical methods of pulping and a short outline of the finishing operations.

Hydrogenation industry—hydrogenation of fats and oils.

Elementary ideas of the following industries—

(i) Leather tanning

(ii) Natural and synthetic rubbers.

(iii) Synthetic fibres and plastics

(iv) Paint, pigment and varnish

(Each of the above topics to be discussed with special reference to Indian conditions).

307. General and Analytical Chemistry (3-0).

Determination of e/m and e. X-ray spectra and atomic number. Isotopes and mass spectrography. Physical and chemical determination of atomic weights.

Bohr’s theory of hydrogen spectrum, quantum numbers, Bohr-Sommerfeld model of atoms, Pauli’s exclusion principle and distribution of electrons in the orbits.

Natural and artificial radioactivity, law of radioactive disintegration, radioactive equilibrium, particle accelerators, discovery of fundamental particles, the cloud chamber, cosmic ray, artificial transmutation.

Electronegativity scale of Pauling, elementary concept of atomic orbitals, covalency treated from stand point of atomic orbitals, “sigma” and “pi” bonds. Hybrid orbitals and directed bonds.

Resonance, Lowry-Bronsted concept of acids and bases. Reaction in liquid ammonia (elementary treatment).

Elements of Nuclear Chemistry—nuclear energy, fission, fusion, nuclear reactor (elementary concept only).

Polymorphism and isomorphism, simple and typical phase diagram of binary alloys.


Principles of permanganometry, dichrometry, iodometry, and argentometry;

Gravimetric analysis: Principles of precipitation, coprecipitation, post-precipitation stages, theory of washing;

Application of solubility product rule and adsorption: variation of pH during acidimetric or alkalimetric titrations; buffer solution; use of pH and buffer in analysis. Variation of electrode potentials in redox titrations.

Indicators: pH, redox and adsorption indicators.

Use of complexing agents in analysis (examples from practical chemistry syllabus);
202

Calibration of burettes, pipettes, and weight boxes; common errors in volumetric and gravimetric analysis.

308. Chemistry Lab.—III (0-15).

(A) PHYSICAL CHEMISTRY

Determination of density of liquids and solutions, refractive index and solubility.


(B) ORGANIC CHEMISTRY

(a) Purifications of organic solvents: methyl and ethyl alcohols, benzene, chloroform.

(b) Preparation of simple organic compounds: methyl iodide, ethyl bromide, ethyl acetate, ethyl benzoate, nitro-benzene, aniline, chlorobenzene, m dinitrobenzene, picric acid, benzoic acid (from toluene), acetonilide, aspirin and methyl orange.

(C) INORGANIC CHEMISTRY

(a) Qualitative analysis of mixtures containing not more than four radicals (basic or acidic or both) selected from the list included in the common course and the following: ferrocyanide, ferricyanide, sulphocyanide, silicate, arsenite.

(b) Quantitative:

(i) Volumetric estimation of phosphorus.

(ii) Gravimetric estimation of lead, magnesium, sulphate and manganese;

(iii) Estimations in mixtures such as—

(a) Fe and Ca,

(b) Fe and Mn,

(c) Ca and Ba,

(d) Ca and Pb,

(e) Cu and Zn,

(f) Pb and Cr,

(g) Fe and Mg,

(h) Cr and Cu.

(c) Analysis of dolomite and/or brass.

CIVIL ENGINEERING (CE)

101. Drawing (0-3) Third Term.


First angle and Third angle projections.

Orthographic projections of points, lines and solids. Brief introduction to Isometric and other pictorial projections.

Plan, Elevation and Sections of Simple Solids.

Intersection of Simple solids and development of surfaces.

Tracings and Blue and Ammonia Prints.
HUMANITIES AND SOCIAL SCIENCES (Hu)

101. English (2-1).

The object of the course in English is to teach students to express themselves in good, simple and correct English and to help them develop a taste for literature.

Tutorial Programme

1st Term

The main rules of syntax; the sentence: its structure; punctuation; paragraph etc. No formal grammar lessons are given; correct use is taught through composition.

2nd Term.

Précis writing; letter writing; comprehension test, etc.

3rd Term.

Paraphrasing; imaginative writing; dialogue, diary, etc., writing short notes on topical issues.

Anthologies of essays and poems and a modern play will be chosen as text for the lecture classes every two years or so.


Structure of Government; Constitution of India with reference to some modern constitutions.

World Order and the U. N.

201. English (1-1).

Tutorial Programme

Advanced prose composition including précis writing; discussion and review of important books; summarising technical reports.

In the lecture classes two books will be discussed in detail; one, preferably a prose play by an outstanding playwright, in the first two terms and the other, one or two long poems or a selection of poems by different poets, or short stories or essays.

202. Logic (1-0).

The province of logic: Nature, Scope and Utility of logic; Fundamental concepts of logic. The relation of logic to psychology, grammar and mathematics.

Logic and language: Words and Terms: Denotation and Connotation and distribution of terms: Classification of terms. Propositions and sentence (classification of propositions, opposition of propositions).


MATHEMATICS (Ma)

101. Mathematics I (6-2).

(Calculus and Differential Equations).


Taylor’s theorem with remainders and its application to Binomial Theorem (any index), trigonometric function.

Maxima-Minima and Indeterminate forms.

Integration as area and limit of sum and as inverse of differentiation. Integration of standard forms (expressions not integrable in closed form to be pointed out). Use of tables of integrals. Logarithm defined as integral and exponential as its inverse.

Ordinary differential equation of first order and second order linear differential equation with constant coefficients. Reduction of second order differential equations to first order.

GEOMETRY


Study of some well known curves (e.g. cycloid, cardiode etc. with the help of calculus wherever necessary).

Analytical geometry of three dimensions-Planes, Straight lines including parametric form and simple conicoids.

ALGEBRA AND TRIGONOMETRY

Complex Numbers and Trigonometry-Argand’s diagram. Demoiver’s theorem and exponential sine—cosine (calculus may be used). Summation of trigonometrical series whose angles are in A.P. and simple cases by ‘C+I S’ method. Gregory’s series. Inter-relation of trigonometric and hyperbolic functions. Geometrical interpretation of hyperbolic functions.


201. Mathematics II (6-2).

ADVANCED CALCULUS

Calculus—Rigorous treatment of sequence, series (including proof of Weirtrass theorem).

Functions of two or more variables. Geometric notion and their continuity. Successive partial derivatives. Statement of a set of sufficient conditions (without proof) for the commutative property of partial derivatives.

Definite Integrals including improper integral. Application to area, length, volume, surface, C.G.

Application to Geometry-Elementary treatment of asymptotes, nodes, cusps. Curvature.

Solution of ordinary differential equation by the method of series (simple cases). First order partial differential equation.

Fourier series (statement of Dirichlet conditions and coefficient calculation) Elementary idea of Fourier transform.


VECTORS AND TENSORS


Dynamics—motion of a straight line using differential calculus (including mass varying motion). Expression for velocity and acceleration in polar and intrinsic coordinates with simple application to free and constrained motion in two dimensions. Central orbits. Collision of elastic bodies, Projectiles, motion in a resisting medium. Motion in a circle.


303. Analysis (3-0).


Taylor’s developments in terms of two or more variables with remainder after n terms. Maxima and minima of functions of two or more variables. Lagrange’s Multipliers.


First and Second Mean value theorem for integrals. Fundamental theorem of Integral Calculus. Improper Integrals. Elementary test of Convergence, Beta and Gamma functions. Differentiation and integration under sign of integration.


304. Modern Algebra and Pure Geometry (3-0).

Modern Algebra—Introduction to the concepts of Groups, Rings, Fields and Vector spaces. (Number of examples to be given and enough practice to be given for deducing simple properties from given axioms).

305. Probability, Statistics and Computation (3-0).


Computation—Solution of simple equations by numerical methods, and interpolation and extrapolation formulae; Remainder terms.

306. Astronomy and Rigid Dynamics (3-0).


Rigid Dynamics—Rigid Dynamics of three dimensions e.g. Motion of a billiard ball on a table, motion of a top. Lagranges equation (without proof) and simple applications.

307. Statics and Hydrostatics (3-0).


308. Special Functions and Differential Equations (3-0).

Legendre, Bessel and Gamma functions. Three well known types of partial differential equation and their simple solutions in cartesian, polar and cylindrical coordinates.

Practical—Statistics and Probability; Numerical Methods.

310. Mathematics III (3-0).

Vector analysis: Gradient, divergence, curl and Laplacian in general orthogonal coordinates, spherical and cylindrical coordinates, Cartesian tensors, symmetric and antisymmetric forms.

Fourier series: Detailed discussion of Fourier series, Orthonormal function and notion of completeness.

Probability: Total and compound probability. Law of large numbers, expectation and dispersion, skewness, moments and cumulants, characteristic function, Bernoulli's series of trials, binomial, Poison and normal distribution, theory of errors, correlation and regression, chi-squared test with application, curve fitting.

Differential equation: Linear differential equations—integration in series, Bessel's and Legendre's equation and their solution, associated function, recursion formulae—simple partial differential equations occurring in physics—Laplace and Poison equation, vibration of strings and circular membranes, One dimensional heat flow, wave equation of D' Alembert etc.

Complex Variables: Consequences of Cauchy theorem, Calculus of residues—Contour integration.
**Numerical methods**: Numerical solution of algebraic and transcendental equations, ideas of accuracy and of successive approximations, iteration and Newton-Raphson methods and method of false position, numerical integration—Simpson's and Weddle's rules.

**MECHANICAL ENGINEERING (ME)**

101. Workshop and Drawing (0-3). First and Second Terms.

Practice in Carpentry, fitting, hand forging, tin and copper smithy, and simple electrical maintenance. Elementary Engineering drawing, engineering sketching of components and study of blue prints.

**Physics (PH)**

101. Physics—I (4-1).

**Mechanics & Properties of Matter**

1. Review of the measurement of length, mass, time; statics and hydrostatics.
3. Friction; static and dynamic friction, limiting friction, Angle of repose.
5. Introduction to elastic properties of matter.

**Sound & Wave Motion**

1. Velocity of sound, effect of pressure, temperature and humidity; measurement of velocity of sound in solids, liquids and gases.
2. Reflection, refraction and interference of sound, the phenomenon of beats.
3. Forced vibration and resonance.
4. General properties of wave motion; progressive and stationary waves.
5. Pitch and quality of sound; principles of analysis of compound notes. Tuning fork; sonometer; vibration of air column, organ pipes, musical sound and noise.
6. Doppler's principle and its application.
7. Elements of architectural acoustics.
8. Principle of sound recording and reproduction and sound ranging.

**Heat & Thermodynamics**

2. Methods of measuring specific heat of solids and liquids; Radiation correction. Cp and Cv for gases and their measurement.
3. Change of state; vapour pressure over curved surfaces.
4. Isothermal and adiabatic changes.
5. Kinetic theory of perfect gases.

Deviation from Boyle's Law. Equation of state for a real gas; critical constants; Law of corresponding states.

Geometrical and Physical Optics

1. Fermat's principle, rectilinear propagation of light. Refractive index—its measurement.
2. Reflection and refraction at spherical surfaces. Thick lens; principal points; combination of thin lenses.
4. Eye pieces and optical instruments—Telescopes and microscopes.
5. Prism; Dispersion and deviation—Spectroscope, Direct vision spectroscope.
6. Velocity of light; group velocity and wave velocity; Doppler's principle in optics.
7. Photometry—Photometers; Brightness of sources. Ideas about microphotometers and spectrophotometers.
8. Ideas about normal and anomalous dispersion—introduction to experimental spectroscopy.

Electricity and Magnetism

Review of electrostatics and magnetostatics.

2. Ampere's theorem; Laplace's Law. Calculation of magnetic field due to current in simple cases. Force on current carrying conductors in a field.

102. Physics Lab—I (0-5).

201. Physics—II (6-0).

Mechanics & Properties of Matter

1. Units and Dimensions—Dimensional analysis.
2. Law of Universal gravitation, Kepler's laws (statement only); Accurate determination of 'G'; gravitational potential and force in simple cases. Kater's pendulum and other accurate methods of measurement of 'g'.
3. Elements of the theory of elasticity and elastic properties of matter, deviation from Hook's law; relation between elastic constants. Bending of beams—simple special cases; Flat spiral spring. Determination of elastic constants.
5. Viscosity of fluids, critical velocity and Reynolds's number, Poiseuille's equation; compressible fluids. Determination of viscosity of fluids; rotating viscometers, stokes law (statement only) and its application. Ideas about lubrication.
Heat & Thermodynamics

1. First and second laws of thermodynamics; Reversible process. Carnot's cycle and theorem. Absolute scale of temperature; Entropy; Maxwell's relations and their application. Clapeyron-Clausius equation.

2. Conductivity and diffusivity, Measurement of thermal conductivity of good and bad conductors.

3. Elementary ideas about convection.


Geometrical and Physical Optics

1. Huyghen's principle and rectilinear propagation of light; reflection and refraction from wave theory of light.

2. Interference of light: Young's experiments; conditions of interference; Biprism, Lloyd's mirror; Newton's rings; Colours of thin films.

3. Michelson interferometer; Standardisation of length.


5. Diffraction; Fresnel and Fraunhofer diffraction; Zone Plate, Simple treatment of diffraction by a straight edge, single slit; double slit, plane grating, absent spectra, ghosts. Concave grating.


7. Polarisation: Methods of production and analysis of polarised light; Nicol Prism; circular and elliptic polarisation.


Electricity and Magnetism

1. Thermoelectricity; Peltier coefficient, Thomson coefficient, Thermo-electric power and Thermo-electric diagram. Measuring devices depending on thermo-electricity. Piezoelectricity; Hall effect and related phenomena.


3. Laws of magnetism, potential and field due to a small magnet; magnetic shell. Forces and couples between the two magnets. Magnetic paradox. Magnetometer and measurement of M and H. Terrestrial magnetism.

4. Magnetic properties of matter; Dia—, para— and ferro—magnetism; Hysteresis.

5. Electromagnetic Induction, self and mutual inductance. Calculation of L and M in simple cases. Eddy current; Ballistic galvanometer and its use; Flux-meter.

6. Growth and decay of currents; charging and discharging of condenser; Induction coil; methods of measuring inductances.


202. Physics Lab II (0-6).


1. Dimensional analysis — Theorem.


4. Rigorous treatment of pendulum (simple, compound and torsional), free and forced oscillations, Resonance, sharpness of resonance, coupled oscillation.

5. Variation of ‘g’. Discussion of Kepler’s laws—Rutherford’s formula. Elementary discussion of space flight.

6. Wave equation, Harmonic waves; solution of wave equation by separation of variables, Plane and spherical waves. Reflection and refraction of waves; Partial and total reflection. Absorption coefficients.

7. Velocity of transverse waves in strings; Theory of plucked, struck and bowed strings. Longitudinal and transverse vibration in bars and plates, rectangular and circular membranes.

8. Velocity of wave transmission in terms of elasticity and density; propagation of sound waves in the atomosphere, zones of silence. Elementary discussion of supersonic speed of sound sources.

9. Velocity of gravity waves in a liquid; capillary waves, ripples.


13. Combination tones; Diatonic scale, temperament, vowel tones, consonance, dissonance.


304. Heat and Thermodynamics (3-0).


2. Thermodynamical potentials and equilibrium of physicochemical systems; chemical equilibria and law of mass action; phase rule; Saha’s thermal ionisation formula. Third law of thermodynamics.

3. Application of thermodynamics to thermoelectricity and cells; thermonic emission; rise of boiling point and lowering of freezing point of solutions.

4. Variation of latent heat with temperature.


7. Quantum theory of radiation; Planck's law; Temperature variation of specific heats of gases and solids—Einstein and Debye's theory.

8. Introduction to the distribution law for Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Entropy of a monatomic gas; chemical constant.

305. Physical Optics (3-0).

1. Interferometry; Rayleigh and Jamin interferometers and their use. Interference with multiple beams; Haidingers and Brewster's fringes, localised fringes, Testing of optical flats. Lummer-Gehrke plate; Fabry-Perot etalon.

2. Fraunhofer diffraction—Expressions for intensity for single slit, double slit, circular aperture and plane grating; Concave grating and theory of different mountings. Echelon gratings.

3. Fresnel diffraction—Theory of diffraction at straight edge, slit and wire; Cornu's spiral.

4. Polarisation—Elements of double refraction in uniaxial crystals; ordinary and extraordinary wave surfaces; Internal and external conical refraction.

5. Quarter and half wave plates; Interference of polarised light. Crystal plates between crossed nicols in parallel and convergent (or divergent) beams of light.


9. Classical theory of Zeeman effects. Description of Faraday, Stark and Kerr effects. Qualitative discussion of the phenomenon of scattering and Raman effects.

306. Electricity and Magnetism (3-0).

1. Potential energy of charged systems—Field as the seat of energy; stresses in the electric field.

2. Dielectric polarisation, surface and volume distribution of charge in a polarised dielectric. Isotropic dielectric; Boundary conditions for E and D.


8. Thermionic emission, Limitation of current by space charge; Child-Langmuir equation; deviation from Child's law. Fundamentals of electron tubes; space charge effect and control of current flow. Vacuum and gas tubes; thyratrons.

9. Diodes—characteristics and uses; rectifying properties, smoothing circuits; voltage regulators, constant current devices.

10. Triodes—characteristics of Triode as amplifier, voltage gain, audio and radio frequency amplifiers. Triode as oscillator; Qualitative discussion about the multigrid tubes, photo cells and photomultipliers.

11. Qualitative discussion of the working principle and use of common electronic instruments, oscilloscopes, wave analysers, Q-meters and valve voltimeters.

307. Atomic Physics (3-0).


4. Large angle scattering of α—particles and determination of nuclear charge.


7. Langevin theories of dia—, and paramagnetism; Weiss theory of ferromagnetism.

8. Atomic theory of dielectric polarisation—Lorentz local field, Clausius-Mossotti (Lorentz-Lorentz) relation.


11. Discovery of neutrons and positrons. Artificial radioactivity. Elementary ideas of Nuclear fission and reactors.

12. Elementary discussion on cosmic rays.

308. Physics Laboratory III (0-15).

SCHEDULE XVII

REGULATION No. 23

Admission to the First Year Class of the Two-Year M.Sc. Degree Course

(a) Minimum Educational Qualifications:

A person seeking admission to the course leading to the Degree of Master of Science in any of the branches must have passed or is expected to pass, before the 1st August of the year of admission, the Bachelor of Science (B.Sc.) Examination of a recognised University either (i) with Honours in Chemistry, or in Mathematics, or in Physics, and Mathematics and Physics, or Chemistry and Physics, or Chemistry and Mathematics as subsidiary subjects respectively; or (ii) with Chemistry, Mathematics and Physics as major subjects if no Honours course is offered by the University concerned.
(b) **Age Limit**:

To be eligible for admission to the First Year class of the two-year Master of Science Degree course a candidate shall, on the 1st October of the year of admission, have completed 18 years of age.

(c) **Standard of Physical Fitness**:

A candidate seeking admission to this course should fulfil the prescribed standard of physical fitness as given below:

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Height</td>
<td>... 1.6 m.</td>
</tr>
<tr>
<td>Weight</td>
<td>... 46 Kg.</td>
</tr>
<tr>
<td>Chest Measurement</td>
<td>... 76 cm. with satisfactory limit of expansion.</td>
</tr>
<tr>
<td>Heart &amp; Lungs</td>
<td>... There should be no abnormality.</td>
</tr>
<tr>
<td>Vision</td>
<td>... Better eye</td>
</tr>
<tr>
<td></td>
<td>Worse eye</td>
</tr>
</tbody>
</table>

\[
\begin{array}{cc}
6/9 & 6/9 \\
\text{Corrected with} & \text{glasses.} \\
6/6 & 6/12 \\
\end{array}
\]

Eyes should be free of congenital or other diseases.

Hearing ... Should be normal.

Good general health and build.

Hernia, Hydrocele, Varicocele, Piles ... Presence of any of these is a temporary disqualification to be rectified before joining.

Opinion of the Institute Medical Officer shall be final and there shall be no appeal.

**SCHEDULE XVIII**

**REGULATION No. 24**

**Entrance Test for Admission to the First Year Class of the Two-Year Master of Science Degree Course**

1. A preliminary selection of candidates shall be made by an Admission Committee after scrutiny of applications including mark sheets and testimonials and only the candidates who prima facie satisfy the minimum requirements will be called for the Entrance Test, the scope of which shall be determined by the Admission Committee. The Entrance Test, written and/or oral, shall be held at the Institute on a date to be fixed by the Senate.

2. Admission to the First Year Class of the course shall be made in order of merit on the results of the Entrance Test.

**SCHEDULE XIX**

**REGULATION No. 25**

**Degree of Master of Science (M.Sc.)**

**Course and Duration**:

1. The Institute shall provide courses leading to the Degree of Master of Science (M.Sc.) in Chemistry, in Mathematics, in Physics, or in any other science subject as the Senate may decide from time to time taking into consideration the accommodation, staff and other facilities available.

2. For persons with adequate academic preparation, the curriculum for the Degree of Master of Science in the subjects mentioned above shall extend over not less than two academic sessions each consisting of three terms.
SCHEDULE XX
REGULATION No. 26
Graduation: Requirement

(a) General Regulations:

1. A student shall not be permitted to appear at any of the examinations for the Degree of Master of Science (M.Sc.) unless (i) he has been regular in attendance in all lectures, laboratories, tutorials, guided studies etc. and (ii) he has satisfied all class teachers that he has conducted himself well within and outside the class room and that he has been regular, diligent and methodical in studies and has independently and satisfactorily performed home and sessional assignments and has regularly submitted these for the scrutiny of the teachers.

2. An entrant into the First Year class of the Two-Year M.Sc. Degree course shall be required to qualify in the First and the Final examinations within a maximum period of three years of study at the Institute.

3. The curriculum for the Degree of Master of Science shall consist of subjects as set forth in Schedule XXI, each of which shall be studied by attendance in lectures, tutorials, seminars, laboratories, as prescribed in the Schedule.

4. The scope of the subjects of instruction shall be as detailed in Schedule XXI. In each subject for examination there shall be written paper or papers or sessional assignments, or written paper or papers and sessional assignments including practicals, as prescribed.

5. The Senate shall determine in respect of each subject of study the scope of the course and the relative proportion in each course of lecture and/or practical, laboratory work and shall also determine in respect of several examinations for the degree the conditions for admission and the standard of examinations.

6. The standard of examination shall be as prescribed in the special Senate Instructions which shall be kept with the Registry and be available only to the Senate and the Board of Examiners.

(b) The Degree of Master of Science (M.Sc.):

1. Subject to the provisions of the Ordinances and Regulations the Degree of Master of Science (M.Sc.) shall be conferred on students who have studied on the prescribed curriculum for not less than two academic sessions the subjects as set forth in Schedule XXI and who have reached the minimum standard in the examinations in one of the branches listed in Schedule XXI, Regulation No. 27.

2. There shall be two complete examinations for the Degree of Master of Science, namely, (i) the First Examination, and (ii) the Final Examination.

3. For each examination a Board of Examiners shall be constituted by the Senate and the Board of Examiners shall comprise the teachers in the subjects of examination and the additional examiner or examiners and other experts.

4. No student may present himself for examination in any subject until he has duly completed the prescribed courses of instruction to the satisfaction of teachers concerned.

5. The First Examination:

(i) The First Examination shall be taken in three sections consisting of two Terminal Examinations each covering the term's work and an End-session Examination covering the entire course for the First Examination.

(ii) A student shall be deemed to have passed the First Examination provided he has secured on the total of the two Terminal and the End-session Examinations requisite minimum marks in the written paper or papers of each subject, in each of the sessional assignments, in the practicals and in the aggregate.

6. The Final Examination:

(i) No student may present himself for examination in any subject of the Final Examination until he has passed the whole of the First Examination.
(ii) The Final Examination shall consist of two Terminal Examinations each covering the term's work and an End-sessional Examination covering the entire course of the Final Examination and a Viva-Voce Examination.

(iii) A student shall be deemed to have passed the Final M.Sc. Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the subjects, in each of the sessional assignments, in the practicals, in the Final Viva-Voce Examination, and in the aggregate.

7. The Maximum Mark: The maximum marks for the First and Final Examinations shall be the total of the maximum marks prescribed for the subjects of the respective End-sessional Examination plus fifty percent of the total of the maximum marks prescribed for the subjects of the two Terminal Examinations.

8. The Weighted Maximum Marks:

(i) The weighted maximum marks for the First Examination shall be the maximum marks of the First examination.

(ii) The weighted maximum marks for the Final Examination shall be the maximum marks of the Final Examination plus the weighted maximum marks of the First Examination.

9. A student passing both the First and Final Examinations shall be declared to have qualified for the M.Sc. Degree in the appropriate branch on the basis of his overall performance in the First and Final Examinations.

10. The students found qualified for the M.Sc. Degree shall, in each branch, be classified in two groups to be denominated respectively First and Second Class on the basis of the weighted total marks they secure out of the weighted maximum marks of the Final Examination. The names of the students in the First class shall be arranged in order of merit and those in the Second class in the alphabetical order.

11. The students satisfying all the conditions prescribed and having passed the prescribed examinations shall be entitled to receive the Degree of Master of Science (M.Sc.) in the appropriate branch.

12. For the Degree of Master of Science in any branch, as set forth above, the graduate shall receive a Diploma wherein shall be set forth the branch of study in which he has obtained the Master's Degree and the Class in which he has been placed.
### SCHEDULE XXI

REGULATION No. 27

Schedule of courses and distribution of marks for Two-year M.Sc. degree courses in Chemistry, Mathematics and Physics

### I. CHEMISTRY

#### FIRST YEAR

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the First Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 401</td>
<td>Physical Chemistry—I</td>
<td>4 0</td>
<td>200—0</td>
<td>2</td>
</tr>
<tr>
<td>Ch 402</td>
<td>Organic Chemistry—I</td>
<td>4 0</td>
<td>200—0</td>
<td>2</td>
</tr>
<tr>
<td>Ch 403</td>
<td>Inorganic Chemistry—I</td>
<td>4 0</td>
<td>200—0</td>
<td>2</td>
</tr>
<tr>
<td>Ch 404</td>
<td>Principles and Techniques of Analytical Methods</td>
<td>2 0</td>
<td>100—0</td>
<td>1</td>
</tr>
<tr>
<td>Ch 405</td>
<td>Advanced Chemistry Lab.—I</td>
<td>0 15</td>
<td>0—600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective (any one)</td>
<td>2 0</td>
<td>100—0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Viva/Term paper</td>
<td></td>
<td>0—100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 15</td>
<td>800—700</td>
<td>8</td>
</tr>
</tbody>
</table>

*Electives

Ch 406 Mathematics
Ch 407 Physics
## SECOND YEAR

**Group A—Physical Chemistry Option**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hours per Week</td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>Ch 506</td>
<td>Advanced Physical Chemistry—I</td>
<td>4</td>
<td>0</td>
<td>200—0</td>
</tr>
<tr>
<td>Ch 507</td>
<td>Advanced Physical Chemistry—II</td>
<td>4</td>
<td>0</td>
<td>200—0</td>
</tr>
<tr>
<td>Ch 502</td>
<td>Organic Chemistry—II</td>
<td>2</td>
<td>0</td>
<td>100—0</td>
</tr>
<tr>
<td>Ch 503</td>
<td>Inorganic Chemistry—II</td>
<td>2</td>
<td>0</td>
<td>100—0</td>
</tr>
<tr>
<td>Ch 505</td>
<td>Advanced Chemistry Lab.—II</td>
<td>0</td>
<td>12</td>
<td>0—600</td>
</tr>
<tr>
<td></td>
<td>Elective (any one of the Physical Chemistry group of subjects)</td>
<td>4</td>
<td>0</td>
<td>200—0</td>
</tr>
<tr>
<td></td>
<td>Viva/Term paper</td>
<td>—</td>
<td>—</td>
<td>0—100</td>
</tr>
</tbody>
</table>

|             |                                   |           |          |                       |                        |
|             |                                   | 16        | 12       | 800—700               | 8                      |
# SECOND YEAR

**Group B—Organic Chemistry Option**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. papers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hours per Week</td>
<td>Marks</td>
<td></td>
</tr>
<tr>
<td>Ch 508</td>
<td>Advanced Organic Chemistry—I</td>
<td>...</td>
<td>4 0</td>
<td>200— 0</td>
</tr>
<tr>
<td>Ch 509</td>
<td>Advanced Organic Chemistry—II</td>
<td>...</td>
<td>4 0</td>
<td>200— 0</td>
</tr>
<tr>
<td>Ch 501</td>
<td>Physical Chemistry—I</td>
<td>...</td>
<td>2 0</td>
<td>100— 0</td>
</tr>
<tr>
<td>Ch 503</td>
<td>Inorganic Chemistry—I</td>
<td>...</td>
<td>2 0</td>
<td>100— 0</td>
</tr>
<tr>
<td>Ch 505</td>
<td>Advanced Chemistry Lab.—I</td>
<td>0 12</td>
<td>0—600</td>
<td>—</td>
</tr>
<tr>
<td><strong>Elective (any one of the Organic Chemistry group of subjects)</strong></td>
<td>...</td>
<td>4 0</td>
<td>200— 0</td>
<td>2 2 hrs. each</td>
</tr>
<tr>
<td>Viva/ Term paper</td>
<td>...</td>
<td>—</td>
<td>0—100</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 12</td>
<td>800—700</td>
<td></td>
</tr>
</tbody>
</table>
### Group C—Inorganic Chemistry Option

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 511</td>
<td>Advanced Inorganic Chemistry—I</td>
<td>4 0</td>
<td>200— 0</td>
<td>2 hrs. each</td>
</tr>
<tr>
<td>Ch 512</td>
<td>Advanced Inorganic Chemistry—II</td>
<td>4 0</td>
<td>200— 0</td>
<td>2 hrs. each</td>
</tr>
<tr>
<td>Ch 501</td>
<td>Physical Chemistry—II</td>
<td>2 0</td>
<td>100— 0</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ch 502</td>
<td>Organic Chemistry—II</td>
<td>2 0</td>
<td>100— 0</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ch 505</td>
<td>Advanced Chemistry Lab.—II</td>
<td>0 12</td>
<td>0—600</td>
<td>—</td>
</tr>
</tbody>
</table>

***Elective (any one of the Inorganic Chemistry group of subjects)***

<table>
<thead>
<tr>
<th>Viva/Term paper</th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Final Examination</th>
<th>All Terms</th>
<th>No. of papers for Exam.</th>
<th>Duration of Exam. papers</th>
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<tbody>
<tr>
<td>Ch 513</td>
<td>Advanced Catalysis.</td>
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<tr>
<td>Ch 514</td>
<td>Chemistry of High Pressure.</td>
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<tr>
<td>Ch 515</td>
<td>Chemistry of High Polymer and Rubber.</td>
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**Elective Subjects**

**Group A—Physical Chemistry Option**

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<th>Duration of Exam. papers</th>
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<tbody>
<tr>
<td>Ch 516</td>
<td>Synthetic Drugs.</td>
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<tr>
<td>Ch 517</td>
<td>Chemistry of Natural Products.</td>
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**Group B—Organic Chemistry Option**

<table>
<thead>
<tr>
<th>Subject No.</th>
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<tbody>
<tr>
<td>Ch 518</td>
<td>Chemistry of Co-ordination compounds.</td>
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<tr>
<td>Ch 519</td>
<td>Nuclear and Radio Chemistry.</td>
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219
## II. MATHEMATICS

### FIRST YEAR

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the First Examination</th>
<th>All Terms</th>
<th>No. of papers</th>
<th>Duration of exam. paper</th>
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</thead>
<tbody>
<tr>
<td>Ma 401</td>
<td>Analysis, Theory of Real Variable and Complex Variable</td>
<td>4 0 200—0</td>
<td>1</td>
<td>3 hrs.</td>
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<tr>
<td>Ma 402</td>
<td>Numerical Methods and High Speed Computations ...</td>
<td>4 0 200—0</td>
<td>1</td>
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<tr>
<td>Ma 403</td>
<td>Differential and Integral equations (Ordinary and partial) and functions ... ... ...</td>
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<tr>
<td>Ma 404</td>
<td>Differential Geometry, Tensors, Linear Algebra ...</td>
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<tr>
<td>Ma 405</td>
<td>Continuum Mechanics—I ... ... ...</td>
<td>4 0 200—0</td>
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<td>Ma 406</td>
<td>Mathematical Computation Laboratory ... ... ...</td>
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<td>Sessional ... ... ... ...</td>
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<td>Viva/Term paper ... ... ... ...</td>
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<td>20 5 1000—500</td>
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### SECOND YEAR

<table>
<thead>
<tr>
<th>Subject No.</th>
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<th>All Terms</th>
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<th>Duration of exam. paper</th>
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<tr>
<td></td>
<td></td>
<td>Hours per week</td>
<td>Marks</td>
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<tr>
<td>Ma 501</td>
<td>Analytical Dynamics, Theory of Potentials</td>
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<tr>
<td>Ma 502</td>
<td>Modern Algebra, Foundation of Geometry and Projective Geometry</td>
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<tr>
<td>Ma 503</td>
<td>Probability and Statistics</td>
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<tr>
<td>Ma 504</td>
<td>Electromagnetic Theory and Special Theory of Relativity</td>
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<td>Ma 505</td>
<td>Statistical Laboratory</td>
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*Elective Subjects:
- Ma 505 Continuum Mechanics—II.
- Ma 506 General Theory of Relativity.
- Ma 507 Advanced Statistics.
<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the First Examination</th>
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<th>Second Term</th>
<th>Third Term</th>
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<tbody>
<tr>
<td>Ph 401</td>
<td>Mathematical Methods in Physics</td>
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<td>Ph 402</td>
<td>Mechanics—I</td>
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<tr>
<td>Ph 403</td>
<td>Thermodynamics and Statistical Mechanics</td>
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<td>Ph 404</td>
<td>Electromagnetic Theory</td>
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<td>Ph 405</td>
<td>Optics</td>
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<td>0 2</td>
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<tr>
<td>Ph 406</td>
<td>Quantum Mechanics I</td>
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<td>0 2</td>
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<tr>
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<td>Ph 408</td>
<td>Electrical and Electronic Measurements</td>
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**Hours per Week**
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<th>Second Term Marks</th>
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<th>Duration of exam. papers</th>
<th>Third Term Marks</th>
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<td>1 2 hrs.</td>
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<td>1 2 hrs.</td>
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### SECOND YEAR

<table>
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<th>Subject No.</th>
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<th>Duration of exam. paper.</th>
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<tr>
<td>Ph 502</td>
<td>Mechanics—II</td>
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<td>100—0</td>
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<td>Ph 506</td>
<td>Quantum Mechanics—II</td>
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<td>1</td>
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<tr>
<td>Ph 511</td>
<td>Atomic Physics and Spectroscopy</td>
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<td>100—0</td>
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<tr>
<td>Ph 512</td>
<td>Nuclear Physics and Cosmic Rays</td>
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<td>100—0</td>
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<tr>
<td>Ph 513</td>
<td>Statistical Mechanics &amp; Properties of Matter</td>
<td>4 0</td>
<td>200—0</td>
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<td>Ph 509</td>
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*Elective subjects—
- Ph 514 X'Ray and Structure of Matter.
- Ph 515 Solid State Physics.
- Ph 516 Nuclear Physics and Elementary Particles.

### DISTRIBUTION OF MARKS
(For each Examination)

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<thead>
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<th>Examination</th>
<th>1st Term Marks</th>
<th>2nd Term Marks</th>
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SCHEDULE XXII
REGULATION NO. 28

Subjects of Instruction for 2-Year Master of Science (M.Sc.) degree courses

CHEMISTRY (Ch)

401. Physical Chemistry I (4-0)

*Gaseous State*: Review of equations of state for gases; Molecular velocities—average velocity, mean square velocity, most probable velocity, Maxwell's law of distribution of velocity and energy, mean free path, collision frequency, viscosity, thermal conductivity, and diffusivity; heat capacities and equipartition of energy.

*Liquid State*: Internal pressure of liquids, structure of liquids, the Vitreous state.

*Solid State*: The crystalline form, symmetry properties of crystals, diffraction of X-rays and electron waves by crystals, Structure of solids, and heat capacities.

*Thermodynamics*: The fundamental concepts, first and second laws of thermodynamics and their applications to chemical systems, ideal and real gases, ideal and non-ideal solutions, partial and molar quantities, equilibrium systems, third law of thermodynamics and its application to chemical systems, free energy calculations.

*Chemical Equilibrium*: Thermodynamic derivation of the law of mass action, reaction isotherm and isochore, effect of temperature and pressure on equilibrium, determination of equilibrium constant in homogeneous and heterogeneous reactions.

*Solution*: Thermodynamics of dilute solution, non-ideal solutions and activity concept.

*Phase rule and heterogeneous equilibrium*: Derivation of phase rule equilibrium, Gibb's Duhem equation and distillation of liquid mixtures, Nernst law of distribution, phase diagram of two and three component systems.

*Electrochemistry*: Debye-Hückel theory of strong electrolyte, Onsager's equation, non-aqueous solvents, e.m.f. of reversible electrodes, galvanic and concentration cells, secondary cells, liquid junction potential, activity coefficient and its determination, acids and bases, ionic product of water, pH, hydrolysis of salts, theory of indicators, potentiometric titrations, electrolysis, decomposition voltage, overvoltage and polarisation.

402. Organic Chemistry I (4-0).


*Terpenes*: Introduction. Isoprene rule. Isolation and general methods of determining structures of terpenes. Classification. Detailed studies of open chain, monocyclic and bicyclic terpenes (one or two examples in each group).

*Heterocyclic compounds*: Compounds containing one hetero atom (Nitrogen, Sulphur, Oxygen) only. Studies of Furan, Pyrrole, Thiophene, Pyridine.


403. Inorganic Chemistry I (4-0).

Modern valency theory and nature of chemical bond.

Mode of occurrence, preparation and properties of elements and their important compounds treated from the point of electronic arrangements. Detailed and critical study of the periodic classification of elements.

Chemistry of the following elements and their relations with other elements in the periodic Table.

Be, Sc, Y, rare earths (general treatment only), Ga, In, Tl, Ti, Zr, Hf, Th, Ge, V, Nb, Ta, Mo, W, U, Se, Te and the platinum metals.

Orthohydrogen and parahydrogen, Active hydrogen, Active Nitrogen.

Boron hydrides and other recently discovered hydrides.

Peroxides and peracids.

Iso and Heteropoly acids.

Carbonyls, nitrosyls and allied compounds.

Inorganic rubber, Borazides, silicones and silicane.

Theory of Acids and Bases, reactions in nonaqueous media with particular reference to liquid ammonia and liquid sulphur-dioxides.

Complex compounds and their isomerism treated in details.

Recent developments in the chemistry of halogens.

404. Principles and Techniques of analytical methods (2-0).

Colorimetry: Visual and photo electric, Turbidimetry and Nephelometry.

Spectrophotometry: Ultraviolet and Visible and Infrared.

Emission Spectrography and Raman Spectrography.

X-Ray and Electron diffraction.

Mass Spectrometry.

Refractometry and Interferometry.

Polarimetry.

Chromatography and Ion exchange.

Conductometry, Potentiometry and Polarography.

Magnetoochemical methods: Magnetic susceptibility and nuclear magnetic resonance.

Dielectric constant and Dipole Moment.

Methods of Gas Analysis: Classical, Thermal conductivity and Gas Chromatography.


Physical: Experiments involving the determination of density, Viscosity, surface tension and refractive index of pure liquids-solution.

Determination of molecular weight-degree of dissociation by vapour density, freezing point and boiling point methods.

Determination of equilibrium constant of the reaction KI + I₂ = KI₂.
Determination of the rate of hydrolysis of an ester (by titration) of cane sugar (by polarimeter).

Calibration of a thermocouple and study of the cooling curve of an alloy.

Determination of heat of neutralisation.

Determination of cell constant, specific conductivity of a solution and the degree of hydrolysis of a salt. Conducto-metric titration of an acid.

Determination of e.c.e. and transport number of an ion.

Organic: General operations for the purifications of compounds. Preparation of organic compounds of an advanced character.

Identification of simple organic compounds by systematic procedure. Separation of compounds from two component mixture containing acidic, basic and neutral substances and their identifications.

Quantitative determination of hydroxyl, amino, ester, amide, and carboxyl groups, Estimation of aldehydes. Molecular weight of an acid by the Ag salt method and by titration.

Inorganic: Qualitative analysis of mixtures containing not more than six ions including interfering ones and insoluble ones, ores and alloys by macro and semi-micromethods. Quantitative estimation of the following either alone or in mixtures, ores and alloys, by volumetric and gravimetric methods:

Ag, Pb, Cu, As, Sb, Sn, Fe, Al, Cr, Ni, Mn, Zn, Ca, Ba, Mg, SO4, CO and CO2.

406. Mathematics (2-0).

1. Functions of two and more variables—idea of continuity and limit—Rules of differentiation and higher derivatives—Total differentials—Maxima and minima.

2. Integration as area and limit of sum—Standard methods of integration—Definite integral including improper integral with applications to area, length, volume.


6. Fourier series—Statement of Dirichlet conditions and coefficient calculation and application.

7. Ordinary differential equations of first order and second order—Linear differential equations with constant and variable coefficients—Solution by the method of series—Bessel's equation, Legendre's equation—simple partial differential equations—Laplace, poisson equation—One dimensional heat flow, wave equation.


407. Physics (2-0).


Introduction to magnetic and dielectrical properties of solids. Maxwell Boltzman, Fermi Driact and Bose Einstein statistics and their applications.
Introduction to solid state physics and the theory of solids-band structure of matter, transition elements, alloys, Semiconductors—surface properties of semiconductors and thin films.

501. Physical Chemistry II (2-0).

Chemical Kinetics and Catalysis: Study of reactions of first, second and third order, consecutive reactions, back reactions and chain reactions, atomic reactions and ionic reactions and reactions in solution, mechanism of the chemical reactions.

Physical and chemical adsorption, adsorption isotherm, theories of catalysis, industrial applications of catalysis, kinetics of heterogeneous reactions, negative catalysis.

Photochemistry: Laws of absorption of light, measurement of high absorption and its application, first and second laws of photochemistry, elements of theoretical and practical photochemistry, photosensitisation, elements of theoretical and practical photochemistry.

Colloid and surface chemistry: Gibbs' adsorption equation, surface films, adsorption of solids from solution, electrokinetic phenomena and zeta potential, electrocapillary phenomena, origin of charge on colloid, stability of lyophobic colloids, coagulation, protective action, size of colloidal particles Brownian motion and distribution of particles, Donnan membrane equilibrium, colloidal electrolytes, emulsions, detergents and gels.


Stereochemistry: Configuration and optical activity of diphenyl molecules.

Steric effects in Organic chemistry. Structure and Mechanism.

Acetylenes: Introduction to higher acetylene chemistry and its role in synthetic organic chemistry.

Application of Lithium aluminium hydride, sodium borohydride, N-bromosuccinimide, lead tetraacetate, periodic acid, alkali metals in liquid ammonia, diazomethane, diazoacetic esters, organolithium compounds and polyphosphoric acid in synthetic organic chemistry.

Vitamins: Introduction. Study of the following vitamins: Vitamin B₁, Vitamin B₉, Pyridoxine and Niacin.

Recent advances in organic chemistry of Free radicals. Reactions involving free radicals. Mechanism of polymerisation.

503. Inorganic Chemistry II (2-0).

General treatment of the chemistry of nontransition elements.

Chemistry of the transition elements: (a) coordination complexes, (b) crystal field and ligand field theory, (c) complexes with π-π bonding ligands, (d) organometallic compounds, (e) elements of the first transition series, (f) elements of the second and third transition series, (g) lanthanides and actinides.

Nuclear structure, Fission and Fusion reactions, Radioactive indicators and tracers.

Metals and intermetallic compounds.

505. Advanced Chemistry Lab. II (0-12).

Physical:

Electrochemistry: Determination of e.m.f. of a concentration cell, pH (e.m.f. method), transition temperature; potentiometric titration.

Colloid Chemistry: Preparation, properties of colloids and to determine speed of cataphoresis.
Verification of Beer's Law and determination of molecular extinction coefficient.

Identification of elements by spectroscope.

Column and paper chromatography.

Gas analysis: Chemical kinetics, determination of surface area of solids, studies on the kinetics of complex reactions (polymerisation) determination of the molecular weight distribution of a macromolecule, use of the D.T.A. technique to study the heat of structure change.

Elementary idea about handling of equipment used in (a) processing and testing of elastomers or (b) high pressure reactions.

Organic: Preparation of organic compounds involving two or three stages and based on important name reactions.

Use of special equipment for small scale preparations. Semimicro preparations. Resolution of racemic mixtures by chemical method.


Inorganic: Qualitative analysis of mixtures containing not more than eight ions including rare metals.

Preparation of inorganic compounds of more difficult type. Quantitative analysis of more complex mixture and instrumental analysis.

506. Advanced Physical Chemistry I (4-0).

(In addition to the portions covered in Ch 501—Physical Chemistry II).

Chemical Kinetics: Theory of rate processes, theory of absolute reaction rates, a detailed analysis of energy of activation and activation volume.

A more elaborate treatment of chain reactions, reactions in solution, ionic reaction, atomic reaction and heterogeneous reaction.

Chemical Crystallography: Geometry of X-ray reflection, Bragg equation, reciprocal lattice, powder photograph and its interpretation, unit cell dimensions and positions of atoms, electron diffraction studies of thin films, neutron diffraction, evidence on crystal structure from physical properties.

Electrochemistry: Modification and extension of Debye—Hückel theory, dissociation constants of weak electrolytes in aqueous and non-aqueous medium, irreversible electrode phenomena, mechanism of cathodic and anodic processes discharge of H+, discharge of metals, discharge of anions, anodic solutions, theory of overvoltage, energy affinity in irreversible electrode phenomena, passivity and corrosion.

507. Advanced Physical Chemistry II (4-0).


Introduction to Statistical Mechanics: Principles of statistical mechanics, elements of probability theory, the ensemble in statistical mechanics, the isolated equilibrium system, system in
equilibrium with a heat bath, energy and entropy in statistical mechanics, ideal gas, classical gas, and quantum gas—partition function, equilibrium constant for ideal gas reactions and heat capacity of gases.

508. Advanced Organic Chemistry I (4-0).

Poly cyclic aromatic hydrocarbons: Various synthetic routes to polycyclic aromatics. Carcinogenic hydrocarbons and their nitrogen isologs.

A general study of Azulenes and Tropolones.


Terpenes: Sesquiterpenes, Diterpenes and Triterpenes. General study. Chemistry of one example of each group.

A general study of quinones, flavones, flavonoids, anthocyanines and xanthones (one or two example in each group).

Studies of naturally occurring benzoquinones, naphthoquinones and anthroquinones. *Vitamin K*. Dicoumarol and blood anticoagulants.

Chemistry of disaccharides (Maltose, lactose, sucrose and cellobiose) and polysaccharides (starch, glycogen and cellulose). Ascorbic acid.

509. Advanced Organic Chemistry II (4-0).


Alkaloids. Detailed study of papaverine, quinine, emetine, reserpine and lysergic acid. Drugs affecting central nervous system.

Recent advances in Protein chemistry.


Chemistry of nucleic acid. Anticancer drugs.

511. Advanced Inorganic Chemistry I (4-0).

Detailed study of d-block and f-block transition elements.

Stereochemistry of various transition metal ions.

Ligand field theory and its application in coordination compounds.

Magnetic and dielectric properties of solids. Band theory of solids and band structure of matter, alloys and semi-conductors.

Detailed study of natural and artificial radioactivity; Nuclear structure. Mattauch's rule. Methods of study of fission products of heavy elements.

512. Advanced Inorganic Chemistry II (4-0).


Introduction to Statistical Mechanics: Principals of statistics, mechanics, elements of probability theory, the ensemble in statistical mechanics, the isolated equilibrium system, system in equilibrium with a heat bath, energy and entropy in statistical mechanics, ideal gas, classical gas and quantum gas—partition function, equilibrium constant for ideal gas reactions and heat capacity of gases.
Crystal Chemistry: Symmetry in inorganic chemistry, non-stoichiometric compounds, Lattice defects. Organic reagents in inorganic analysis.

513. Advanced Catalysis (4-0).


514. Chemistry of High Pressure (4-0).

Uses and scope of high pressure in chemical synthesis. Synthesis of ammonia, methanol and higher alcohols. Fischer Tropsch and allied synthesis. Hydrogenation of coal, tar and oils by Bergius process. Synthesis of urea, polymerisation of olefines, etc. Recent advances in the high pressure chemistry of carbon monoxide and acetylene.


P. V. T. relationships of gases and liquids, specific heats of gases, viscosity of gases, etc. at high pressure.

515. Chemistry of High Polymer & Rubber (4-0).

Introduction to and classification of high polymers; kinetics of polymerisation and co-polymerisation.

Molecular weights of high polymers, distribution of molecular weights and chain length in simple systems, thermodynamics of polymers solution.

Chemistry of natural and synthetic elastomer and important compounding ingredients. Techniques of and principles involved in processing of elastomers, ageing of rubbers. Rheology and statistical theory of rubber elasticity.

ELECTIVE (ORGANIC GROUP)

516. Synthetic Drugs (4-0).


Organic Sulphur compounds: Sulphonamides and sulphones. Antitubercular and anti-leprosy drugs.
Analogesics and antipyretics: Morphine and morphine substitutes. Local and General Anaesthetics.

Introduction to Cardiac glycosides. Cardiovascular drugs.

Antibiotics: Penicillins, Streptomycin, Chloramphenicol, Tetracyclines and macrolides (one example only).


517. Chemistry of Natural Products (4-0).


Bio—isoeterin and bio—isoeteric groups. Chemotherapy introduction, biological staining and classification of organisms, testing of chemotherapeutic drugs, mechanisms of the therapeutic action.

Detailed studies of alkaloids, steroids and hormones, proteins and amino acids, carbohydrates, vitamins, antibiotics, enzymes, purine derivatives, terpenes azulenes, and tropolones.

ELECTIVE (INORGANIC GROUP)

518. Chemistry of Coordination Compounds (4-0).

Ligand field theory: Correlation of structure, magnetic property and spectra of transition metal complexes.

Studies on metal ion complex formation in solution. Reaction rates of transition metal complex formation, decomposition and substitution.

Thermodynamics and kinetics of stereochemical changes in coordination compounds.

Ultraviolet, visible and infrared spectra of complex compounds.

Magnetoochemistry of coordination compounds.

Use of ESR, EPR, NMR and Moss-bauer effect in the study of coordination complexes.

519. Nuclear and Radiochemistry (4-0).

Short historical development of nuclear theory.

Current picture of nuclear structure, properties of nucleus, binding energy, nuclear forces, energy levels in nuclei, stability rules, Liquid drop model and mass equation, shell model and magic number.

Radioactive decay processes, equations for decay and growth of radioactive substance, secular and transient equilibrium, theories of γ and β decay.

Introduction of radiation with matter, range and energy determination of γ and β particles. Energy determination of γ-rays, positrons and neutrons.

Detection of radiation, types of detection instruments, Ionisation chambers, GM tubes, proportional counter, Scintillation counters and coincidence counting.

Errors in radioactivity measurements, Geometry of the counters, Radioactivity as a statistical phenomenon, review of distribution laws, Calculation of standard deviation in counting.
Induced nuclear reactions, conservation laws in nuclear reactions, Bohr's compound nucleus theory, potential carrier, reaction threshold, cross section, excitation function, Sopperheimer-Phillips process spallation, fission process, nuclear chain reaction, four factor formula, nuclear reactors (elementary theory, types and use), nuclear energy in India. Particle accelerators.

Principles of separation and identification of radio activities from irradiated or naturally occurring substances, precipitation methods.

**NOTE:** Some practical work in radiochemistry should be arranged.

Finding plateau of a GM counter.

Micropipetting and mounting of samples.

Statistics of counting with T1204.

Determining energy of particle by absorption.

Finding half life period of Mn56.

Isotopic and non-isotopic carriers, electrodepositions, ion exchange, solvent extraction, adsorption, volatilisation, Isotopic exchange law.

Chemical effects of nuclear reactions, physical basis, neutron capture, isomeric transition, other reactions, Szilard-Chalme r's process.


Application of radioisotopes in Analytical Chemistry.

Energy production in stars, Geo and cormochronology, Genesis of elements.

MATHEMATICS (Ma) 3(56)

401. Analysis—Theory of real and Complex variable (4-0).

**Real Variable:** Elements of point set theory: Finite, countable and uncountable sets, open set, closed set, connected set, compact set, perfect set.

**Metric space:** The real and complex numbers looked upon as metric spaces: limit, continuity, sequence, series defined on metric spaces.

Theory of Riemann-Stieltjes Integral: Definition and existence of the integral, the integral as a limit of sums, the fundamental theorem of integral calculus, functions of bounded variation.

**The Lebesgue Theory:** Set functions, construction of the Lebesgue measure; measure spaces, measurable functions, simple functions, Integration, comparison with Riemann integral.

Fourier series and integral (rigorous treatment).


402. Numerical Methods and High Speed Computations (4-0).


403. Differential and Integral Equations (ordinary and partial) and special functions (4-0).


Simple cases of standard integral equations. Use of integral transforms in the solution of equations, Laplace and Mellin transform and inversion, elementary ideal of other transforms.


404. Differential Geometry, Tensors, Linear Algebra (4-0).


Application of tensors to physical problems: Form Invariance of physical laws, base vectors, physical components, stress and strain tensor. Covariant derivative and its physical meaning.


Determinant, Non-singular matrix, Adjoint of a matrix, Inverse of a matrix.

Similarity of matrices, Characteristic polynomial of a matrix, Cayley-Hamilton theorem.

405. Continuum Mechanics I (4-0).


Vortex motion: Circular vortex, Hollow circular vortex, Rankine combined vortex, rectilinear vortex filament, motion of a system of vortex filament, vortex doublet, Karman vortex sheet. Drag due to a vortex wake.

Waves: Wave motion, Kinematical condition at free surface, surface waves, Deep water waves, standing or stationary waves, waves at common surface of two liquids stability, group velocity and its dynamical significance.

Viscous flow: Measurement of viscosity, stresses in the fluid, constitutive equation of Newtonian fluids. Navier stokes equations, dissipation of energy, Reynolds number, vorticity vorticity and circulation in viscous fluid; slow motion of a sphere, Stokes and O’seen solution. Motion of viscous fluid in various simple cases. Elements of boundary theory and elementary idea of turbulence.

Modern topics: Selected topics of Non-Newtonian and viscoelastic fluids.

406. Mathematical Computation Laboratory (0-5).

Programming in Analog and Digital computer. Application to physical problems.

Analytical Dynamics: Rotating axes, Euler's equation, Spinning tops, Lagrange's equations, Theory of small vibrations, Noether's theorem, Hamilton's equation's, Liouville's theorem. Contact transformations, Poisson Brackets, Hamilton-Jacobi equations, Lagrangian and Hamiltonian formalism for continua.


Modern Algebra: Groups: Abelian and non-abelian, Subgroups, Isomorphism, Homomorphism, Cosets, Lagrange's theorem, Cycle and permutation groups, Groups of transformation, Conjugate and Classes, Normal Subgroups, Quotient groups.

Rings: Polynomial rings, Ideals, Residue Class rings, Integral Domains, Unique factorisation domain and principal ideal domains.


Projective Geometry: Axiomatic foundation, Axiomatic introduction to higher dimensional space, Extended theory of projectivity, Cross ratio, Conics, Quadratic surfaces, Ruled surfaces.

503. Probability and Statistics (4-0).


Random Variables and Probability Distributions: Univariate discrete and continuous Distributions, Bivariate and Multivariate Distributions.


504. Electromagnetic Theory and Special Theory of Relativity (4-0).


505. Continuum Mechanics II (4-0). (Elective).

Deformation gradients, Deformation tensor, Rate of deformation tensor, Rotation tensor, Spin, Vorticity, Circulation, Material derivative of a tensor, Stress tensor, Stress flux, rate of stress tensor, stress invariants, strain invariants, material derivatives of elements of length of an arc, surface and volume Kinematics of line, surface and volume integration, strain energy.

Conservation laws (mass, energy, momentum, moment of momentum).
Thermodynamics of deformation, entropy, equation of heat conduction, equation of state, Thermal stresses.

Invariance requirements.

Constitutive equations: Definition, idealised models, hyperelastic bodies (Green's model), elastic bodies (Cauchy's model), isotropic ideally elastic bodies, Stokesian fluids, Simple Viscelastic bodies.


Elastic-perfectly plastic bodies: Hencky, Von Mises, St. Venant theories and simple problems.

Elasticity: Definitions of stress and strain, Analysis of stress, Analysis of strain, stress equations of equilibrium, compatibility relations, Hooke's law, isotropic bodies, strain energy, anisotropic and aelotropic bodies, St. Venant's principle, simple problems, function theoretic method of solution of two dimensional elastic problems, elementary ideas of plates and shells, Elastic waves.

506. General Theory of Relativity (4-0).


507. Advanced Statistics (4-0). (Elective).

Candidates may offer any two of the following topics:

1. Stochastic processes.
2. Theory of games.
4. Decision Theory.
7. Information theory.

508. Statistical Laboratory (0-5).

Practical work based on the following:

1. Construction of Univariate frequency distributions from raw data and Graphical representations.
2. Computation of specified discrete probability distributions. Use of Random Numbers to generate specified frequency distributions and comparison of these frequencies with theoretical distribution.
4. Fitting of a Normal Curve to given data.
5. Test of significance and Estimation in one variable.
6. Analysis of Variance.
7. Bivariate distributions, Scatter diagram and Correlation.
8. Multiple Regression.

Short review of the topics of Vector and Tensor Algebra, Fourier series, probability, Linear Differential Equations and Numerical Analysis as given in elective mathematics for Physics Honours students.

Matrices—orthogonal, Hermitian and Unitary. Linear Transformation, Diagonalisation and eigen values of matrices.

Partial differential equations of common occurrence in Physics and special functions—*viz.*—Bessel, Legendre, Laguerre, Hermite and Hypergeometric functions (some simple properties).

Fourier and Laplace transforms.

Functions of complex variables. Cauchy theorem. Cauchy’s integral formula. Singularities; Contour integration; Analytic continuation.

402. Mechanics I (2-0).


Motion of rigid body about a fixed axis, Euler’s angles, Euler’s equation of motion, precession and Nutation.

403. Statistical Mechanics and Thermodynamics (2-0).


The Onsager relations; imperfect gases, Cluster configurations, the second virial coefficient, thermodynamic functions of imperfect gases, Equation of state.


Thermodynamic probability and Boltzmann hypothesis. Relations between thermodynamic functions and partition functions. Maxwell-Boltzmann statistics and some of its applications. Entropy constant and chemical constant.

404. Electromagnetic Theory (4-0) First term and (2-0)—Second and third terms.


Maxwell’s equations and general boundary conditions; scalar and vector potentials; wave equations and its solutions; retarded potentials.

Currents and their interactions, magnetic materials and boundary value problems.

Theory of propagation of electromagnetic waves in the ionosphere.

Radiation patterns from simple antenna, radiation damping, wave guides (simple cases).

405. Optics (2-0).

Review of Maxwell equation and their solutions.

Metallic reflection and optical constants. Discussion of the nature of experimental results.

Dispersion-normal and anomalous; absorption region, Dispersion formula for metals. Scattering-Tyndall, Rayleigh, Thomson, Raman and Compton.

Propagation of electromagnetic waves in crystals, Unaxial and biaxial; phase and ray velocities; principle of duality; Wave and normal surfaces; Conical refraction; birefringence.

Theories of Interference and diffraction; Babinet's principle. Theory of phase contrast microscope, Kirchhoff's formula; Fraunhofer diffraction for three dimensional gratings and Bragg's Law.

Optical rotation; Electro-optic and Magneto-optical phenomena.

406. Quantum Mechanics I (2-0).


407. Special Theory of Relativity (2-0) 2nd and 3rd terms.


Relativistic Lagrangian formalism and classical field theory, Maxwell-Lorentz equation; their covariance. Electromagnetic field tensor, Transformation equation for field variables. Hamiltonian functions. Covariant equation of motion of charged particles; motion in a magnetic field; Energy momentum tensor and conservation laws.

408. Electrical and Electronic Measurements (2-0).


Physics of the Termionic tubes; typical tubes, their constants and use. Fundamental processes in gas discharges.

Phenomenological discussions about plasma physics. Amplifiers—resistance, transformers and impedance coupled. Audio-radio and video-frequency amplifiers, power amplifiers; feedback; cathode follower. Class A, B and pushpull amplifiers.


Integro-Differential circuits, Computing circuits, Gating circuits, Decade and binary scalers, Pulse height analysers.

Transistor-characteristics, application as an amplifier and oscillator, Typical transistor circuits.
Instruments-Valve voltmeter, cathode ray oscillograph, wave meter, Q-meter.

Elements of electron optics.

502. Mechanics II (2-0).

Stress strain relationship; strain energy function; Waves in unbounded elastic medium.

Theory of small vibrations, normal modes, normal coordinates. Vibrations of strings and membranes.


506. Quantum Mechanics II (2-0).


511. Atomic Physics and Spectroscopy (2-0).


X-ray emission and absorption spectra, —Spin and Screen doublets, Non diagram lines, absorption edges.

Transition probabilities; Einstein's A & B coefficients, intensity of spectral line, absorption coefficient and oscillator strength; Breadth of spectral lines, life time of excited state.

Critical potential of atoms and molecules, collisions of the first and second kinds, resonance radiation and fluorescence quenching and sensitisation.

General features of spectra of diatomic molecules, Franck-Condon principle, isotopic effects.

Experimental methods in spectroscopy in different spectral regions, absorption spectrophotometry; Intensity measurement of spectral lines.

Special topics—EPR & NMR spectra; Raman effect, Laser and their applications.

512. Nuclear Physics and Cosmic rays (2-0).

Detection and measurement of ionising radiations ionisation chamber, G.M. Counter, proportional counters, cloud chamber, bubble chamber. Crystal and scintillation counters, photographic emulsion technique. Simple type of y-ray and X-ray spectrometers.

Particle accelerators.

Mass spectrometry, Nuclear mass data, Weissacker mass formula.

Static properties of nuclei, Determination of spin and magnetic moments-Schmidt lines. Nuclear binding energies.

Theories of the nucleus, Nuclear forces, theories of emission of α, β & γ-rays and their energy loss in matter, Mossbauer effect. Theory of deuteron, shell theory of nucleus, liquid drop model, nuclear isotopic spin; nuclear reactions; resonance and capture, nuclear fission; chain reaction.

Cosmic rays: primary cosmic-ray particles and their composition, relative abundance of various primary nuclei. Primary intensity and energy spectrum. Geomagnetic theory.


Free electron theories of Lorentz and Sommerfeld, electrothermal effects, Hall effect Thermionic emission, photoelectric effect, photoconduction. An introduction to the band theory of solids, introductory ideas of semiconduction.

Crystal structure: reciprocal lattice, structure factor, determination of structure by X-ray diffraction, electron diffraction, Neutron diffraction.

Radiation damage in solids, Diffusion in solids, dislocation and mechanical properties of metals.

Magnetic, Dielectric and thermal properties of matter.


514. X-ray and Structure of matter (4-0).

X-ray generating equipments and accessories, X-ray detecting devices, photographic and counter measurement of X-ray intensities.

Scattering of X-ray by electrons, atoms and group of atoms; X-ray diffraction by gases, liquids, amorphous and crystalline solids and fibres.

The powder diffraction technique and its applications in chemical analysis and in study of lattice imperfections. The low angle scattering technique.


Various modern X-ray techniques of studying lattice imperfections. Industrial radiography.


Symmetry elements and space lattices, Derivation of point and space groups. The reciprocal lattice and its application in the interpretation of X-ray diffraction patterns. Different types of camera and other apparatuses for studying X-ray diffraction in disordered lattices.

Trial and error, Fourier transform, Vector set and direct method of crystal structure analysis: Instrumental techniques for structure factor and Fourier Synthesis calculation: Method of refinements of structure and estimation of accuracy of coordinates. Applications of neutron diffraction in crystal structure analysis.

515. Solid State Physics (4-0).

Classification of solids, Lattice energy of ionic crystals, cohesive energy of metals and ionic crystals, vibrations in one, two and three dimensions, Acoustical and optical modes, phonons, theory of specific heat of crystalline solids, elastic and force constants.

Optical properties of solids, excitons, Luminescence; Energy transfer processes, Radiation damage, colour centres.

Properties of defective solids, metals and order-disorder phenomena in alloys, Bragg-Williams’ theory, Ising model.

Band approximation in solids, Kronig. Penney model, Brillouin Zones, connection between zone structure and crystal symmetry, Wigner-Seitz and tight-binding methods of band
structure analysis, effective mass of electrons in crystals, application of Brillouin Zone theory to metals and semiconductors.

Intrinsic and impurity semiconductors; donors and acceptors, Fermi level, life time and recombination, properties of metal-semiconductor and semiconductor-semiconductor junctions, rectification, junction and other types of transistors, properties of important semiconducting materials.

Mechanism of electrical conductivity; modification of Boltzmann equation for the Bloch scheme; collision between electrons and lattice vibrations in metals; residual resistance; Galvanomagnetic, thermomagnetic and thermoelectric effects, superconductivity.

Magnetic properties of crystals; Van Vleck’s theory of paramagnetism, internal crystalline fields in solids. Magnetism of free and quasibound electrons, de-Haas van Alphen effect, Weiss-Heisenberg and Bloch theories of ferromagnetism.

516. Nuclear Physics and Elementary Particles (40).

Fundamental properties and structure of nuclei, including the liquid drop, shell and collective models; Spin, parity and statistics; nuclear forces-High and low energy scattering; modes of nuclear decay; nuclear reactions; nuclear spectroscopy—\( \beta \) and \( \gamma \)-ray spectra; interaction of particles and radiation with matter particle accelerators.

Nuclear fission and reactor theory.

The properties of the elementary particles and their interactions, specially at high energies. The classification of particles and their properties, strangeness theory, pion-nucleon and nucleon interactions, photoproduction of pions, production of strange particles.

Shower Theory and related topics in cosmic rays.

**SCHEDULE XXIII**

**REGULATION NO. 29**

*Admission to the First Year class of the 5-year integrated course leading to the B.Sc./M.Sc. Degrees.*

(a) Minimum Educational Qualifications:

Admission to the First Year class of the 5-year integrated course leading to the M.Sc. Degree in Applied Geology and Exploration Geophysics shall be open to any person who has passed or is expected to pass before the 1st July of the year of admission in one of the following examinations:

(i) Higher Secondary Examination of a recognised University or of any of the recognised Boards of Secondary Education in the Science stream with Chemistry, Mathematics and Physics;

(ii) Pre-University or Pre-degree or University Entrance Examination of a recognised University or Board with Chemistry, Mathematics and Physics after passing the Matriculation or School Final or High School or equivalent examination conducted by a recognised University or Board;

(iii) Senior Cambridge or Indian School Certificate Examination with Elementary Mathematics and Additional Mathematics, Physics and Chemistry as separate subjects;

(iv) General Certificate Examination ‘O’ level with Chemistry, Mathematics and Physics as separate subjects;

(v) First Year Examination of the two-year Inter-Science or F.Sc. course of a recognised University or Board or Institute affiliated to a recognised University or Board with Chemistry, Mathematics and Physics as separate subjects;
(vi) Jamia Higher Secondary Examination (Three-Year course after VIII standard) with Chemistry, Mathematics and Physics as separate subjects;

(vii) First Year Examination of the two-year course of the Joint Services Wing of the National Defence Academy with Chemistry, Mathematics and Physics as separate subjects;

(viii) Army Higher Secondary Certificate Examination with Chemistry, Mathematics and Physics; and

(ix) Any other public examination deemed to be equivalent for the purpose by the Senate of the Institute.

Admission of a limited number of students to the Fourth Year of the course may be made from among the candidates who have passed the Three-Year B.Sc. Degree Examination of a recognised University either with Honours in Geology, and Chemistry and Physics or Mathematics as subsidiary subjects; or with Honours in Physics (or Mathematics), and Geology and Mathematics or Physics as subsidiary subjects.

(b) Age Limit:

To be eligible for admission to the First Year class, a candidate shall, on the 1st October, of the year of admission, be over 16 years of age, and for admission to the Fourth year class shall be over 18 years of age.

(c) Standard of Physical Fitness:

Candidates seeking admission to the First Year class should fulfil the prescribed standard of physical fitness, as given below:

- Height ... 1.5 m
- Weight ... 41 Kg.
- Chest Measurement ... 69 Cm. with satisfactory limit of expansion.
- Heart & Lungs ... There shall be no abnormality.
- Vision ... Better eye 6-9 or Worse eye 6-9} corrected with glass.

Eyes shall be free from congenital or other diseases.

- Hearing ... Must be normal.
- Good general health and build.
- Hernia, Hydrocele, Varicocele, Piles. ... Presence of any of these is a temporary disqualification to be rectified at own expense before joining.

The decision of the Institute Medical Officer in regard to the fitness of a candidate shall be final and there shall be no appeal.

**SCHEDULE XXIV**

**REGULATION NO. 30**

Method of admission to the First Class of the five-year integrated course leading to the B.Sc./M.Sc. Degrees and to the Fourth year class of the course.

1. Admission to the First Year class of the 5-year integrated course leading to the B.Sc./M.Sc. degrees shall be made on the basis of the performance of the candidates in the qualifying examination as prescribed and on their being found medically fit by the Institute Medical Officer.

2. Applications received by the Institute in response to advertisement shall be considered by an Admission Committee set up by the Senate for the purpose and selections be made on the basis of the standard as may be decided by the Senate from time to time.
3. Direct admission to the Fourth Year class shall be made on the results of an entrance test, written and/or oral, as may be decided by the Senate from time to time. The test shall be held at the Institute on a date to be fixed by the Senate. A preliminary selection of candidates shall be made by an Admission Committee or Committees, set up by the Senate, after scrutiny of applications including mark sheets and testimonials and only the candidates who prima facie satisfy the minimum requirements will be called for the entrance test.

**SCHEDULE XXV**

**REGULATION NO. 31**

**Five-Year Integrated course leading to the B.Sc./M.Sc. Degrees and its Duration**

1. The Institute shall provide integrated course leading to the degree of Bachelor of Science (B.Sc.) with Honours in Geological Sciences at the end of the third year and to the Degree of Master of Science (M.Sc.) in Applied Geology or in Exploration Geophysics at the end of the Fifth year, as the Senate may decide from time to time taking into consideration the accommodation and staff position, and other facilities available.

2. The curriculum for the degree of Master of Science in the subjects mentioned in para 1 shall extend over not less than five academic sessions, each consisting of three terms except that there shall be an additional Fourth term in the Final session.

For the students admitted directly to the Fourth year of the course, the curriculum shall extend over not less than two academic sessions, provided that the students whose academic background is not considered upto the standard may be required to take up, in addition to the prescribed subjects, suitable pre-requisite course as may be decided in individual cases.

**SCHEDULE XXVI**

**REGULATION NO. 32**

**Graduation Requirement**

**5-Year Integrated course leading to B.Sc./M.Sc. Degrees.**

(a) **General Regulations**

1. Every candidate for the Bachelor's and Master's Degree must, before entering on the curriculum, have complied with the admission requirements.

2. A student shall not be permitted to proceed to the next higher class unless he has fulfilled to the satisfaction of the Senate all requirements in respect of attendance and study and has passed the prescribed examinations.

3. A student shall not be permitted to take any of the examinations unless (i) he has been regular in attendance (a student shall be expected to be regular in attendance in all lectures, tutorials, laboratories, guided studies, drawing office, field work and Workshop classes), and (ii) he has satisfied all class teachers that he has conducted himself well within and outside the class rooms and that he has been regular, diligent, and methodical in his studies and has independently and satisfactorily performed the home and sessional assignments and has regularly submitted these for teachers' scrutiny.

4. A student may study in the fourth and fifth sessions an additional subject of his choice from amongst the approved optional subjects listed in Schedule X, if he so desires, and receive in the examinations such credit, over and above his aggregate total marks in the obligatory subjects, as may be prescribed by the Senate.

5. During the first two sessions it shall be obligatory on the part of all men students to participate in one of the units of the National Cadet Corps; for the women students, the foreign students, and for those men students who may not be upto the standard of physical fitness required in the N.C.C., it shall be obligatory to participate in Physical Training. In the third, fourth and fifth sessions, all students are expected to participate in Physical Training and may receive
in the examinations such additional credit over and above their aggregate total marks in the obligatory subjects as may be prescribed by the Senate.

6. Subjects of each examination shall be as given in Schedule XXVII. In each subject for examination there shall be written paper or papers and/or sessional assignments, as prescribed in the Regulations. The sessional assignments may comprise tutorials, guided studies, laboratory and field work, workshop practice and drawing office work.

7. The marks allotted to each subject in the terminal as well as in the end-sessional examinations shall be as prescribed in Schedule XXVII.

8. The Senate shall determine in respect of each subject of study the scope of the course and the relative proportion in each course of lectures, and/or practical or laboratory work. The Senate shall also determine in respect of several examinations leading to the degree, conditions for admission and the standard of examination.

9. Special Senate instructions specifying the standard of examinations shall be kept with the Registry to be made available only to the Senate and the Board of Examiners.

10. A student who, does not comply with all the provisions of the Ordinances and Regulations for an Honours Degree but has, in the opinion of the Senate, shown sufficient merit in his studies and examinations may, on the special recommendation of the Senate, be admitted by the Board of Governors to the Ordinary B.Sc. Degree at the end of the Third year, the diploma being suitably inscribed to that effect.

11. A student who after admission to the First Year class does not qualify in the first examination within one academic session of attendance at the Institute shall be required to leave the Institute unless specifically permitted by the Senate to repeat the course on grounds to be recorded by the Senate.

12. A student who fails in any of the subsequent examinations may be allowed to repeat the course subject to the following conditions:

That an entrant to the First year class shall be required to qualify in the First, the Second and the B.Sc. Examinations within a maximum period of four years of study at the Institute unless specifically permitted by the Senate to exceed this period by being allowed to repeat any part of the prescribed course and take the examination on grounds to be recorded by the Senate, and that, thereafter, every student shall be required to qualify in the Fourth and the Final M.Sc. examinations within a maximum period of three years of study at the Institute after passing the B.Sc. examination, and that a student admitted directly to the Fourth Year class shall be required to qualify in the Fourth and the Final M.Sc. examinations within a maximum period of three years of study at the Institute unless specifically permitted by the Senate to exceed this period by being allowed to repeat any part of the prescribed course and take the examination on grounds to be recorded by the Senate.

13. If a student fails in an examination and he is permitted to repeat the course his marks shall be as may be secured by him when he repeats the course.

14. If a student is allowed to appear at an examination without repeating the course the marks allotted to him for the sessional assignments and the terminal examinations shall be the marks as he may secure when he completed the course.

15. The Senate shall be competent on the recommendations of the Board of Examiners to deviate from the prescribed Ordinances and Regulations relating to the examinations and consider special cases not covered by the Ordinances and Regulations subject to the approval of the Board of Governors.

(b) Other requirements

1. Subject to the provisions of the Ordinances and Regulations the degree of Bachelor of Science shall be conferred on students who have followed the prescribed curricula for not less than three academic sessions studying subjects set forth in the regulations (Schedule XXVII) and have reached the standard in the examinations in Geological Sciences; and the degree of Master of Science on those who have followed the prescribed curricula for not less than five academic sessions studying subjects set forth in the regulations (Schedule XXVII) and have reached the standard in the respective examinations in one of the following branches: (i) Applied Geology, (ii) Exploration Geophysics—except that those admitted to the fourth year class must have followed the prescribed curricula for not less than two academic sessions.
2. There shall be five complete examinations for the Degree of Master of Science (M.Sc.),

namely, (i) the First examination, (ii) the Second Examination, (iii) the B.Sc. Examination, (iv) the
Fourth Examination and (v) the Final M.Sc. Examination.

3. For each examination a Board of Examiners shall be constituted by the Senate and
the Board of Examiners shall comprise the teachers in the subjects of the examination and the
additional examiner or examiners and other experts.

4. No student may present himself for examination in any subject until he has duly com-
pleted the prescribed course of instruction to the satisfaction of the teachers concerned.

5. **The First Examination**: (i) the First Examination shall be taken in three sections
consisting of two Terminal examinations each covering the term's work and an End-sessional
Examination covering the entire course of the First Examination.

(ii) No student may present himself for the End-sessional Examination in any subject
unless he has secured on the total of the two Terminal examinations requisite minimum marks in the
written paper or papers of each of the obligatory subjects and in each of the sessional assign-
ments.

(iii) A student shall be deemed to have passed the First examination provided he has
secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional
assignments and in the aggregate.

6. **The Second Examination**: (i) No Student may present himself for examination in any
subject of the Second Examination until he has passed the whole of the First Examination except
those who have been granted admission direct to the Second year class and exempted from the
First examination.

(ii) The Second Examination shall consist of two Terminal Examinations each covering
the term's work and an End-sessional Examination covering the entire course of the Second Exami-
nation.

(iii) No student may present himself for the End-sessional Examination in any subject
unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the
written paper or papers of each of the obligatory subjects and in each of the sessional
assignments.

(iv) A student shall be deemed to have passed the Second Examination provided he has
secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional
assignments and in the aggregate.

7. **The B.Sc. Examination**: (i) No student may present himself for examination in any
subject of the B.Sc. Examination until he has passed the whole of the Second Examination.

(ii) The B.Sc. examination shall consist of two Terminal Examinations each covering the
the term's work and an End-sessional Examination covering the entire course of the B.Sc. Exami-
nation and a Viva-voce Examination.

(iii) No student may present himself for the End-sessional Examination in any subject
unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the
written paper or papers of each of the obligatory subjects and in each of the sessional
assignments.

(iv) A student shall be deemed to have passed the B.Sc. Examination provided he has
secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional
assignments, in the Viva-voce Examination and in the aggregate.

8. **The Fourth Examination**: (i) No student may present himself for examination in
any subject of the Fourth Examination until he has passed the whole of the B.Sc. Examination, except those who have been admitted directly to the Fourth year of the course and Exempted from
the First, Second and the B.Sc. Examinations.

(ii) The Fourth Examination shall consist of two Terminal Examinations each covering
the term's work and an End-sessional Examination covering the entire course of the Fourth Exami-
nation.
(iii) No student may present himself for the End-sessional Examination in any subject unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) A student shall be deemed to have passed the Fourth Examination provided he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments and in the aggregate.

9. The Final Examination: (i) No student may present himself for examination in any subject of the Final Examination until he has passed the whole of the Fourth Examination.

(ii) The Final Examination shall be taken in five sections comprising the two Terminal Examinations each covering the term's work and an End-sessional Examination, the Viva-voce Examination, and an examination on thesis on an approved subject which each student shall be required to carry out in the Final session.

(iii) No student may present himself in any subject of the End-sessional Examination, in the Viva-voce Examination, and in the Thesis Examination unless he has secured on the total of the two Terminal Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects and in each of the sessional assignments.

(iv) The End-sessional Examination shall cover the entire course prescribed for the Final Examination.

(v) A student shall be deemed to have passed the Final M.Sc. Examination if he has secured on the total of the two Terminal and the End-sessional Examinations requisite minimum marks in the written paper or papers of each of the obligatory subjects, in each of the sessional assignments, in the Viva-voce Examination, in the thesis Examination and in the aggregate.

10. The Maximum Marks: (i) The maximum marks for the First, Second, B.Sc. and the Fourth Examinations shall be the total of the maximum marks prescribed for the obligatory subjects of the respective End-sessional Examinations plus fifty percent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.

(ii) The maximum marks for the Final Examination shall be the total of the maximum marks prescribed for the obligatory subjects of the End-sessional Examination, for the Viva-voce Examination and for the Thesis Examination plus fifty percent of the total of the maximum marks prescribed for the obligatory subjects of both the Terminal Examinations.

11. The Weighted Maximum Marks: (i) The weighted maximum marks for the First, Second and the Fourth Examinations shall be the maximum marks for the First, Second and the Fourth Examinations respectively.

(ii) The weighted maximum marks for the B.Sc. Examination shall be the maximum marks of the B.Sc. Examination plus two-thirds of the weighted maximum marks of the Second Examination plus one-third of the weighted maximum marks of the First Examination.

(iii) The weighted maximum marks for the Final Examination shall be the maximum marks of the Final Examination plus the weighted maximum marks of the Fourth Examination.

12. A student passing all the five examinations for the Degree of Master of Science shall be declared to have passed in the appropriate branch on the basis of his overall performance in all the five examinations, except that a candidate who has been admitted direct to the fourth year class shall be declared to have passed in the appropriate branch on the overall performance in the two examinations, viz., the Fourth and the Final.

A student passing all the first three examinations, viz., the First Examination, the Second Examination and the B.Sc. Examination shall be declared to have passed the B.Sc. Examination with Honours in Geological Sciences on the basis of his overall performance in all the three examinations.

13. The students found entitled to the Degree of Master of Science shall, in each branch, be classified in two groups to be denominated respectively the First and Second class on the basis of the weighted total marks they secure out of the prescribed weighted maximum marks of the Final Examination.
The students found eligible for the B.Sc. (Honours) Degree shall be also classified in two
groups to be denominated respectively the First and Second class on the basis of the weighted total
marks they secure out of the prescribed weighted maximum marks of the B.Sc. Examination.

14. The names of the students in the First class shall be arranged in order of merit and
those in the Second class in the alphabetical order.

15. The students satisfying all the conditions prescribed and having passed the prescribed
examinations as mentioned in para. 13 shall be entitled to receive the Degree of Master of Science
and/or Bachelor of Science (with Honours) in the appropriate branch of study.

16. For the Degree of Master of Science (M.Sc.) in any branch as set forth above and the
Bachelor of Science (B.Sc.) the graduate shall receive a Diploma wherein shall be set forth the
branch of study in which he has obtained the Degree of Master of Science, or the Bachelor's
Degree and the class in which he has been placed.
**SCHEDULE XXVII**

**REGULATION No. 33**

Schedule of Courses and Distribution of Marks for Five-year Integrated M.Sc. Degree Courses in Applied Geology and Exploration Geophysics

**FIRST YEAR (Common)**

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the First Examination</th>
<th>All Terms</th>
<th>No. of papers for examination</th>
<th>Duration of exam. papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu 111</td>
<td>English</td>
<td>2 2</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Hu 113</td>
<td>Principles of Government</td>
<td>1 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ma 114</td>
<td>Mathematics I</td>
<td>6 2</td>
<td>3</td>
<td>3 hrs. each</td>
</tr>
<tr>
<td>Ch 114</td>
<td>Chemistry I</td>
<td>4 1</td>
<td>2</td>
<td>2 hrs. each</td>
</tr>
<tr>
<td>Ch 115</td>
<td>Chemistry Lab. I</td>
<td>0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph 114</td>
<td>Physics I</td>
<td>4 1</td>
<td>2</td>
<td>2 hrs. each</td>
</tr>
<tr>
<td>Ph 115</td>
<td>Physics Lab. I</td>
<td>0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE 113</td>
<td>Drawing and Descriptive Geometry</td>
<td>0 4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ge 101</td>
<td>Introduction to Earth Sciences</td>
<td>1 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>N.C.C./P.T.</td>
<td></td>
<td>0 3</td>
<td></td>
<td></td>
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Field Tour (one week).
Duration of papers for end-sessional examination shall be 3 hours.
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<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the Second Examination</th>
<th>All Terms Hours per week</th>
<th>Marks 1st term</th>
<th>Marks 2nd term</th>
<th>Marks 3rd term</th>
<th>No. of papers for examination</th>
<th>Duration of exam. papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu 211</td>
<td>English</td>
<td>1 1</td>
<td>50—50</td>
<td>50—50</td>
<td>50—50</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Hu 212</td>
<td>Logic</td>
<td>1 0</td>
<td>50—0</td>
<td>50—0</td>
<td>50—0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ma 214</td>
<td>Mathematics II</td>
<td>4 1</td>
<td>200—50</td>
<td>200—50</td>
<td>200—50</td>
<td>2</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ph 214</td>
<td>Physics II</td>
<td>3 1/2</td>
<td>150—100</td>
<td>150—100</td>
<td>150—75</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ph 215</td>
<td>Physics Lab. II</td>
<td>0 3/2</td>
<td>150—100</td>
<td>150—100</td>
<td>150—75</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ch 214</td>
<td>Chemistry II</td>
<td>3 1/2</td>
<td>150—100</td>
<td>150—100</td>
<td>150—75</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Ch 215</td>
<td>Chemistry Lab. II</td>
<td>0 3/2</td>
<td>100—50</td>
<td>100—50</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ge 201</td>
<td>Principles of Geology</td>
<td>2 2</td>
<td>100—50</td>
<td>100—50</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ge 210</td>
<td>Crystallography and Mineralogy</td>
<td>2 3</td>
<td>100—50</td>
<td>100—50</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ge 222</td>
<td>Paleontology I</td>
<td>2 2</td>
<td>100—50</td>
<td>100—50</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Ge 250</td>
<td>Field Geology II (4 weeks)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Viva-Voce</td>
<td></td>
<td></td>
<td>0—50</td>
<td>0—50</td>
<td>0—50</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>N.C.C./P.T.</td>
<td></td>
<td></td>
<td>0—100</td>
<td>0—100</td>
<td>0—100</td>
<td>1</td>
<td>2 hrs.</td>
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<td><strong>18 20</strong></td>
<td><strong>900—600</strong></td>
<td><strong>900—600</strong></td>
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<td>Subjects for the B.Sc. (Hons.) Examination</td>
<td>Hours per Week</td>
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</tr>
<tr>
<td>Ph 314</td>
<td>Atomic and Nuclear Physics</td>
<td>First Term: 2 0</td>
<td>Second Term: 2 0</td>
<td>Third Term: 2 0</td>
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<tr>
<td>CE 214</td>
<td>Surveying</td>
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<td>1 3</td>
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<tr>
<td>Ge 310</td>
<td>Optical Mineralogy</td>
<td>2 6</td>
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<tr>
<td>Ge 312</td>
<td>Petrology</td>
<td>2 0</td>
<td>2 6</td>
<td>2 6</td>
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<tr>
<td>Ge 322</td>
<td>Stratigraphy I</td>
<td>2 0</td>
<td>2 0</td>
<td>2 0</td>
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<tr>
<td>Ge 330</td>
<td>Economic Geology</td>
<td>2 0</td>
<td>2 0</td>
<td>2 0</td>
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<tr>
<td>Ge 340</td>
<td>Structural Geology</td>
<td>2 3</td>
<td>2 3</td>
<td>2 3</td>
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<tr>
<td>Ge 350</td>
<td>Field Geology II (4 weeks)</td>
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<td>2 0</td>
<td>2 0</td>
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<tr>
<td>Ge 360</td>
<td>General Geophysics I</td>
<td>2 0</td>
<td>2 0</td>
<td>2 0</td>
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<td>Ge 370</td>
<td>Applied Geophysics</td>
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<td>3 0</td>
<td>2 2</td>
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<td>+Electives (any one Group)</td>
<td>3 3</td>
<td>3 3</td>
<td>3 3</td>
<td>3 3</td>
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</tr>
<tr>
<td>Viva Voce</td>
<td></td>
<td></td>
<td>2 0</td>
<td>2 0</td>
<td>2 0</td>
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<td></td>
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<td>0 2</td>
<td>0 2</td>
<td>0 2</td>
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</table>

+E elective: A Group

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the B.Sc. (Hons.) Examination</th>
<th>Hours per Week</th>
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</thead>
<tbody>
<tr>
<td>Ph 315</td>
<td>Physics Laboratory III</td>
<td>0 3</td>
</tr>
<tr>
<td>Ma 314</td>
<td>Adv. Calculus and Diff. Equations</td>
<td>3 0</td>
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</table>

+E elective: B Group

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Subjects for the B.Sc. (Hons.) Examination</th>
<th>Hours per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 314</td>
<td>Physical and Analytical Chemistry</td>
<td>2 0</td>
</tr>
<tr>
<td>Ge 331</td>
<td>Economic Geology Laboratory</td>
<td>0 3</td>
</tr>
<tr>
<td>Ge 314</td>
<td>Rock Forming Minerals</td>
<td>1 0</td>
</tr>
<tr>
<td>Marks 1st term Papers for exam.</td>
<td>No. of 1st term papers</td>
<td>Duration of exam.</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>100— 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>100—150</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>100— 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>100— 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>100— 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>100—100</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>100— 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>150— 0</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>150—100</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>0— 100</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>0— 50</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1000—500</td>
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<td>—</td>
<td>—</td>
</tr>
<tr>
<td>150— 0</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>100— 0</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>50—100</td>
<td>1</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>Subject No.</td>
<td>Subjects for the Fourth Examination</td>
<td>First Term</td>
</tr>
<tr>
<td>------------</td>
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</tr>
<tr>
<td>Hu</td>
<td>*Language, (any one) ...</td>
<td>2</td>
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<tr>
<td>Ge 412</td>
<td>Igneous and Metamorphic Petrology</td>
<td>3</td>
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<td>Ge 415</td>
<td>Geochemistry ...</td>
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<td>Ge 420</td>
<td>Paleontology II</td>
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<tr>
<td>Ge 433</td>
<td>Non-Metallic Mineral Deposits ...</td>
<td>1</td>
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<td>Ge 434</td>
<td>Geology of Coal</td>
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<td>Ge 435</td>
<td>Geology of Petroleum ...</td>
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<td>ChE 436</td>
<td>Testing of Solid Fuels ...</td>
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<tr>
<td>Ge 437</td>
<td>Ground Water Geology ...</td>
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<td>Ge 438</td>
<td>Engineering Geology ...</td>
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<td>Ge 440</td>
<td>Structural Geology and Tectonics ...</td>
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<tr>
<td>Ge 450</td>
<td>Field Geology III (8 weeks)</td>
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<tr>
<td>ChE 434</td>
<td>Mineral Dressing &amp; Ore Beneficiation</td>
<td>2</td>
</tr>
<tr>
<td>Viva Voce</td>
<td>...</td>
<td>—</td>
</tr>
</tbody>
</table>

|          |                                    | 17         | 18          | 16         | 19         | 14         | 19         |
| Option    |                                    | 2          | 0           | 2          | 0           | 2          | 0          |
| Physical Training |                              | 19         | 18          | 18         | 19         | 16         | 19         |

*Languages
Hu 411 Elementary French.
Hu 412 Elementary German.
Hu 413 Elementary Russian.
<table>
<thead>
<tr>
<th>Marks 1st term</th>
<th>No. of Papers for exam.</th>
<th>Duration of exam. papers</th>
<th>Marks 2nd term</th>
<th>No. of papers for exam.</th>
<th>Duration of exam. papers</th>
<th>Marks 3rd term</th>
<th>No. of papers for exam.</th>
<th>Duration of exam. papers</th>
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<tbody>
<tr>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
<td>100—50</td>
<td>1</td>
<td>2 hrs.</td>
<td>100—50</td>
<td>1</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>150—150</td>
<td>1</td>
<td>3 hrs.</td>
<td>150—150</td>
<td>1</td>
<td>3 hrs.</td>
<td>150—150</td>
<td>1</td>
<td>3 hrs.</td>
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<tr>
<td>——</td>
<td>—</td>
<td>—</td>
<td>150—0</td>
<td>1</td>
<td>3 hrs.</td>
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</tr>
<tr>
<td>100—0</td>
<td>1</td>
<td>2 hrs.</td>
<td>100—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>100—100</td>
<td>1</td>
<td>3 hrs.</td>
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<tr>
<td>50—75</td>
<td>1</td>
<td>2 hrs.</td>
<td>50—100</td>
<td>1</td>
<td>2 hrs.</td>
<td>100—100</td>
<td>1</td>
<td>3 hrs.</td>
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<tr>
<td>150—75</td>
<td>1</td>
<td>3 hrs.</td>
<td>50—100</td>
<td>1</td>
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<td>100—0</td>
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<td>1</td>
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<td>3 hrs.</td>
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<td>3 hrs.</td>
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<td>100—100</td>
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<td>Subjects for the Fourth Examination</td>
<td>Hours per Week</td>
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INDIAN INSTITUTE OF TECHNOLOGY
KHARAGPUR

DISTRIBUTION OF MARKS
(For each Examination)

5-Year Integrated B.Sc./M.Sc. Degree Courses in Applied Geology and Exploration Geophysics

<table>
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<tr>
<th>Examination</th>
<th>First Term Marks</th>
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+ Viva-Voce  200
+ Thesis     300
114. Chemistry I (4-1).

Elementary idea of atomic nucleus and fundamental particles. Cathode ray, electron and its e-m, X-ray, radioactive rays, atomic number, Mosley's work, isotopes, isobars. Mendeleef and Bohr's periodic table: group displacement law.


Volumetric and gravimetric compositions of H₂O, NH₃, N₂O, NO, SO₂, CO, CO₂, CH₄, C₂H₄ and C₃H₄. Chemical calculations involving volume to volume and weight to volume conversions.

Acids, bases and amphoteric oxides. Theory of acids and bases.

Ideal gas laws and molar gas constant. Kinetic theory of gases, specific heats of gases. Van der Waals equation, molecular weight and thermal dissociation, critical phenomena, continuity of state, liquefaction of gases.

Reversible reactions, law of mass action and chemical equilibrium in homogeneous and heterogeneous systems. Le Chatelier's principle and its applications.

Characteristic features of different types of solutions including distillation of binary liquid mixtures. Extraction, solubility curves and fractional crystallisation.

Osmotic pressure, lowering of vapour pressure, elevation of boiling point, depression of freezing point. Experimental determination of molecular weights of solutes, abnormal colligative properties.

A condensed syllabus covering the preparation and properties of aliphatic and simple alicyclic compounds.

- Hydrogen, water, hydrogen peroxide, ozone, inert gases.
- Study of the following elements and their compounds.
- Elements of group IA, IB, II A, IIB (excluding francium and radium). Halogens, Oxygen, Sulphur (excluding thionic acids) and nitrogen.
- Metallurgy, uses and alloys of Na, K, Cu, Ag, Au, Mg, Ca, Sr, Ba, Zn, Cd, Hg, Al, Sn, Pb, As, Sb, Bi, Fe, Ni.

115. Chemistry Lab. I (0-3).

Qualitative analysis of mixtures containing not more than three radicals.

- Acid radicals:—CO₃, Cl, Br, I, F, SO₄, SO₂, S₂O₃, S, NO₂, NO₃, PO₄, AsO₄, BO₃, CrO₄.
- Basic radicals:—Na, NH₄, K, Cu, Ag, Ba, Ca, Sr, Mg, Zn, Cd, Hg, Al, Pb, Sn, Cr, Mn, Fe, Co, Ni, As, Sb, Bi.

214. Chemistry II (3-1).

Elements of thermodynamics (1st and 2nd laws). Thermochemistry.

Electrochemistry—Arrhenius’s theory of Electrolytic dissociation, degree of dissociation, Vant Hoff’s factor. Important electrolytic processes.

A condensed syllabus covering the preparation and important properties of aromatic compounds. Heterocyclic compounds (pyrole and pyridine only).

Manufacture of the following:—

Cement, ceramics, glass and refractories.

Study of the chemistry of the following elements and their compounds:—

B, Al, C, Si, Sn, Pb, N, P, As, Sb, Bi, Cr, Mn, Fe, Co, Ni.

Study of groups I, II, III, IV, V, and VII. Study of the following elements and their compounds:—

Au, Be, Rare earths, Si, Ti, Zr, V, Co, Ni, Pt.

215. Chemistry Laboratory II (0-3).

Volumetric estimation of Fe, Cu, Ca, Ag.

Gravimetric estimation of Fe and Ba.

Estimation of Cu and Fe or Ca and Fe in a mixture.

314. Physical and Analytical Chemistry (2-0).

Thermodynamics, 1st and 2nd laws. Phase rule as applied to Geology.

Advanced topics in Electrochemistry.

Chemical kinetics treated in advanced level. Artificial transmutation of elements and related topics.

Principles of permanganometry, dichromatometry, iodoxymetry and argentometry, etc.
Gravimetric and Silicate analysis.
Instrumental analysis.
Use of complexing agents in analysis.

CHEMICAL ENGINEERING (ChE)

434. Mineral Dressing & Ore beneficiation (2-3) First Term.

Recovery of minerals from ore. Equipments used for grinding and size separation. Methods of concentration. Flow sheet of important ore dressing operations.

(For Geologists)

436. Testing of Solid Fuels (0-3). Third Term.

Proximate Analysis, ultimate analysis, calorific value, washability of coal, coking properties of coal.

(For Geologists)
113. Drawing and Descriptive Geometry (0-4).

Lettering, scales, Mathematical Curves, Lines and Planes, isometric and oblique views, orthographic Projections, conventions and dimensioning, sketching and elementary drawing.

Representation of plane figures and solids, edge views, and true shapes, location of planes, inclination of planes, distances of lines and planes, intersection of planes, sections, inter penetration of bodies, development of surfaces, determination of shadows and perspective drawings.

214. Surveying (1-3). Second and Third Terms.

Principles and Practice of chain and compass surveying and plotting, plane table surveying; two and three point problems. Use and adjustment of instruments; levelling; contours and sections; setting out buildings, measurement of earth work. Planimeter, its theory and use. Field practice.

ELECTRICAL ENGINEERING (EE)

401. Electrical Technology (2-3). Second and Third Terms.

Introductory study of magnetic & electric fields and circuit parameters. Production of e.m.f. Construction and principles of operation of transformer, alternator and D. C. machines. Current, voltage, power and energy meters. Measurement of inductances and capacitances (Bridge methods).

(For Geophysicists)

ELECTRONICS & ELECTRICAL COMMUNICATION ENGINEERING (Comm) -


(For Geophysicists)

GEOLOGY & GEOPHYSICS (Ge)

(a) Geology

101. Introduction to Earth Sciences (1-0).

The Earth Sciences—their nature, materials, processes and methods. The challenges of the profession. Field Tour (7 days)—Visit to mines, projects etc.

201. Principles of Geology (2-2).

This course introduces all the main disciplines of Geology. It deals with the origin, evolution, physical behaviour and chemical constitution of the earth, and also with the common properties of earth materials. The laboratory part of the course includes basic problems of structural geology and hand-specimen identification of rocks.


Introduction. Symmetry concepts, representation methods of crystal symmetry. Crystallographic measurements, constructions and calculations. Seven systems and thirty-two classes of crystals. Internal symmetry of crystals.

Atomic structure, chemistry and physics of minerals. Systematic study of important minerals.
222. Paleontology I (2-2).

Nature and significances of fossil record. Elements of taxonomy. Systematic invertebrate palaeontology, with emphasis on stratigraphically important fossil groups. Introduction to palaeobotany.

250. Field Geology I (3 to 4 weeks).

Mapping in a relatively simple area with unconformity, dykes, faults etc. Tape and compass survey.

310. Optical Crystallography (2-6). First Term.


312. Petrology (2-0), First term; (2-6), Second and Third Terms.

Forms of igneous bodies, classification of igneous rocks, silicate melt equilibria, reaction principle. Variation in associated igneous rocks, crystallization of basaltic and granitic magmas. Description and genesis of the common rock types. Origin of magmas.


Processes of sedimentation, characters of sedimentary rocks. Classification and description of important sedimentary rock types. Rock cycle.

314. Rock Forming Minerals (1-0).

Structure, crystal chemistry, physical properties (mainly optical), and an elementary consideration of phase relations of the important rock-forming mineral groups.

322. Stratigraphy I (2-0).

Introduction to general principles of stratigraphic analysis and correlation. Details of the principal stratigraphic units of India, comparison of these with corresponding units of the European type areas and other important regions.

330. Economic Geology (2-0).

Materials and processes of formation of minerals and mineral deposits. Geology of the important mining districts in India in relation to the origin and characteristics of mineral deposits.

331. Economic Geology Lab (0-3).

Study of the important ores and non-metallic minerals and ore associations with special reference to India.

340. Structural Geology (2-3).


350. Field Geology II (4 weeks).

Mapping in a metamorphosed Precambrian terrain with significant lithologic variation and having a relatively simple structure. Plane table survey.
412. Igneous and Metamorphic Petrology (3-6).


415. Geochemistry (3-0) 2nd term.

Composition of the earth, geochemical classification and distribution of elements, meteorites. Thermodynamics and its application in geochemistry. Principles of crystal chemistry. Phase rule and its applications. Geochemistry of a few important elements.

420. Pal-eontology II (2-0) 1st term ; (2-3) 2nd term ; (2-6) 3rd term.


Part B—Micropal-eontology : morphology of principal kinds of microfossils, with emphasis on Foraminifera and Ostracoda; stratigraphic applications.

433. Non-Metallic Mineral Deposits (1-3) 1st and 2nd terms ; (2-3) 3rd term.


434. Geology of Coal (1-3) 2nd Term and (1-0) Third term.

Characters and correlation of coal seams and coal measure formations. Properties, classification and origin of coal. Indian coal fields.

435. Geology of Petroleum (3-2) 1st Term.

Origin and occurrence of petroleum in different types of traps. Sedimentary and tectonic habitat of oil with special reference to India. Laboratory problems on subsurface methods.

437. Ground Water Geology (2-0) 1st Term.


438. Engineering Geology (2-0) 2nd and 3rd terms.


440. Structural Geology and Tectonics (2-3) First and Second Terms, (2-0) Third Term.


450. Field Geology III (6 to 8 weeks).

(a) Mapping in a structurally complex area with emphasis on detailed structural analysis (3 weeks).

(b) Sedimentary facies mapping with detailed environmental analysis. Measurement of stratigraphic sections (2 weeks).

(c) Prospecting and underground mapping (1 week).

(d) Theodolite survey (1 week).

502. Geomorphology and Photogeology (2-0) First Term, (2-2) Second Term, (1-6) Third Term.

Description and genesis of the prominent types of landforms. Critical study of all dynamical agents. Laboratory study of regional geomorphology from topographic sheets.

Introduction to photogrammetry and photo interpretation. Study of air photo of all prominent landforms and rock types. Techniques of preparation of geologic maps from air photos.

512. Silicate Analysis (0-6) Second Term.


513. Sedimentary Petrology and Sedimentation (2-6) First Term, (1-3) Second Term, (3-0) Third Term.

Study of textures, structures, Classification and description of sedimentary rocks.

Study of environmental factors, processes of sedimentation and classification and description of environments of recent sediments. Tectonics in relation to sedimentation and sedimentary facies.

522. Stratigraphy II (2-0).


525. Mineral Economics (1-0) Second Term.

Importance of minerals in national economy. Pattern of mineral relationship; Economic features of the mining industry; International flow of minerals; National mineral policy; Mineral Concession Rules; Mineral Policy and the Five-Year Plans in India.

532. Ore Genesis and Metallic Mineral Deposits (3-6) First and Second Terms, (3-3) Third Term.

Geochemical principles and processes involved in ore deposition: Mineral equilibria at high and low temperature and their bearing on problems of ore deposition—Sulphide and oxide systems; Metallogeny in relation to stratigraphy and tectonics: Detailed study of the different genetic types of iron, manganese, copper, gold, silver, lead, zinc, chromium and radioactive mineral deposits of the world: Laboratory investigation of ore specimens.

535. Geology of Petroleum (3-2) First Term; same as Ge 435 (For Geophysicists).

536. Prospecting (Geophysical, Geochemical and Geological) (2-1) First and Second Terms, (2-0) Third Term.

Suitability and application of the various geological, geophysical and geochemical methods for prospecting for minerals, oil and natural gas and water.
550. Field Geology IV (8 weeks).
(a) Field work for geochemical prospecting course (1 week).
(b) Field work for project and thesis (7 weeks approximately).

551. Mining Geology and Drilling Methods (2-0) First Term, (1-0) Second and Third Terms.
Relation of Geology to mining: Geological consideration structure and occurrence of mineral deposits in relation to prospecting, exploration, development and exploitation; Examination and development of prospect: Geological work in an operating mine: Reserve estimation: Elements of mining engineering: Techniques of drilling—equipments, procedure, logging, etc.

552. Geology Seminar (0-1).
Review of topics and papers on General and Applied Geology. Each student is required to give a talk once a term.

554. Technical Report Writing (0-1) Second Term.
Discussion on various types of research and professional reports and their preparation.

555. Project and Thesis (0-10) Third Term.
A thesis project based on individual work on any chosen topic in Applied Geology.

557. Clay Mineralogy (3-3) First Term.

(b) Geophysics

360. General Geophysics I (2-0).

370. Applied Geophysics (3-0) First and Second Terms, (2-2) Third Term.
Principles of different geophysical methods applied to geological problems and prospecting. A quick survey without going into details of interpretation and field techniques. Principles of geophysical instruments with demonstrations in the field.

462. Theory of Fields I (4-0) First Term.
Concept of the physical field. Different kinds of field in Geophysics. Fields due to several point sources, continuous distributions, and double layers. Fields within attracting masses. Lines of Force. Potential.

464. Nuclear Geology (3-3) First Term.


490. Gravity and Magnetic Methods (0-3) First Term, (4-3) Second Term, (4-6) Third Term.


Laboratory problems on the calibration of instruments, computation of anomalies, geometrical constructions. Preparation of residual and derivative maps, upward and downward continuation.

496. Field Geophysics I (6 weeks) Field Term.

Field training in gravity, magnetic and radioactive methods of prospecting. Students will undertake field problems, process and interpret the data and submit a report in professional form.

560. General Geophysics II (3-0) First and Third Terms, (2-0) Second Term.


562. Theory of Fields II (4-0) First Term.


563. Theory of Elastic Waves (4-0) First Term.


570. Electrical and Electromagnetic Methods (0-4) First Term, (4-6) Second Term, (4-3) Third Term.

Classification. Electrical equivalents of geological bodies. Electrical properties of rocks and minerals. General theory of stationary current distribution in a stratified medium. Theory


Laboratory measurements of electrical properties of rocks and minerals. Model experiments in electrical and electromagnetic prospecting. Theoretical computation. Interpretation of field data.

575. Well Logging (2-3) Second and Third Terms.


Laboratory measurements on core samples. Interpretation of various types of field logs and the use of Schlumberger and other interpretation charts.

580. Seismic Methods (0-3) First Term, (4-6) Second Term; (4-3) Third Term.


Laboratory work on the study of components of the seismic equipment, the equipment as a whole and interpretation of field data.

595. Geophysics Seminar (0-1).

Review of topics and papers on General and Applied Geophysics. Each student is required to give a talk once a term.

596. Field Geophysics II (8 weeks) Field term.

Field training in electrical and seismic methods of prospecting. Students will undertake field problems, process and interpret the data and submit a report in professional form.

598. Project and Thesis (0-3) First and Second Terms, (0-6) Third Term.

A student is required to take up an independent investigation in some branch of Geophysics at the beginning of the Fifth year under the guidance of a teacher. A properly supervised and accepted technical report on the investigation has to be submitted at the end of the year.

HUMANITIES AND SOCIAL SCIENCES (Hu)

111. English (2-2).

The object of the programme is to teach students how to express themselves in good, simple, and correct English and to help them develop a taste for literature.

TUTORIAL PROGRAMME

1st Term

The main rules of syntax; the sentence; its structure; punctuation; paragraph; no formal grammar lessons are given; correct use is taught through composition.

2nd Term

Precis-writing; letter-writing; comprehension test etc.
3rd Term

Paraphrasing; imaginative writing; Report writing; dialogue, diary, etc., writing short notes on topical issues.

 Anthologies of essays and poems and a modern play will be chosen as text for the lecture classes. The text will be changed from time to time.


2. Structure of Government; Constitution of India with reference to some modern constitutions.

3. World Order and the U. N.

211. English (1-1).

TUTORIAL PROGRAMME

Advanced prose composition including precis writing; discussion and review of important books; summarising technical reports.

In the lecture classes two books will be discussed in detail; one, preferably a prose play by an outstanding playwright in the first two terms and the other, one or two long poems or a number of poems by different poets, or short stories or essays.

212. Logic (1-0).

The province of logic: Nature, Scope and Utility of logic; the fundamental concepts of logic. The relation of logic to psychology, grammar and mathematics.

Logic and language: Words and Terms; Denotation and Connotation and distribution of terms: Classification of terms. Propositions and sentences (classification of propositions, opposition of propositions).


411. Elementary French (2-1).

Basis and essentials of French language: graduated course to cover pronunciation and elements of grammar, reading of varied matter, literary and scientific, to lay the foundation of vocabulary for facilitating further independent reading of scientific journals and writings. Practice in hearing and speaking French may be supplemented by audio-visual devices (French records, pictures, etc.).

Introduction to the more general technical terms and to the easier texts of technical books of Geology and Geophysics.

412. Elementary German (2-1).

Basis and essentials of German language: graduated course to cover pronunciation and elements of grammar, reading of varied matter, literary and scientific, to lay the foundation of vocabulary for facilitating further independent reading of scientific journals and writings. Practice in hearing and speaking German may be supplemented by audio-visual devices, (German records, pictures, etc.).

Introduction to the more general technical terms and to the easier texts of technical books of Geology and Geophysics.
413. Elementary Russian (2-1).

Basis and essentials of Russian language: graduated course to cover pronunciation and elements of grammar reading of varied matter, literary and scientific, to lay the foundation of vocabulary for facilitating further independent reading of scientific journals and writings. Practice in hearing and speaking Russian may be supplemented by audio-visual devices (Russian records, pictures etc.).

Introduction to the more general technical terms and to the easier texts of technical books of Geology and Geophysics.

MATHEMATICS (Ma)

114. Mathematics I (6-2).


Analytical geometry of two dimensions. Homogeneous equation of the second degree, classification of conics. Tangents, Polar coordinates. Analytical geometry of three dimensions. Planes, straight lines and simple conoids.


214. Mathematics II (4-1).


Motion in a straight line. Velocity and acceleration in polar and intrinsic coordinates, free and constrained motions. Central orbits. Collision of elastic bodies. Projectiles. Motion in a resistive medium. Motion in a circle.

314. Advanced Calculus and Differential Equations (3-0).


414. Methods of Applied Mathematics (4-0). First Term, (3-0). Second and Third Terms.


MINING ENGINEERING (MIN)

516. Drilling Methods and Elements of Mining (2-0). First Term, (1-0). Second and Third Terms.

Drilling Methods

Simple hand methods, percussive and rotary methods for prospecting and miscellaneous purposes; drilling for petroleum; deviation of boreholes; difficulties in boring; borehole surveying and logging; directional drilling.

Elements of Mining

Historical background; mine development; explosives and blasting; support, mining methods; mine valuation.

PHYSICS (Ph)

114. Physics I (4-1).

Review of elementary principles of mechanics; circular motion, moment of inertia, conservation of energy and momentum, collision of elastic bodies, simple harmonic motion, simple and conical pendulums, torsional oscillations; balance; production and measurement of load pressure; Law of gravitation, Kepler's law, measurement of g; elasticity and elastic properties of matter; units and dimensions.

Nature of sound, velocity of sound and its measurement; properties of waves, progressive and stationary waves; damped and forced vibrations; intensity; pitch and quality; musical sound and noise; principle of sound analysis; Doppler's principle; ultrasonics; sound recording and reproduction.

Geometrical optics. Fermat's principle; thick lens, principal points, combination of lenses; spherical and chromatic aberrations; velocity of light, Doppler's principle; optical instruments; emission and absorption spectra; photometry, colour and vision.

Thermal expansion; change of state, hygrometry, transmission of heat; sp. heat of gases; isothermal and adiabatic changes; mechanical equivalent of heat, first law of thermodynamics.

Various types of cells; electrolytic conduction; Ohm's law and Kirchhoff's law; electrical measurements and instruments; thermoelectricity; review of electrostatics and magnetostatics; Gans's theorem and its application.

115. Physics Laboratory I (0-3).

Simple experiments pertaining to subject matter covered in Ph 114.

214. Physics II (3-1).

Flow of liquids and Bernoulli's theorem; surface tension; viscosity; kinetic theory of matter; production and measurement of low pressure.

Equation of state of perfect and real gases; M—B velocity distribution, transport phenomena; thermal conduction and convection; reversible process; Carnot's theorem; entropy and second law of thermodynamics; Maxwell's relations and their applications; theory of radiation.

Wave theory of light-Huyghen's principle; interference and diffraction phenomena; polarisation. Fresnel's theory; Kerr and Faraday effects.

Electromagnetism, electromagnetic induction; Ballistic galvanometer, fluxmeter; L.C.R. circuits, alternating current; dielectric polarisation; Maxwell's electromagnetic induction; magnetic properties of matter,
215. Physics Laboratory II (0-3).

Simple experiments pertaining to subject matter covered in Ph. 214.

314. Atomic and Nuclear Physics (2-0).

Discharge through tubes; measurement of e and e/m of the electrons; thermoionic emission; positive rays and measurement of q/m; isotopes and mass spectroscopy; quantum theory of radiation; photoelectricity; compton scattering; structure of atoms, Hydrogen and Alkali-spectra; Pauli’s exclusion principle, periodic classification of elements theory of sp. heat of solids; dielectric polarisation; dia—, para— and Ferromagnetism, x-rays and crystal structure; qualitative discussion of:—fluorescence and phosphorescence, Zeeman effect, piezoelectricity and ultrasonics, etc; introduction to nuclear physics:—ray spectra, nuclear structure, binding energy, instruments for measurements; Cosmic rays, age determination.

315. Physics Laboratory III (0-3).

Advanced experiments pertaining to subject matter covered in Ph 114 and Ph 214.

414. Physics of Solids (2-0).

Structure of matter, classification of solids and general nature of the properties of different types of solids, molecular forces; crystal lattice, lattice imperfections, dislocations; structure sensitive properties of solids, lattice vibrations; elastic and thermal properties of crystals; an elasticity, plastic flow; internal friction; properties of matter under high pressure; dual aspect of matter, De Broglie’s hypothesis, matter wave, elements of electron diffraction; Schrodinger’s wave equation—one dimensional cases only; elements of solid state physics—electrical properties of matter—conductors and semiconductors; descriptive discussion of the free electron and hand theory of solids, effective mass, positive holes; brief discussion about the metal semiconductor junctions, rectification, transistor action and related phenomena.

(For Geophysicists)

415. Physics Laboratory IV (0-3).

Advanced experiments pertaining to subject matter in Ph 114 and Ph 214.

(For Geophysicists)
PART IV
REGULATIONS

SCHEDULE OF COURSES AND SUBJECTS OF INSTRUCTION
FOR 2-YEAR M.TECH., M. C. P. AND M. R. P. DEGREE
COURSES AND 1-YEAR D. I. I. T. COURSES
Admission to the Postgraduate Courses

(a) Minimum Educational Qualifications:

(i) Master of Technology (M.Tech.) Degree—

A person seeking admission to any of the postgraduate courses in engineering and technology leading to the Degree of Master of Technology must have a Bachelor's Degree in the appropriate branch of engineering and technology and should preferably have industrial or professional experience of one year or have qualifications deemed equivalent by the Senate.

(ii) Master of City Planning (M.C.P.) Degree and Master of Regional Planning (M.R.P.) Degree:

A person seeking admission to any of the two postgraduate courses leading to the Degree of Master of City Planning and the Degree of Master of Regional Planning must have respectively a Bachelor's Degree in Architecture or Civil Engineering; or a Bachelor's degree in Architecture or Civil Engineering or Master's Degree in Economics or Geography or Statistics or Social Sciences, or have qualifications deemed equivalent by the Senate.

(iii) Postgraduate Diploma (D.I.I.T.):

A person seeking admission to any of the postgraduate courses leading to the Postgraduate Diploma (D.I.I.T.) should either have a Master's Degree in the appropriate branch of Science or Arts or a Bachelor's Degree in engineering or technology appropriate to the specialisation on which he wishes to enter upon, or have qualifications deemed equivalent by the Senate.

Minimum educational qualifications for admission to the various postgraduate courses shall be as may be decided by the Senate from time to time; at present for—

A. M.Tech. Degree Courses: in—

(i) Agricultural Engineering (Farm Machinery & Power; Soil & Water Conservation Engineering).

A First Class Bachelor's Degree in Agricultural or Mechanical or Civil Engineering or its equivalent.

(ii) Chemical Engineering (Chemical Engineering Plant Design & Fabrication; Combustion Engineering and Fuel Economy; Petroleum Refinery Engineering & Petrochemicals).

A First Class Bachelor's Degree in Chemical Engineering. For Combustion Engineering & Fuel economy Mechanical Engineering graduates are also eligible.

(iii) Civil Engineering (Advanced Hydraulic Engineering; Harbour Engineering; Highway Engineering; Public Health Engineering; Soil Mechanics & Foundation Engineering; Structural Engineering).

A First Class Bachelor's Degree in Civil Engineering.

(iv) Electrical Engineering (Control System Engineering; Electrical Machines; Power System Engineering).

A First Class Bachelor's Degree in Electrical Engineering. For Control System Engineering, Electrical Communication Engineering graduates are also eligible.

(v) Electronics & Electrical Communication Engineering (Industrial Electronics; Ultra High Frequency & Microwave Engineering).

A First Class Bachelor's Degree in Electronics and Electrical Communication Engineering or its equivalent.

(vi) Mechanical Engineering (Foundry Engineering: Heat Power—with specialisation either in I.C. Engines and Gas Turbines or Refrigeration and Air Conditioning or Steam Power Engineering).
Plant. Industrial Engineering and Operations Research; Machine Design; Mechanical Handling Science and Technology; Mechanism and Vibration; Production Science and Technology).

A First Class Bachelor's degree in Mechanical Engineering. (First Class graduates in Electrical, Electrical Communication, Mining and Metallurgical Engineering of this Institute are also eligible for admission to the Industrial Engineering and Operations Research specialisation. First class graduates in Metallurgical Engineering are also eligible for admission to the Foundry Engineering specialisation).

(vii) Metallurgical Engineering (Physical Metallurgy; Process Metallurgy).

A First Class Bachelor's Degree in Metallurgical Engineering, First Class M.Sc. in Physics or Chemistry with three years' experience in a Metallurgical establishment are also eligible for admission to this course.

(viii) Mineral Engineering.

A First Class Bachelor's Degree in Mining Engineering or its equivalent.

(For admission to the Industry based courses practical or Industrial experience of at least one year is essential).

B. Master of City Planning and Master of Regional Planning courses in—

(i) Master of City Planning: A First Class Bachelor's Degree in Architecture or Civil Engineering.

(ii) Master of Regional Planning: A First Class Bachelor's Degree in Architecture or Civil Engineering, or a First Class Master's Degree in Economics or Geography or Statistics or Social Sciences.

(For admission to these courses professional experience of at least one year is essential).

C. Postgraduate Diploma (D.I.I.T.) Courses in—

(i) Applied Botany: A First Class Master's Degree in Botany or Agriculture or its equivalent.

(ii) Farm Management Technology: A First Class Master's Degree in Agriculture, or Agronomy or Agricultural Economics or its equivalent.

(iii) Soil Technology: A First Class Master's Degree in Agriculture or Soil Science or its equivalent.

(iv) Dairy Engineering: A First Class Bachelor's Degree in Agricultural or Chemical or Electrical or Mechanical Engineering or its equivalent.

(v) Applied Chemistry: (a) High Polymer & Rubber Technology: A First Class Master's Degree in Chemistry or Applied Chemistry, or Bachelor of Science Degree in Chemistry with Physics and Mathematics as subsidiary subjects with considerable experience as Chemist in a Polymer or Rubber industry.

(b) Synthetic Drugs & Fine Chemicals: A First class Master's Degree in Organic Chemistry with Physics and Mathematics as subsidiary subjects in B.Sc. course.

(c) Technical Gas Reactions & High Pressure Technology: A First Class Master's Degree in Physical or Applied Chemistry with Physics and Mathematics as subsidiary subjects in B.Sc. course or a first class Bachelor's Degree in Chemical Engineering.

(vi) Structural Steel Design: A First Class Bachelor's Degree in Civil Engineering.

(vii) Concrete Technology and Design: A First Class Bachelor's Degree in Civil Engineering.
(viii) Electric Traction: A First Class Bachelor’s Degree in Electrical Engineering.

(ix) Applied Geology: A First Class Master of Science Degree in Geology with some field experience.

(x) Exploration Geophysics: A First Class Master of Science Degree in Geophysics or a First Class Master of Science Degree in Physics with at least one year’s research and/or field experience in Exploration Geophysics or a First Class Master of Science Degree in Physics with Geology as one of the subjects in B.Sc. course.

(xi) Geochemistry: A First Class Master of Science Degree in Geology with Mathematics as one of the subjects in B.Sc. course.

(xii) Industrial Psychology & Industrial Relations: A First Class Master’s Degree in Psychology or Industrial Relations or Economics or Sociology or a First Class Bachelor’s Degree in Engineering.

(xiii) Applied Mathematics (Magneto Fluid Dynamics; Non-Linear Mechanics; Plasticity & Rheology): A First Class Master’s Degree in Mathematics or a First Class Bachelor’s Degree in Engineering.

(xiv) Industrial Physics: A First Class Master of Science Degree in Physics or Applied Mathematics or a First Class Bachelor’s Degree in Electrical or Mechanical or Electrical Communication Engineering.

(xv) Planning: A First Class Bachelor’s Degree in Civil Engineering or Architecture.

(b) Age Limit: To be eligible for admission to any of the Postgraduate courses a candidate, on the 1st October of the year of admission, must have completed 20 years of age.

(c) Standard of Physical Fitness: To be eligible for admission to any of these courses a candidate must fulfill the prescribed standard of physical fitness as given below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>1.6 metre</td>
</tr>
<tr>
<td>Weight</td>
<td>46 Kilogram</td>
</tr>
<tr>
<td>Chest Measurement</td>
<td>76 cm. with satisfactory limit of expansion.</td>
</tr>
<tr>
<td>Vision</td>
<td>Better eye 6/9 or 6/9 Corrected 6/12 with glass.</td>
</tr>
</tbody>
</table>

Eyes should be free from congenital or other diseases.

Hearing: Normal.

Good general health and build.

Heart & Lungs: There should be no abnormality.

Hernia, Hydrocele, Varicocele, Piles: Presence of any of these is a temporary disqualification to be rectified before joining.

Opinion of the Institute Medical Officer in regard to fitness of a candidate shall be final and there shall be no appeal.

SCHEDULE XXX

REGULATION NO. 36

Entrance Test for Admission to the Post-graduate Courses

1. A preliminary selection of candidates shall be made by the Admission Committee after scrutiny of applications including mark sheet, Grade card and testimonials, and only those who Prima-facie satisfy the minimum requirements will be called for the entrance test, the scope of which shall be determined by the Admission Committee. The entrance test, written and/or oral, shall be held at the Institute on a date to be fixed by the Senate.

2. Admission to these courses shall be made in order of merit on the results of the entrance test.
SCHEDULE XXXI
REGULATION NO. 37
Courses and Duration

A. Degree of Master of Technology (M.Tech.)

1. The Institute shall provide postgraduate courses leading to the Degree of Master of Technology (M. Tech.) with specialisation in any of or all the branches listed in Schedule xxix (Regulation No. 33) as the Senate may decide from time to time taking into consideration the accommodation, staff position and other facilities available.

2. For persons with adequate academic preparation and requisite industrial and/or professional experience the curricula for the Degree of Master of Technology in the branches listed in Schedule XXIX shall extend over a period of two academic years. The first academic year shall consist of four terms of approximately three months, each, of which the first three terms shall be devoted mainly to course work in lecture classes, laboratory, workshops, field and drawing classes at the Institute: the fourth term of about three months shall be devoted to industrial or professional training either in industry or at the Institute depending on the specialisation. The second academic year shall consist of not less than nine months but ordinarily not more than twelve months during which a student shall devote himself to research or design or project work at the Institute or in an establishment recognised for the purpose, under the guidance of supervisor or supervisors to be appointed by the Head of the Department.

3. A person who, in the opinion of the Admission Committee, needs a preparatory course may be required to spend a preparatory academic session or part thereof and qualify in the prescribed test or tests before he is permitted to enter upon the postgraduate curriculum for the Degree of Master of Technology.

4. A member of the teaching staff of the Institute permitted to enter upon the Postgraduate curriculum on part-time basis shall be required to devote not less than three academic years to qualify for the Degree of Master of Technology.

B. Degree of Master of City Planning (MCP) and Degree of Master of Regional Planning (MRP)

1. The Institute shall provide postgraduate courses leading to the Degree of Master of City Planning (MCP) and the Degree of Master of Regional Planning (MRP) as the Senate may decide from time to time taking into consideration accommodation, staff position, and other facilities available.

2. For a person with adequate academic background and requisite professional experience, the curriculum for the Degree of Master of City Planning and the Degree of Master of Regional Planning shall extend over a period of two academic years. The first academic year shall consist of three terms of approximately three months each of which shall be devoted mainly to course work in the lecture classes, laboratories and studies of the Institute and the fourth term of approximately two months shall be devoted to practical training in a Planning Office. The second academic year shall also consist of four terms, the first two or three terms of approximately three months each shall be devoted mainly to course work in the lecture classes, laboratories and studies of the Institute. During the third and/or the fourth terms, of about three months a student shall devote himself to design or thesis work at the Institute under the guidance of a Supervisor to be appointed by the Head of the Department.

3. A person who, in the opinion of the Admission Committee needs a preparatory course, may be required to spend a preparatory academic session or part thereof and qualify in the prescribed tests before he is permitted to enter upon the curriculum for the Degree of Master of City Planning or the Degree of Master of Regional Planning.

4. A member of the teaching staff of the Institute permitted to enter upon the postgraduate curriculum on a part-time basis, shall be required to devote not less than three academic years to qualify for the Degree of Master of City Planning or the Degree of Master of Regional Planning.

C. Postgraduate Diploma (D.I.I.T.)

1. The Institute shall provide Postgraduate Diploma courses in any of or all the specialised branches mentioned above and those listed in Schedule XXIX (Regulation 33) as may be decided by the Senate from time to time taking into consideration the staff position, accommodation and other facilities available,
2. For a person with adequate academic preparation and requisite industrial and/or practical experience the curriculum for the Postgraduate Diploma course shall extend over a period of one academic year of twelve months consisting of four terms of approximately three months each, of which the first three terms shall be devoted mainly to course work in lecture classes, laboratories, workshops, field and drawing classes at the Institute, while in the fourth term a student shall be required to undergo some practical training in industries or at the Institute as may be prescribed for a particular course and submit a dissertation or a project report and also submit himself to an oral examination.

3. A person who, in the opinion of the Admission Committee, needs a preparatory course may be required to spend a preparatory academic session or part thereof and qualify in the prescribed test/s before he is permitted to enter upon the curriculum for the Postgraduate Diploma.

4. A member of the teaching staff of the Institute permitted to enter upon the curriculum for the Postgraduate Diploma on part-time basis shall be required to devote not less than two academic years of twelve months each to qualify for the Diploma.

SCHEDULE XXXII
REGULATION NO. 38
Graduation Requirement (P.C.)

A. General Regulations:

1. A student shall not be permitted to appear at any of the examinations for the degree of Master of Technology (M.Tech.), or the Degree of Master of City Planning (M.C.P.) or the Degree of Master of Regional Planning (M.R.P.) or the Postgraduate Diploma (D.I.I.T.) unless he has been regular in attendance in all lecture classes, laboratories, guided studies, drawing office, workshop classes, field work, studios or factory training, and he has satisfied the class teachers and he has conducted himself well within and outside the class rooms and he has been regular, diligent and methodical in his studies and has independently and satisfactorily performed the home and sessional assignments and has regularly submitted these for scrutiny by the teachers.

2. A candidate for the Degree of Master of Technology or the Degree of Master of City Planning or the degree of Master of Regional Planning shall be required to qualify for the degree within a period of not more than four years of study at the Institute, provided that a member of the teaching staff of the Institute permitted to undergo the course on a part-time basis may do so within a period of not more than five years.

3. A candidate for the Postgraduate Diploma shall be required to qualify for the Diploma within a period of not more than three years of study at the Institute, provided that a member of the teaching staff of the Institute permitted to undergo the course on a part-time basis may do so within a period not exceeding four years.

B. Degree of Master of Technology:

1. The curriculum for the Degree of Master of Technology shall consist of subjects as set forth in the Schedule for Postgraduate courses. (Schedule XXIX).

2. The scope of the subjects of instruction shall be as detailed in the Schedule for Postgraduate courses. (Schedule XXIX). In each subject of examination there shall be written paper or papers and/or sessional assignments, as prescribed.

3. Each subject carries a certain number of units to indicate the number of contact hours per week, that is, the number of hours per week a student has to spend on it in class, laboratory, etc. under the supervision of a teacher. (Usually, one unit corresponds to one hour of lecture, tutorial or seminar per week or two to four hours of laboratory, field or drawing office per week).

4. A student preparing for the Degree of Master of Technology is expected, during the first academic year, to take up course work of not less than twelve units per term and not more than eighteen units per term during the first three terms. To be eligible for the Degree, a student is, however, required to complete satisfactorily at least 48 units, industrial or professional training during the fourth term of the first academic year being reckoned as 12 units.
While research or project work shall not carry any unit as such the thesis or dissertation shall be graded.

5. A member of the teaching staff of the Institute preparing for the Degree of Master of Technology may not ordinarily be permitted to take more than half the number of units of course work per term as prescribed for a particular course.

6. The Senate shall determine in respect of each subject of study the relative proportion of lecture and/or practical, laboratory work, and shall also determine in respect of several examinations for the Degree, the standard of examination and the conditions for admission thereto.

7. No candidate may present himself for examination in any subject until he has completed the prescribed course of instruction to the satisfaction of the teachers concerned. In the event of unsatisfactory progress and poor performance in an examination a postgraduate student may be required to leave the Institute.

8. The examination for the Degree of Master of Technology shall be taken in five sections comprising three terminal examinations each covering term's work during the first three terms, report on the industrial or professional training during the fourth term of the first academic year and the final thesis and viva-voce examination at the end of the second academic year. The Viva-voce examination shall cover the student's work for the entire course and shall include examination in defence of the thesis and/or Project report or Design work submitted by him.

9. Special Senate instructions specifying the standard of examination shall be kept with the Registry to be available to the Senate and the Board of Examiners only.

10. **Scholastic Requirement.**

The quality of student's work in the various subjects of study shall be determined by a system of grades as given below:

- "A" denotes Excellent
- "B" denotes Good
- "C" denotes Fair
- "F" denotes Failed

The grade "F" in a subject may be removed only by repeating the subject in which case a fresh grade without credit may be awarded. Not only the new grade but also the original grade "F" shall appear in the Grade Card which shows all the subjects taken and the respective grades obtained.

11. A student who has secured the required credit point average in the first academic year shall be eligible to submit (in triplicate) and in the approved for his thesis on the research, or design or project work carried out during the second academic year on a date to be fixed by the Senate. The thesis shall be examined separately by the Supervisor and the Additional examiner to be appointed by the Senate. Both the examiners shall be required to report separately on the thesis and forward their recommendation to the Registry which shall place the reports before the Board of Examiners. The Head of the Department, the Additional examiner and the supervisor(s) shall constitute the viva-voce Board which should include one or two other teachers also. The Board shall test the depth and breadth of knowledge of the candidate in the special field and also in the allied field of study and grade the quality of the thesis or Design or project report and performance of the candidate in the viva-voce examination, and make recommendation to the Board of Examiners. A candidate whose thesis has been found to be unsatisfactory by the Additional examiner will not normally be eligible to appear at the viva-voce examination. In the event of a thesis or Design or Project report being found unsatisfactory the candidate shall be required to resubmit the work after due modification along the line of criticism made by the examiner within a time limit as may be fixed by the Senate.

12. A student securing requisite average credit in the course work, industrial/professional training report, thesis and viva-voce examination shall be deemed to have qualified for the Degree of Master of Technology.

13. A candidate shall be deemed to have passed the Master of Technology Degree Examination provided he has secured on the total of the three terminal examinations the requisite minimum standard in each of the written papers and sessional assignments, on the industrial or professional training report, and in the thesis design examination and in the viva-voce examination, and secured the minimum credit point average.
14. Subject to the provisions of the Ordinances and Regulations the Degree of Master of Technology (M. Tech.) shall be conferred on candidates who have studied on the prescribed curriculum for not less than two academic years, the subjects as set forth in Schedule XXXIII and have reached the minimum standard in the examination in one of the subjects listed in Schedule XXIX.

15. For the Degree of Master of Technology the graduate shall receive a Diploma wherein shall be set forth the branch and the subject of specialisation in respect of which the Degree has been awarded.

16. A student failing to secure the minimum credit point average on the overall total of the first three terms may be allowed to repeat in part or in full as may be decided by the Senate. In the event of a student failing to secure the minimum credit on the Industrial or professional training in the fourth term he shall be required to undergo further industrial or professional training during the next academic year.

17. A student who has been admitted to the Master of Technology Degree course but decides to proceed instead, to the Postgraduate Diploma course or has been found, in the opinion of the Head of the Department, more suitable for the Postgraduate Diploma course rather than for the Master of Technology Degree course, would be required to submit a formal application for permission to take the Postgraduate Diploma course. Ordinarily, such applications should be made at the beginning of the third term. If the application for the change is granted then the student shall be assigned a project work for the fourth term and he shall be required at the end of the first academic year to submit a dissertation on his project work and submit himself to an oral examination for the Postgraduate Diploma in the subject of his specialisation.

18. The Senate shall be competent, on the recommendations of the Board of Examiners, to deviate from the prescribed Ordinances and Regulations relating to the examination and consider special cases of students not covered by the Ordinances and Regulations subject to the approval of the Board of Governors.

C. Degree of Master of City Planning and Degree of Master of Regional Planning:

1. The curriculum for the Degree of Master of City Planning and the Degree of Master of Regional Planning shall consist of subjects as set forth in Schedule XXXIII.

2. The scope of the subjects of instruction shall be as detailed in Schedule XXXIII. In each subject for examination there shall be written paper or papers and/or sessional assignments as prescribed.

3. Each subject carries a certain number of units to indicate the number of hours a student spends on it under the supervision of a teacher. (Usually one unit corresponds to one hour of lecture, tutorial or seminar per week, or two to four hours of laboratory or studio work per week).

4. A student preparing for the Degree is expected to take up a minimum of 10 units of work per term and normally not more than 18 units. To be eligible for the Degree a student is required to complete satisfactorily at least 90 units, of which about 10 units shall be counted towards Thesis or Design including Viva-voce examination.

5. A member of the teaching staff of the Institute preparing for any of the Degrees may not ordinarily be permitted to take more than half the number of units of course work per term as prescribed for a particular course.

6. The examinations for the Degree of Master of City Planning and the Degree of Master of Regional Planning shall be taken in eight sections comprising three terminal examinations each covering the term’s work in each of the two academic years, the report on the practical training in the fourth term of the first academic year, and the final thesis or design a. 4 Viva-voce examination. The Viva-voce examination shall cover the students’ work for the entire course and shall include examination in defence of the thesis or design work submitted by him.

7. Other relevant Regulations for the Degree of Master of Technology shall, in general, apply to these Degree courses also.
D. Postgraduate Diploma (D.I.T.)

1. The curriculum for the Postgraduate Diploma (D.I.T.) shall consist of subjects as set forth in the Schedule for Postgraduate Diploma courses (Schedule XXIX) each of which shall be studied by attendance in lectures, tutorials, seminars, laboratory, drawing office, field work and workshop classes, as prescribed in the Schedule. In addition, each candidate shall be required to submit in duplicate, for examination in the prescribed form a dissertation and/or a project report on a problem that will be assigned to him not later than in the second term by the Head of the Department. He may, in the preparation of the dissertation and/or project work, take guidance from the supervisor who shall be appointed for the purpose by the Head of the Department.

2. The scope of the subjects of instruction shall be as detailed in Schedule for Postgraduate Diploma courses (Schedule XXIX). In each subject for examination there shall be written paper or papers and/or sessional assignments, as prescribed.

3. Each subject carries a certain number of units to indicate the number of hours per week a student spends on it under the supervision of the teacher. (Usually, one unit corresponds to one hour of lecture, tutorial, or seminar per week; or, two to four hours of laboratory, field or studio work per week).

4. A student preparing for the Postgraduate Diploma is expected to take up a minimum of 12 units of work per term and, normally, not more than 18 units. To be eligible for the Diploma, a student is required to complete satisfactorily at least 48 units of which a minimum of 12 units can be counted towards dissertation or project report including Viva-voce examination.

Students preparing for the Postgraduate Diploma in Applied Geology, Exploration Geophysics and Geochemistry are expected to take up a minimum of 24 units of course work. The balance should be on field work, project report or dissertation and Viva-voce Examination.

5. A member of the teaching staff of the Institute preparing for the Postgraduate Diploma (D.I.T.) may not ordinarily be permitted to take more than half the number of units of course work per term as prescribed for a particular course.

6. The examination for the Postgraduate Diploma shall be taken in four sections comprising three terminal examinations each covering the term's work and the final dissertation and Viva-voce examination. The Viva-voce examination shall cover the student's work for the entire session and shall include examination in defence of his dissertation and/or field or project report submitted by him.

7. Other relevant Regulations for the Degree of Master of Technology shall, in general, apply to the Postgraduate Diploma courses also.
SCHEDULE XXXIII
REGULATION NO. 39

Schedule of Courses for M.Tech, M.C.P., M.R.P. and
D.I.I.T. Courses

AGRICULTURAL ENGINEERING (AgE)

The Department of Agricultural Engineering offers a postgraduate course of two-year duration leading to the degree of Master of Technology in Agricultural Engineering with specialisations in (a) Farm Machinery and Power; (b) Soil and Water Conservation Engineering.

The Department also offers postgraduate courses of one-year duration leading to the Diploma of Indian Institute of Technology (D.I.I.T.) in the following fields: (c) Applied Botany; (d) Dairy Engineering; (e) Farm Management Technology; (f) Soil Technology.

A. Course work for the M.Tech. degree course.

Common subjects for both the specialisations.

<table>
<thead>
<tr>
<th>FIRST YEAR</th>
<th></th>
<th>Units per Term</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subject No.</td>
<td>1st</td>
</tr>
<tr>
<td>AgE 601</td>
<td>Dimensional Analysis</td>
<td>...</td>
</tr>
<tr>
<td>AgE 623</td>
<td>Irrigation Equipment Design</td>
<td>...</td>
</tr>
<tr>
<td>AgE 667</td>
<td>Soil Physics for Agr. Engineers</td>
<td>...</td>
</tr>
<tr>
<td>AgE 693</td>
<td>Seminar</td>
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</tr>
<tr>
<td>Ma 684</td>
<td>Vector Analysis and Matrices</td>
<td>...</td>
</tr>
<tr>
<td>Ma 685</td>
<td>Theory of Complex Variables</td>
<td>...</td>
</tr>
<tr>
<td>Ma 686</td>
<td>Ordinary and Partial Differential Equations</td>
<td>...</td>
</tr>
<tr>
<td>Ma 687</td>
<td>Operational Methods</td>
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SECOND YEAR

<table>
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<tr>
<th></th>
<th>Units per Term</th>
</tr>
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<tbody>
<tr>
<td>AgE 641</td>
<td></td>
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<tr>
<td>AgE 642</td>
<td></td>
</tr>
<tr>
<td>AgE 693</td>
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<td>Ma 641</td>
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<tr>
<td>Ma 644</td>
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<tr>
<td>Thesis/Project</td>
<td>9 to 12 months.</td>
</tr>
</tbody>
</table>
### (a) For Farm Machinery and Power specialization

<table>
<thead>
<tr>
<th>Subject</th>
<th>No.</th>
<th>Subject</th>
<th>Units per term</th>
</tr>
</thead>
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<tr>
<td></td>
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<td></td>
<td>1st</td>
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<tr>
<td>AgE</td>
<td>611</td>
<td>Advanced Farm Power</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>612</td>
<td>Farm Machinery Design</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>613</td>
<td>Farm Machinery Testing</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>614</td>
<td>Agricultural Process Equipment Design</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>615</td>
<td>Dairy Engineering</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>616</td>
<td>Tractor Design Principles</td>
<td>...</td>
</tr>
<tr>
<td>ME</td>
<td>6681</td>
<td>Analysis of Stresses</td>
<td>...</td>
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<tr>
<td>ME</td>
<td>6271</td>
<td>Production Engineering I &amp; II</td>
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<td>ME</td>
<td>6281</td>
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<td>6191</td>
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<tr>
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</tr>
<tr>
<td></td>
<td></td>
<td>*Special Topics</td>
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<tr>
<td></td>
<td></td>
<td><em>(Units to be arranged)</em></td>
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</tr>
<tr>
<td>AgE</td>
<td>692</td>
<td>Design and Testing Project</td>
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<td></td>
<td></td>
<td><em>Industrial Training—12 units in the fourth term.</em></td>
<td></td>
</tr>
</tbody>
</table>

### (b) For Soil and Water Conservation Engineering specialization

<table>
<thead>
<tr>
<th>Subject</th>
<th>No.</th>
<th>Subject</th>
<th>Units per term</th>
</tr>
</thead>
<tbody>
<tr>
<td>AgE</td>
<td>621</td>
<td>Soil Conservation Structures Design</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>622</td>
<td>Irrigation Engineering</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>624</td>
<td>Head Water Hydrology for conservation</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>625</td>
<td>Upstream Flood control</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>626</td>
<td>Conservation Planning in River Valley Projects</td>
<td>...</td>
</tr>
<tr>
<td>AgE</td>
<td>627</td>
<td>Farm Drainage Systems Design</td>
<td>...</td>
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<tr>
<td>AgE</td>
<td>678</td>
<td>Agronomy, Forestry and Agrobiology in Soil Conservation</td>
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<tr>
<td>AgE</td>
<td>679</td>
<td>Arid Zone Conservation</td>
<td>...</td>
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<tr>
<td>CE</td>
<td>621</td>
<td>Fluid Mechanics I</td>
<td>...</td>
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<tr>
<td>CE</td>
<td>609</td>
<td>Soil Mechanics and Foundation Engg. I.</td>
<td>...</td>
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<tr>
<td>CE</td>
<td>626</td>
<td>Dams and Dam Construction III</td>
<td>...</td>
</tr>
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<td></td>
<td></td>
<td>*Special Topics</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(Units to be arranged)</em></td>
<td></td>
</tr>
<tr>
<td>AgE</td>
<td>692</td>
<td>Design and Testing Projects</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Industrial Training—12 units in the fourth term.</em></td>
<td></td>
</tr>
</tbody>
</table>
B. Course work for Postgraduate Diploma Courses in Applied Botany, Dairy Engineering, Farm Management Technology and Soil Technology

**c) Applied Botany**

<table>
<thead>
<tr>
<th>Subject</th>
<th>No.</th>
<th>Subject</th>
<th>Units per term</th>
</tr>
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<tr>
<td></td>
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<tr>
<td>AgE</td>
<td>651</td>
<td>Genetics</td>
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<td>AgE</td>
<td>652</td>
<td>Plant Breeding</td>
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<td>AgE</td>
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<td>Plant Breeding Laboratory</td>
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<td>AgE</td>
<td>654</td>
<td>Cytogenetics</td>
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**d) Dairy Engineering**

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**Special Topics (Units to be arranged)**

**Fourth Term**

Industrial training for 3 months—12 units.


### (e) Farm Management Technology

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*Special Topics

(Units to be arranged)

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12-16 units in fourth term.

### (f) Soil Technology

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* C. Special Topics (Units to be arranged) |

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<td>Farm Power Analysis</td>
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ARCHITECTURE AND REGIONAL PLANNING (Ar)

The department offers two-year Postgraduate Courses leading to the degree of Master of City Planning (M.C.P.) and the degree of Master of Regional Planning (M.R.P.).

FIRST YEAR
(Common to both the courses)

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<td>Ar 603</td>
<td>Transportation I</td>
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Intenship in a Planning Office—Summer Term (2 months)—3 units.

(a) For Master of City Planning Course only

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<td>Transportation—II</td>
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(b) For Master of Regional Planning Course only

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SECOND YEAR
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*Elective Subjects

- Ar 715 Demography
- Ar 716 Aerial Photogrammetry
- Ar 717 Village Development

(a) For Master of City Planning Course only

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**Elective (any one)                |                |

**Elective Subjects

- Ar 718 Urban Renewal
- Ar 719 Town Design
- Ar 720 Metropolitan Area Planning
- Ar 721 Regional Planning
- Ar 722 Planning Legislation

Thesis (Summer Term)                | 10 units

(b) For Master of Regional Planning Course only

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Thesis (Summer Term)                | 10 units
APPLIED CHEMISTRY (Ch)

The Department offers one-year Postgraduate course leading to the Postgraduate Diploma (D.I.I.T.) with following specialisations.

(A) High Polymer and Rubber Technology
(B) Synthetic Drugs and fine chemicals
(C) Technical Gas Reaction and High Pressure Technology

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Factory Training/Research/Project Report—Units to be arranged—Fourth term.
(B) Synthetic Drugs and Fine Chemicals

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Factory Training/Research/Project Reoprt—Units to be arranged—Fourth term.

(C) Technical Gas Reactions and High Pressure Technology

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*Elective Subjects

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Factory Training/Research/Project Report—Units to be arranged—Fourth term.
**CHEMICAL ENGINEERING (ChE)**

The Department of Chemical Engineering offers postgraduate course of 2-year duration leading to the degree of Master of Technology (M.Tech.) in Chemical Engineering with specialisation in:

(a) Chemical Engineering Plant Design and Fabrication;
(b) Combustion Engineering and Fuel Economy;
(c) Petroleum Refinery Engineering and Petro-chemicals.

Common for all specialisations.

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**Total** | 12   | 10   | 10   |

**Note:** Mechanical Engineering graduates taking up “Combustion Engineering and Fuel Economy” specialization shall be required to take ME 668 Analysis of stresses 3 units in the 1st term in place of ChE 604, Chemical Engineering Science III (Mass Transfer), and one of the following subjects—4 units in the 3rd term—in place of ChE 612, “Advanced Applied kinetics and Reactor Design”:

- ME 6431—Gas Turbines and Compressors.
- ME 6432—Internal Combustion Engines.
- ME 6436—Steam Turbines.
- ME 6438—Nuclear Power Station.
(a) For Chemical Engineering Plant Design & Fabrication specialization:

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(b) For Combustion Engineering & Fuel Economy specialization:

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(c) For Petroleum Refinery Engineering and Petrochemicals specialization:

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295
CIVIL ENGINEERING

The Department offers 2-year Postgraduate Course leading to the degree of Master of Technology with following specializations:

(A) Structural Engineering,
(B) Advanced Hydraulic Engineering,
(C) Soil Mechanics and Foundation Engineering,
(D) Highway Engineering,
(E) Public Health Engineering,
(F) Harbour Engineering.

(a) Structural Engineering

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296
(b) Advanced Hydraulic Engineering

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**Total**

| 12 | 12 | 12 |

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### Electives

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<td>Dams and Dam Construction III</td>
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(f) Harbour Engineering

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<td>CE</td>
<td>682 Wind Waves and Tides</td>
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<td>Gr</td>
<td>661 Introduction to Physical Oceanography</td>
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<td>614 Engineering Mathematics</td>
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<td>622 Fluid Mechanics II</td>
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<td>644 Statistical Methods in Engineering</td>
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<td>Ph</td>
<td>691 Physical Measurements</td>
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<td>Ma</td>
<td>647 Computational Techniques</td>
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In addition, the department also offers 1-Year Postgraduate courses in (A), Structural Steel Design (B), Concrete Technology and Design leading to Postgraduate Diploma (D.I.T.)

(a) Structural Steel Design

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| CE 601     | Advanced Theory of Structures        | ...            | ...   | ...   | ...   |
| CE 602     | Advanced Strength of Materials       | ...            | ...   | ...   | ...   |
| CE 603     | Stability of Structures              | ...            | ...   | ...   | ...   |
| CE 607     | Steel Design I                       | ...            | ...   | ...   | ...   |
| CE 608     | Steel Design II                      | ...            | ...   | ...   | ...   |
| CE 615     | Bridge Engineering I                 | ...            | ...   | ...   | ...   |
| CE 617     | Bridge Engineering III               | ...            | ...   | ...   | ...   |
| CE 618     | Advanced Structural Analysis         | ...            | ...   | ...   | ...   |
| CE 619     | Industrial Building                  | ...            | ...   | ...   | ...   |
| CE 671     | Structural Design and Drawing I      | ...            | ...   | ...   | ...   |
| CE 672     | Structural Design and Drawing II     | ...            | ...   | ...   | ...   |
| Ma 614     | Engineering Mathematics              | ...            | ...   | ...   | ...   |
|            |                                      |                |       |       |       |
|            |                                      |                | 8     | 10    | 8     |

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| CE 605     | Concrete Technology              | ...            | ...   | ...   | ...   |
| CE 609     | Soil Mechanics and Foundation Engineering I | ... | 3     | ...   | ...   |
| CE 610     | Soil Mechanics and Foundation Engineering II | ... | ...   | ...   | ...   |
| CE 613     | Shell Structures I               | ...            | ...   | ...   | ...   |
| CE 614     | Shell Structures II              | ...            | ...   | ...   | ...   |
| CE 651     | Design of Highways I             | ...            | ...   | 2     | ...   |
| CE 652     | Design of Highways II            | ...            | ...   | 2     | ...   |
| Ma 644     | Statistical Method in Engineering| ...            | ...   | ...   | 2     |
(b) Concrete Technology and Design

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304

ELECTRICAL ENGINEERING

The department offers 2-year Postgraduate course in Electrical Engineering leading to the degree of Master of Technology (M.Tech) with the following specialisations:

(a) Electrical Machines.
(b) Control System Engineering
(c) Power System Engineering.

FIRST YEAR

(a) Electrical Machines

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Total ... 17 17 17

Industrial Training during Fourth Term—12 units.

FIRST YEAR

(b) Control System Engineering

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<td>Control System Components</td>
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<td>Electronic Circuits and Applications</td>
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Total ... 16 18 16

Industrial Training during Fourth Term—12 units.

### FIRST YEAR

#### (c) Power System Engineering

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| Total       | 18 17 17                         |

Industrial Training during Fourth term—12 units.

The department also offers one-year Postgraduate course leading to the Postgraduate Diploma (D.I.I.T.) in “Electric Traction”.

### Electric Traction

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| Total       | 16 16 16                         |

Project work during Fourth term—12 units.
306

ELECTRONICS AND ELECTRICAL COMMUNICATION ENGINEERING

The Department of Electronics and Electrical Communication Engineering offers a 2-year Postgraduate course leading to the degree of Master of Technology in Electronics and Electrical Communication Engineering with specializations in

(a) Industrial Electronics.
(b) Ultra High Frequency and Microwave Engineering.

FIRST YEAR

<table>
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<td>Physics of Materials</td>
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<td>Network Synthesis</td>
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<td>Theory of Communication Systems</td>
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<td>Gas Discharge and Plasma</td>
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<td>Comm 613</td>
<td>Switching and computation</td>
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<td>Comm 617</td>
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<td>Pulse Techniques</td>
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*Elective Subjects

Industrial Training — about 3 months (Fourth term).
SECOND YEAR
Research and/or Design work — 9 to 12 months.

**Geology and Geophysics**

The Department of Geology and Geophysics offers the following one-year Postgraduate Courses leading to the Postgraduate Diploma (D.I.T.).

(a) Applied Geology.
(b) Exploration Geophysics.
(c) Geochemistry.

(a) **Applied Geology**

A student is required to take a minimum of 48 units(*) of which not less than 24 units should be devoted to course work and not less than 12 units to field, project and thesis work.

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<td>Ge 611</td>
<td>Advanced Sedimentation</td>
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<td>Selected Topics in Precambrian Stratigraphy</td>
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<td>Ge 630</td>
<td>Selected Topics in Ore Deposition</td>
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<td>Ge 632</td>
<td>Studies in Metallic and Non-metallic deposits</td>
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<td>Ge 633</td>
<td>Subsurface Geologic Methods</td>
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<td>Ge 634</td>
<td>Coal Geology</td>
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<td>Petroleum Geology</td>
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<td>Ge 636</td>
<td>Selected Topics in Exploration and Prospecting Methods and Mining Geology</td>
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<td>Ge 637</td>
<td>Selected Studies in Groundwater Geology</td>
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<td>Ge 638</td>
<td>Selected Studies in Engineering Geology</td>
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<td>Ge 640</td>
<td>Selected Topics in Post-Precambrian Stratigraphy</td>
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<td>Ge 678</td>
<td>Reservoir Geophysics</td>
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*Students may have to take some pre-requisites, without credit, if necessary.
(b) **Exploration Geophysics**

A student is required to take a minimum of 48 units of which not less than 24 units should be devoted to course work and not less than 12 units to field, project and thesis work. The student may have to take some pre-requisites, without credit, if necessary.

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<td>Petroleum Geology</td>
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<td>Theoretical Geophysics (selected topics)</td>
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<td>Physics of Solids</td>
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<td>Analysis and Interpretation of Geophysical Data</td>
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<td>Ge 685</td>
<td>Exploration Planning and Case Histories</td>
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<td>Geophysical Instrumentation</td>
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<td>Research and Thesis</td>
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</table>
(c) **Geochemistry**

A student is required to take a minimum of 48 units of which not less than 24 units should be devoted to course work and not less than 12 units to field, project and thesis work.

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<th>Subject</th>
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<td>X-ray Crystallography (Theory and Laboratory)</td>
<td>... 4</td>
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<td>Ge 615</td>
<td>Introductory Geochemistry</td>
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<td>Ge 616</td>
<td>Theoretical Petrology</td>
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<td>Ge 617</td>
<td>Geochemistry I</td>
<td>... 3</td>
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<td>Ge 618</td>
<td>Geochemistry II</td>
<td>... 3-4</td>
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<td>Inorganic Chemistry for Geochemists</td>
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<td>Ge 627</td>
<td>Physical Chemistry for Geochemists</td>
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<td>Ge 628</td>
<td>Analytical Chemistry for Geochemists (mainly laboratory)</td>
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<td>Studies in Metallic and Non-metallic Mineral Deposits</td>
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<td>Ge 635A</td>
<td>Geology and Geochemistry of Petroleum</td>
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<td>Ge 636A</td>
<td>Geological Prospecting</td>
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<td>Geochemical Prospecting (field and laboratory)</td>
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HUMANITIES & SOCIAL SCIENCES

The Department offers one-year Postgraduate Course leading to the Postgraduate Diploma in Industrial Psychology and Industrial Relations.

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<td>602</td>
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<td>603</td>
<td>Psychology of Industrial Relations</td>
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<td>604</td>
<td>Social Psychology (Group Dynamics)</td>
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<td>Selection and Placement of Personnel</td>
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<td>606</td>
<td>Physiology of Work</td>
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<td>Hu</td>
<td>607</td>
<td>Labour Movement and Labour Organisation</td>
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<td>608</td>
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<td>609</td>
<td>Consumer Research and Mass Media</td>
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<td>610</td>
<td>Government Labour Policy and Labour Legislation in India</td>
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<td>611</td>
<td>Research Methodology</td>
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<td>612</td>
<td>Personnel Administration</td>
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<td>Labour Welfare and Social Security</td>
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<td>615</td>
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MATHEMATICS

The Department offers a one-year Postgraduate course in Mathematics leading to the Postgraduate Diploma (D.I.I.T.) with the following specializations:

(a) Non-linear Mechanics.
(b) Plasticity and Rheology.
(c) Magnetofluiddynamics.

(Common to all specializations)

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<td>641</td>
<td>Numerical Methods and High Speed Computation</td>
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<td>Theory of Probability and Statistical Methods</td>
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<td>612</td>
<td>Mechanics of Continuous Media</td>
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<td>ME</td>
<td>6572</td>
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### A (For Non-linear Mechanics specialization)

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<td>Transition theory in continuous media</td>
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<td>Ma</td>
<td>619</td>
<td>Non-linear vibrations and Gyrostatics</td>
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<td>680</td>
<td>Theory of Shells and Plates</td>
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**Total**...14 12 16

### B. (For Plasticity and Rheology specialization)

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**Total**...14 12 16

### C. (For Magnetofluidodynamics specialization)

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<td>Selected topics from Magnetofluid dynamics</td>
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<td>Ma</td>
<td>630</td>
<td>Theory of Hydromagnetic stability and Wave Motion</td>
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<td>Ma</td>
<td>632</td>
<td>Plasma Dynamics and Relativistic fluid dynamics</td>
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<td>Mechanics of Continuous Media (Gas Dynamics)</td>
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**Total**...14 12 16

Seminar, Dissertation and *Viva-voce* (Fourth Term) ... 14
312

MECHANICAL ENGINEERING

The Department offers 2-year Postgraduate course leading to the Degree of Master of Technology with following specialisations:

(a) Foundry Engineering.
(b) Heat Power with specialisation either in I. C. Engines and Gas Turbines or Refrigeration and Air Conditioning or Steam Power Plants.
(c) Industrial Engineering and Operations Research.
(d) Machine Design.
(e) Mechanical Handling Science and Technology.
(f) Mechanism and Vibration.
(g) Production Science and Technology.

(a) Foundry Engineering

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<td>Chemistry of Sands, Clays and Binders</td>
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*For graduates in Metallurgical Engineering ME 6512—Machine Element Design (4 units) instead of Met/Ph 622.

(b) Heat Power

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METALLURGICAL ENGINEERING (Met)

The Department of Metallurgical Engineering offers a 2-year Postgraduate course leading to the degree of Master of Technology in Metallurgical Engineering with specialisation in—
(a) Physical Metallurgy.
(b) Process Metallurgy.

FIRST YEAR

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Electives subjects as per specialisation
Industrial training (4th term)
8-12 units per term
12 units

SECOND YEAR

Thesis work 9-12 months

List of Elective subjects for Physical and Process groups

| Met 603   | Ferroalloy production               | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 604   | Plant layout and Furnace design     | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 605   | Recent trends in Ferrous Metallurgy | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 606   | Pyrometallurgy of Non-ferrous metals| ...   | ...   | ...   | 2    | 2    | 2    |
| Met 607   | Hydrometallurgy and Electrometallurgy| ...   | ...   | ...   | 2    | 2    | 2    |
| Met 608   | Recent advances in Non-ferrous Metallurgy| ...   | ...   | ...   | 2    | 2    | 2    |
| Met 609   | Physical Metallurgy                 | ...   | ...   | ...   | 3    | 3    | 3    |
| Met 610   | X-Ray Metallography and Electron diffraction| ...   | ...   | ...   | 3    | 3    | 3    |
| Met 611   | Physics of Metals                   | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 612   | Dislocation theory and mechanism of plastic flow | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 613   | Magnetic materials                  | ...   | ...   | ...   | ...  | ...  |
| Met 614   | High temperature materials          | ...   | ...   | ...   | 1    | 1    | 1    |
| Met 615   | Mechanical working of metals-theory and applications | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 616   | Powder Metallurgy                   | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 617   | Diffusion in metals                 | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 618   | Advanced Phase diagrams             | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 619   | Theory of Metallurgical Processes   | ...   | ...   | ...   | 3    | 3    | 3    |
| Met 620   | Metallurgy of rare metals and Atomic Energy metals | ...   | ...   | ...   | 2    | 2    | 2    |
| Met 621   | Foundry Science and Engineering     | ...   | ...   | ...   | 3    | 3    | 3    |
| Met 625   | Corrosion                           | ...   | ...   | ...   | ...  | 2    | 2    |
| Ph 692    | Quantum Mechanics                   | ...   | ...   | ...   | 2    | 2    | 2    |
MINING ENGINEERING (Min.)

The Department offers a Two-year Postgraduate course leading to the degree of Master of Technology (M.Tech.) in Mineral Engineering.

FIRST YEAR

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Industrial Training | ... | ... | (Fourth Term)

SECOND YEAR

Research/Project Work | ... | ... | 9 to 12 months
PHYSICS AND METEOROLOGY (Ph.)

The Department of Physics and Meteorology offers one-year Postgraduate Course leading to the Postgraduate Diploma (D.I.I.T.) in Industrial Physics.

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<td>Theory of Probability and Statistical Methods</td>
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<td>Nuclear Radiation and their applications</td>
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<td>Imperfections in Solids</td>
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<td>Special topics in Crystal Physics</td>
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<td>Quantum Mechanics III</td>
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Project or Thesis—Units to be arranged (Fourth Term).
SCHEDULE XXXIV
REGULATION NO. 40


AGRICULTURAL ENGINEERING (AgE)

601. Dimensional Analysis in Agricultural Engineering 2 units (2-0), First Term.


602. Instrumentation and Measurements 2 units (1-3) Second term.

Requirements of an optimum measurement system. Elementary description of commonly used transducers and terminating devices. Principles of design of instrumentation for research.

Selection, maintenance and use of the common instruments used for measurement of length, mass, force, pressure, fluid flow, temperature, humidity rainfall, soil properties and runoff.

603. Techniques of Research 2 units (1-3) Third term.

Experimental error and uncertainty. Test sequence. Checking and rejection of data. Reduction of variables. Data analysis and presentation.

604. Agricultural Land Development 2 unit (2-0) First term.

Jungle clearing; rooting; rough levelling, land grading, levelling. Bund construction, road layout, irrigation and drainage channels, fencing, farm buildings, water resources. Selection of farm machinery and power in relation to type of job for land development. Economic of the operation for land development.

605. Farm Survey and Drafting 2 units (0-6); First and Second terms.


Sketching and elements of engineering drawing.

606. Mechanical Properties of Soils 2 units (2-0), Third term.


607. Soil Conservation 2 units (2-0); Second Term.


608. Irrigation and Drainage 2 units (2-0), Third Term.

609. Farm Power and Machinery Management 2 units (1-3).

Comparative study of tractors, engines, electric motors and animals as sources of farm power. Types of prime movers available in the market. Principles of operation, troubles, repairs, maintenance and adjustments of engines, tractors and electric motors. Elementary study of wind and water power.

Role of farm machinery in increasing production per capita, production per hectare and reduction of cost of production. Classification of farm machinery. Power and energy requirements of farm machinery. Operation troubles, repairs and maintenance and adjustments of common implements and machines available for mechanised farming.

Workshop requirements for a mechanised farm. Study of basic workshop operation and mechanical tools. Specialised workshop equipment needed for common repairs done on tractors, engines and farm machinery. Workshop management.

610. Farm Produce Storage : 2 units (2-0) Second Term.

Loss in storage, causes, detection and control of infestation. Modern construction of storage structures, modern methods of handling stores, moisture control, disinfection and preservation. Comparative studies of economics of farm and central storage structures.

611. Advanced Farm Power 2 units (2-0) First and Third Term.


612. Farm Machinery Design. 3 units (2-3), First and third Terms, 2 units (1-3) Second Term.

Basic principles of design of machines, implements and tools. Performance design of Farm Machinery. Principles of kinematics and theory of machines as applied to Farm Machinery. Design of various machine parts for strength and wear. Selection of materials and manufacturing processes for economic manufacture of Farm Machinery. Design office practice.

613. Farm Machinery Testing : 2 units (1-3), Second Term.


614. Agricultural Process Equipment Design : 2 units (2-0) First Term.

Basic physical and engineering principles involved in processing and handling of agricultural materials. Short, long and medium distance transfer. Horizontal and vertical movement. Size reduction, cleaning and sorting, grading, mixing, pelleting, metering, drying, heating, cooling, threshing, winnowing, crushing. Description and design of important processing and transport equipment. Application of time motion study to agricultural processing and transport. Cost analysis.

615. Dairy Engineering. 2 units (2-0), Third Term.

Physical and chemical properties of milk and milk products. Description, operation, use, selection, installation and maintenance of equipment used in dairies. Electric motors, pumps, pipes and fittings, boilers, refrigerators and cold storage, pasteurizers, homogenizers, evaporting and drying equipment, can-washing and sterilizing equipment. Bottle cleaning and bottle equipment. Ice cream freezers, Cream separators, butter, cheese making equipment.
616. Tractor Design Principles. 2 units (2-0), Third Term.
Thermodynamic and mechanical design of tractor engines. Considerations in selection of engines for various types of tractors. Principles of design of transmission, chassis, steering, hitches, and controls.

617. Farm Machine Analysis. 3 units. One Term.
Detailed theoretical and practical analysis of physical phenomena such as tillage, fertilizer application, puddling, threshing, harvesting, farm product processing and of farm machines from design and operation standpoints. Research trends in Farm Machinery.

618. Farm Power Analysis. 3 units. One Term.
Detailed theoretical and practical design and operation analysis of farm power units. Research trends in farm power.

621. Soil Conservation Structures Design. 2 units (1-3).
Biological and mechanical control measures. Types of temporary and permanent gulley control structures, their function and adaptability for soil and water conservation purposes in India. Hydrologic, hydraulic and structural aspects of design of structures, surplussing arrangements and outlets for bund and terrace systems.

622. Irrigation Engineering. 3 units (2-3) First and Second Terms.

623. Irrigation Equipment Design. 2 units (2-0) Third Term.
Water lifts operated by human and animal power. Design of don, Persian wheel and chain pump.


624. Headwater Hydrology for Conservation. 2 units (1-3) First Term.
Precipitation: intensity, duration, distribution and frequency of typical storms. Analysis of storm data at a point and in an area.

Runoff: as a function of precipitation, infiltration, evaporation, surface detention and storage. Analysis and synthesis of runoff hydrograph by unit graph theory as applied to small watersheds. Limitations of unit graph theory and practice.

Flood Routing: the simplified equation, flood routing through reservoirs and retarding basins. Theoretical and graphical methods. Special problems in soil conservation work.

625. Upstream Flood Control: 2 units (1-3) Second Term.

626. Conservation Planning in River Valley Projects. 2 units (2-0) Third term.

627. Farm Drainage Systems Design. 3 units (2-3), Third Term.

Movement of water in soil. Physics of land drainage. Theory and design of surface and sub-surface farm drainage systems.

628. Micromeritics. 3 units. One Term.

Particle shape, structure, magnitude and measurement, specific surface. Area and activity relationships, behaviour of particles in fluids, lyophobic and lyophilic colloid behaviour, electrokinetic and electrostatic phenomena. Dynamics of small particles, size distribution, microscopic, sedimentation, elutriation, centrifugal, dialytic, ultrafiltration and sieving methods for size analysis. Diffusion of particles, surface properties chemical, optical sonic, and electrical properties of particles. Suspensions, gels, viscosity, plasticity and rigidity properties of two, and three-phase mixtures, Theories of fine grinding, homogenising and crushing. Transport theories of particles in fluids, flow through packings; behaviour of particulate mixture under pressure, sampling and separation of particulate matter from fluid streams.

629. Advanced Theory of Flow of Water in Soils. 3 units One Term.


Unsaturated flow: Recent advances in theories of unsaturated flow problems. Klute’s equation, Phillip’s equation. Comparison of diffusion type equations with hydraulic equations.


631. Dairy Plant Equipment 3 units (2-3) First and Second Terms.

Metals for dairy equipment: principles of operation, construction and maintenance of dairy plant equipment such as: Milk receiving equipment, canwashers; separator; clarifiers; filters; storage tanks; transport equipment; homogenizers; heat exchangers, heaters and coolers; pasteurizers; vacuum treatment equipment; temperature, pressure indicating and recording instruments; bottle filler and cappers; bottle washers; ice cream freezer, evaporator; drum dryer, spray drying; butter churning equipment, equipment for ghee and other Indian indigenous products; cheese and casein equipment. Water supply system for dairy and dairy farm; pumping, storage, distribution and drainage. Dairy waste and effluent disposal.


Applications of the principles of engineering and mechanics to the selection and design of equipment for dairy processing industry. Design, cost estimation and selection of dairy plant equipment such as heat exchangers coolers and heaters, pressure vessels, storage and transport tanks etc. Dairy process design based on unit operations controlled by such factors as form, utility, cost and reproductibility.


Selection of site and arrangement of dairy plants. Space requirements, arrangements of receiving, processing and storage areas. Installation of plants and maintenance procedures.

Design of dairy and other buildings, dairy cattle housing design with respect to various requirement. Illumination of dairy building. Design of illumination system. Electrical

634. Dairy Product Processing—2 units (2-0) First and Second Terms.

Engineering processing for food sterilization, steam process engineering, process calculations.

Dehydration, theory of drying process and drying producers involved in dairy product processing.

Various processes involved in manufacture of different milk products.

Process conditioning, cost analysis, manual operation economy.

635. Dairy Technology and Quality Control 3 units (2-3).


Improved and indigenous breeds of milk cattle, their distribution requirements, economics. Feeds and feeding of animals. Clean milk production methods and equipment.


Chemistry of milk products such as : cream, butter, ice-cream, sour milk, condensed and dried milk, cheese and ghee.

Growth and reproduction of bacteria, yeast and moulds, their importance.


641. Instrumentation in Agricultural Engineering. 2 units (1-3) First Term.


Principles of operation and use of the instruments for measuring length, mass, time, velocity, power, pressure, fluid flow and strain.

Instrumentation for temperature, humidity, heat, rainfall, soil properties and runoff.

642. Research Methods in Agricultural Engineering. 2 units (1-3) First Term.


Research techniques: Methods of measurement, advanced analytical methods for investigation of physical, mechanical, electrical, organic, inorganic and biological factors. Use of automatic controls and recorders. Use of calculating machines and computers.
651. Genetics 2 units (2-0).


652. Plant Breeding 2 units (2-0).


653. Plant Breeding Laboratory 2 units (0-8).

Field study of variability in cross polinated, self pollinated and vegetatively propagated crop plants. Introduction and selection methods.


654. Cytogenetics 1 unit (1-0) First and Second Terms.


655. Biochemical Cytology 1 unit (1-0).


656. Cytology Laboratory 2 units (0-8).


657. Molecular Genetics 3 units—One Term.


658. Radiation Biology 3 units. One Term.


659. Cellular Ultrastructure 3 Units (3-0) One Term.

Construction and operation of Electron Microscope—electron beam, lens system, resolution, depth of focus, contrast and image formation. Techniques for biological material—replica technique and ultrathin sectioning. Fixation, embedding, staining and metal binding. Techniques of electron histochemistry and electron autoradiography.

Ultrastructure of origin and development, and function of mitochondrion, golgi body, chloroplast, lysosome, endoplasmic reticulum, nuclear and cell membrane, cell wall. Role of double-layered membrane and fine particles in unit biological functions. Ultrastructure of mitosis—chromosome, spindle, centriole, centrometre. Ultrastructural aspects of cellular differentiation in root apex, sporogenous tissue, microsporocytes, embryo and cancer cells.

660. Advanced Cell Biology 3 Units (3-0)—One Term.


Problems of cellular differentiation—role of nucleic acids and histones in differentiation. Antimetabolites and inhibitors of protein synthesis—their effects on cellular structure and function.

661. Advanced Soils 2 units (2-0) First Term.


662. Soil Physics Principles 2 units (2-0) First Term.

Mechanical composition. Colloidal Clay; nature and surface behaviour. Soil-water systems; hydration, viscosity, consistency, puddlability. Soil water; properties, concepts, constants, movement, measurement and management. Soil air; functions, air capacity, measurement and management. Soil temperature; sources, conductance, factors affecting and control; Soil colour; occurrence, causes, classification and soil evaluation. Physical properties of soil and wind and water erosion.

663. Soil Physics Laboratory 2 units (0-6) First and Second Terms.


664. Physical Edaphology 2 units (2-0) Second Term.

Soil as a physical system. Soil skeleton, structure, crust etc. Soil tilth, soil cultivation, dynamic properties of soil and implement design. Mechanical impedance and plant growth. Soil water and plant growth. Soil water system, soil water storage and movement, irrigation, drainage, soil moisture stress and plant growth: draught and tolerance and efficiency of water use by plant. Soil aeration and plant growth; soil processes and properties affected by aeration;
effect on plant growth and water absorption. Soil temperature. Factors affecting the plant growth processes.

665. Soil Survey 2 units (0-6) Third Term.


666. Irrigated Soils 2 units (2-0) Third Term.


667. Soil Physics for Agricultural Engineers. 2 units (1-3) Second Term.

Physical properties of soil affecting fluid flow, tillage soil and water conservation and implement design. Soil temperature. Measurements of physical properties.

668. Tillage Physics 3 units. One Term.


670. Mineral Nutrition of Plants 3 units One term.


671. Farm Organisation and Management 2 units (2-0) First and Second Terms.

Terms: Characteristics of farming as a business; Factors affecting types of mechanised farming. Selection of crops; crop machinery and livestock for a mechanised farm. Livestock housing and power management.

Farm budgeting: utilisation of labour and power and equipment; research methods, Special problems in farm planning.

672. Economics of Mechanized Farming 2 units (2-0) Third Term.

Principles of production—Economics applied to agriculture with emphasis on profitable combinations of factors of production. Cost of production of farm enterprises. Resource combination and cost minimisation.

673. Advances in Agronomy 2 units (2-0) Second Term.


674. Crop Ecology 2. units (2-0) Third Term.

The environmental requirements of crop plants and their physiological basis; adequacy of the environment provided by crop land in India as a function of management, soil and climate. The distribution and yield of selected crops as a function of environment.

675. Plant Protection Technology 3 units (3-0) First Term.

The mechanism of infection—the effects of aphid and climate factors. The resistance mechanisms in plants. The sources of infection, transmission of pathogens and epidemiology of infectious diseases, prophylaxis against infections.

676. Marketing of Farm Products 2 units (2-0) Third Term.


677. Principles of Agronomy. 2 units (2-0) First term.

Agricultural Geography and climate of India. Principles, practices and economics of soil management and crop production. Dry farming and conservation farming.


The environmental requirements of crop plants and their physiological bases; adequacy of the environment provided by crop land in as a function of management, soil and climate. The distribution and yield of selected crops as a function of environment.


678. Agronomy, Forestry and Agrostology in Soil Conservation 2 units (2-0) First and Second Terms.


Role of plants, trees, pastures and grasses in soil and water conservation. Selection of plant material, planting, maintenance.

679. Arid Zone Conservation 2 units (2-0) Second Term.


680. Agriculture in World Economy 3 units One Term.


681. Chemicals and Plant Growth—3 Units (3-0)—One Term.

Plant growth as a process and its regulation factors involved in this regulation. Growth-regulating products and bio-synthesis and their classification—auxins, gibberellins, kinins, vitamins, pigments and growth-inhibiting compounds, anti-transpirants including germination inhibitors and toxins.

Chemistry of commonly used fertilizers, herbicides, insecticides, and plant growth regulators—their classification, preparation and general properties.

Mechanism of action of bio-synthetic and synthetic plant growth regulators. Structure—activity relationship of such compounds.
691. Microbiology for Civil Engineers 2 Units (1-2) Second and Third Terms.


692. Design Testing Project (Units to be arranged).

693. Seminar 1 unit (0-1).
Seminar talks to be prepared given by the candidates.

Research problem to be selected in consultation with the Department and research work to be carried out.

695. Any Specific Topic (Units to be arranged).

Industrial Training: 12 units during the Fourth Term. (For M. Tech.).

ARCHITECTURE AND REGIONAL PLANNING (Ar)

601. Planning Principles 1—2 units.
Objectives of town and country planning—planning at local, regional and national level-factors, influencing the growth of settlements—classification of towns and villages.

Comprehensive plan—its goals and objectives—its contents, Physical and socio-economic surveys—Assessment of the planning problems and presentation of survey findings.

Land Use:


Planning of new towns—Chandigarh, Brasilia, Hook Town and other studies.

Planning in existing towns—redevelopment and renewal. Problems of Indian villages and their development—Community Projects and N. E. S. Blocks.

602. Housing and Community Facilities 1—1 unit—First and Second terms.
Housing through the ages—problems of congestion, slums, and renewal. Qualitative and quantitative aspects of housing demand.

Economics of housing—market, rent, subsidy.

Types of housing—Communities facilities—Field studies.

Objectives of housing policy—mobilisation of resources of housing and community facilities.

Institutional financing of housing—cooperative housing societies—Private investors—State guarantees—capital and rent subsidies.

603. Transportation—I. 1 unit—First and Second terms.

Goals for transportation: Urban & Regional Transportation—Transportation as a function of land use.

Economics of Transportation: Freight Policies: Priorities for Transportation in a Developing Economy: Choice of Technology.

Case studies to illustrate High capacity movement on Roads, Railways, Mass-transit.

604. Local Self-Government—1 unit—Third Term.

Types of local self-governments—Historical development of Panchayatraj-Panchayats, Municipalities, corporations, Districts Boards—their functions and powers—Financial resources—duties of executive authorities and the elected bodies—various sections in the local authority office—committee system.

controls by State Governments.

Improvement Trusts.

605. Geography (Physical and Urban)—2 units—Second and Third Terms.

Land forms, classification and nature. Land form evolution agents of weathering, erosion, deposition and their work.

Elements and controls of climate—areal variation in distribution, Broad climatic pattern.

Soils: Their formation and distribution, correlation of climate, soil and vegetation.

Physical geographic region.


606. Planning Problem I—7 units—First and Second Terms common for City and Regional Planners—7 units also in Third Term for City Planners.

Field surveys and studio work relating to metropolitan and regional planning.

Environmental design studio—an interdisciplinary programme meant to acquaint the student with the activities taking place in any environment, the scales of representation, the presentation techniques, maps, charts, and other tools.

Urban Planning Studio: methods of survey and analysis, Problems of urban areas such as land sub-division, sector lay-outs, transportation, relation between various activities, preparation of comprehensive plans.

607. History of Towns—1 unit—First and Second Terms.


608. Housing and Community Facilities—II—1 unit—Third Term.

Residential Areas—Design standards—Planning of dwelling units—space between buildings—merits and demerits of different housing types—climatology—ventilation, etc. standards for community facilities.
609. Transportation—II—1 unit—Third term.

Place & Function of Transportation—Development & History—Transportation Systems—Hierarchy.

Layout & Design of Roads, Railways, Waterways—Junctions, Terminals, Parking, Layout of Airport—Location with reference to settlements.

Study of U.S., European & Indian standards.

610. Architectural Design—1 unit—Second and Third Terms.

Brief study of historic as well as contemporary styles of Architecture—use of small scale problems of familiar subject matter to establish basic concepts through harmonious relationship between use and form, structure and space, materials and appearance.

Design of houses and flats-orientation-basic design features of public buildings, offices and factories—study of architectural elements contributing to the environmental quality of the neighbourhood, school, playgrounds and parks, shopping and community centre.

611. Development of Planning Thought—1 unit—First and Second Terms.

Historical Survey : Early settlements.

Development of planning treated as the capacity of the community to make adequate changes in land-use.


Medieval Planning : Fortifications, the nobles and the church, the medieval place. Changes brought about by trade and commerce.

Renaissance Planning : Planning on the grand scale, development of urban design, the Place and the Piazza, Garden design.

Industrial Revolution : Social reform, large centres of manufacture and large centres of trade, commerce, administration and transport. The emergence of resource regions as regions of activity.

Contemporary developments in transport and communications, utilities and services vis-a-vis population movements. Socio-economic aspects of growth of population. Formation of metropolitan areas. Rural-urban migration.

Contribution of Ebenezer Howard, Landuse surveys of Britain and their impact on national and regional planning. Industrial location and regional analysis.


612. Theory of Resource use—1 unit—Second and Third Terms.

Classification of resources : Basis of resource evaluation : The principle of conservation of resource : allocation of resources for the activities of man-international, regional and area groupings : Elements of regional resource development with particular reference to Water, Power, Agriculture, Forestry, Minerals, Manpower : Case Studies of Regional Resource Development : Correlation between Regional Economical and Regional Physical—objectives, priorities and programmes : Concept of regional income : Regional growth interpreted as a consequence of regional resource development barriers and constraints.
Impact of modern methods of transportation and communications on land planning: Industry, its changes and adaptations—consequences of automation, diversification and improved methods of management. New sources of power. Scope of technology in answering the developing needs of the community.

614. Planning Problem I-A—7 units—Third Term for Regional Planners only.

Regional aspects of urban area: collection of regional data on transport, land-use, resources, industries and population. Presentation of the data on map leading to the preparation of regional Plan.

625. Economic Geography—2 units—First Term.

Man’s physical environment—social, economic and political consequence of geographical conditions, physical features, climate, etc. and their effect on urban and rural communities.

The regional distribution of world’s resources—industries and population. Analysis of the distribution and comparative importance of manufacturing, mining, forest, agriculture and trade in relation to such factors as power resources, raw materials, climate, land forms, centres of population and world trade routes. Economic geography of India and its relation to town planning.

701. Planning Principles II—2 units.

Metropolitan Region—Delineation—evolving metropolitan framework—special problems of the central areas and suburbs—Housing, Industry, Recreation and Transportation Structure—Migration from rural areas—Decentralisation policies—Hierarchy of town centres—Satellite townships and green belt.


702. Landscape Design—1 unit—First and Second Terms

Types of landscape and its development at various planning levels—role of man in changing the landscape—survey and reconstruction of survey.

Outline history of development of parks and gardens in various countries and their contribution to present day landscape.

Parks and open spaces system—Regional, National and District Parks—Types of recreational—Development of recreational areas and water front development.

Plant materials with special reference to roadside planning—Shelterbelts, etc.—National highway, parking areas.

Effect of various natural resources on landscape—treatment of derelict, industrial waste lands and erosion control. Climatic factors which affect man’s environment—planting for micro-climatic effects.

Principles of plant ecology—study of plant communities—Regional Landscape Development.

704. Planning Legislation and Administration—2 units—Second and Third terms.

Brief survey of development of planning legislation in U.K., U.S.A. and India: Fundamental Rights under the constitution in relation to police powers and eminent demand and land acquisition procedure—basis for determining compensation—special powers for dealing with slums.
Planning agencies at national, State and local levels—their functions and relationship—contents and preparation of Development Plans—meaning of development—control over development—appeals—detailed planning schemes—betterment levy and compensation—arbitration—execution of planning schemes—control over advertisements—preservation of trees and special buildings.

Building by-laws—zoning laws—planning provisions in the municipal acts—Improvements Trusts and their scope.

706. Planning Problems IIA—7 units.

Surveys and studio work relating to metropolitan and regional planning.

709. Regional Geography of India—1 unit—First Term.


The Regions of India, regional delineation—physiographic, river-valleys, rural, metropolitan, economic, commercial and trading, and planning region. Broader aspects of such regions. The analysis of regions and regional economic development.

710. Regional Planning and Analysis—2 units.

Study of the major influence of natural resources, climate, and topography on the location and character of settlements. Study of the problems relating to population, transport, industry, agriculture, commerce, etc. in the Indian Five Year Plans: Regions and national development. National Resources Planning Board and other studies.

Types and characteristics of regions. Single purpose and multipurpose regions such as resource regions, river valley regions, climatic regions, soil regions, population regions, transportation regions, metropolitan regions, etc. process of regional delineation. Methods and types of regional surveys and analysis. Barriers and constraints. Water, power and transportation treated as determinants for regional development. Impact studies, Identification of the problems of region.

Study of the planning aspects of a river valley region, an industrial region or a metropolitan region taken up as an illustration of the principles of regional planning. Decision making in regional planning. Nature of the Regional Planning Authority.

Introduction to regional science. Industrial complex analysis of selected industry groups. Studies in location and space economy.

711. Theory of Industrial Location—1 unit—First and Second Terms.

The economic theories of location—Weber, Losch, Hoover, Isard. Access as a basic factor in location—factors of industrial location, barriers and constraints for location. Industrial location analysis—industrial complexes, comparative cost approach, labour and similar co-efficients, localisation, specialisation, diversification and factor analysis with particular reference to regional delineation. Correlation between resources evaluation, industrial development and location of industry. Case studies of iron and steel, petro-chemicals, coal-based activities, port-terminal activities.

712. Public Administration and Legislation—1 unit—Second and Third Terms.


The Planning function in Government—powers to delegate responsibilities in the decision making process: Flexibilities of the system to handle new functions. Critical review of existing methods of data collection, policy formulation and project implementation.

Methods of financing and programming of development plans, public participation. Case-study of a project in India to demonstrate the role of the public administrator in Regional Planning.
713. Workshop—1 unit—Third Term.

A study of a regional plan through extensive reading, seminars, discussions and field visits leading to a critical evaluation of the plan. Typical workshop courses may be offered on the Damodar Valley Region and the Calcutta Metropolitan Region.

714. Planning Problems II—7 units—First and Second Terms. 6 units—Third Term (for Regional Planners only).

Regional Studio

Resource surveys: water, power, transportation, population, Socio-economic correlations.


APPLIED CHEMISTRY (Ch)

601. High Pressure Technique 3 Units First Term. 2 Units Second and Third Terms.


P-V-T relationships of gases and liquid. Specific heats of gases, Viscosity of gases and liquids, etc., at high pressure.

602. Technical Gas Reaction. 1 Unit First Term. 3 units Second and Third Terms.

Industrial gases, Tonnage oxygen. Economics of the manufacture of oxygen. Uses and scope of high pressure in chemical synthesis. Synthesis of ammonia, methanol and higher alcohols. Fischer-Tropsch and allied synthesis. Hydrogenation of coal, tar and oils by the Bergius process. Synthesis of urea, polymerization of olefines etc. Recent advances in the high pressure chemistry of carbon monoxide and acetylene.

603. Chemical Kinetics and Thermodynamics. 1 Unit.


604. Catalysis. 2 units Second and Third Terms.


605. Physical Organic Chemistry 1 Unit.


606. Advanced Chemistry. 3 Units.

Kinetic theory, Maxwell's law of distribution of velocities, characteristic equations of actual gases, theory of corresponding state, liquefaction of gases.
Kinetics of chemical reactions. Classification of chemical reactions, active molecules, energy of activation, the mechanism of chemical changes. Chain reactions, typical atomic reactions, ionic reactions important industrial reactions in the gaseous and liquid systems.

Electrochemistry. Outline of the theory of complete dissociation, concentration cells, standard electrodes, Potentio-metric and conductometric titrations, measurement of pH decomposition potential, electro analysis, polarisation, Colloids and surface chemistry.

Radio activity, theoretical and applied. Atomic structures elements of quantum theory, valency, atomic number, isotopes and periodic tables.

Double and complex salts. Corrosion. Application of physico-chemical methods to analysis.

Selected topics in organic chemistry.

610. Physical Chemistry of High Polymers 2 units First and Second Terms, 1 unit Third Term.

General introduction, kinetics of addition polymerisation, (emulsion, ionic etc.) and copolymerisation, Molecular weight determination, distribution of molecular weight and Chain length, Thermodynamics of High Polymer solutions.

Lab: Study of the kinetics of polymerisation of styrene (vinyl acetate) in bulk, solution and emulsion, determination of mol. wt. of the heterogeneous sample by viscosity measurements, fractionation of the hetero sample and determination of mol. wt. by viscosity and osmotic pressure measurement, copolymerisation of styrene with butadiene (vinyl acetate) condensation of phenol with formaldehyde and effect of different fillers.

611. High Polymer Technology 1 unit First and Second Terms.

(i) Techniques and manipulation in polymer industry including methods of polymerisation, processing, compounding and moulding.

(ii) Thermoplastics and Thermosetting resins. Principles of the manufacture and utilisation of Phenol formaldehyde, urea formaldehyde, Melamin formaldehyde, alkyd and epoxy resins, poly amides poly esters, cellulose derivatives, polyurethane, polyethylene, polypropylene, polystyrene, polyvinyl chloride, polymethylmethacrylate, polyvinyl acetate, polyvinyl alcohol, Acrylate resins.

612. Rubber Technology 2 units First Term, 4 units. Second and Third Terms.

Historical introduction, Plantation industry, manufacture & gradation of Natural Rubber, Properties of latex and raw rubber, manufacture & Technology of Reclalm and other compounding ingredients, manufacture and Technology of Styrenebutadiene rubber nitrile rubber, neoprene, butyl rubber, and other synthetic rubbers, compounding of latex.

Study of the elementary processes: Cutting, mixing, calendering, frictioning, spreading, moulding and vulcanisation with particular emphasis on machineries used.

Study of the manufacturing process involved in preparation of foot wares, hot water bottles, hoses, conveyer and transmission belts, buffer springs, tyres, foam rubber and other latex products.

Rubber Lab: Determination of acetone extract, free and total sulphur and rubber hydrocarbon. Preparation of mixes to illustrate the effect of various compounding ingredients on the plasticity, curability and mechanical properties of elastomer.

613. Rubber Physics: 1 unit Third Term.

Structure of elastomers by X-ray, infrared and electron microscope, Kinetic theory of rubber elasticity.

614. Chemistry of Rubber. 1 unit Second Term.

Composition of rubber, determination and distribution of molecular weight of rubber, reactivity of rubber towards heat, light, air etc. Cyclisation and hydrochlorination of rubber, Chemistry of mastication, ageing and Vulcanisation of rubber.
615. Mechanical Behaviour of High Polymers : 1 unit.

Ideal elastic deformation, viscous flow, engineering definition of various mechanical properties, effect of relaxation, stress strain behavior of high polymeric solids. Anomalous flow of liquids, molecular theory and Rheological behaviour, Testing procedure and equipment.

(ii) Elastic modulus and tensile strength, static structural considerations, creep, stress concentration and notch effects, factors affecting binder filler product.

(iii) Dynamic stress, Impact resistance, behaviour under cyclic stress, fatigue endurance.

Electrical, thermal and optical properties of High Polymers :

(i) Volume resistance, surface resistance, electrical break down, dielectrics, anomalous dispersion, dielectric heating.

(ii) Heat resistance, thermal conductivity, and expansion.

(iii) Colour and constitution of organic compounds, bifringence, stability of optical properties, safety glass.

616. Advanced Organic Chemistry. 2 units.

Organic reactions, their application in synthetic organic chemistry. Bond making and bond breaking processes. Application of Lithium aluminium hydride, polyphosphoric acid, hydriodic acid, periodic acid, leadtetraacetate, aluminium isopropoxide etc. in organic chemistry.

617. Heterocyclic Chemistry. 1 unit.

Five membered rings with one hetero atom, pyridine, bicyclic rings, containing one nitrogen, two nitrogen, three nitrogens and four nitrogens atoms. Preliminary molecular orbital treatment and its application to correlate their properties.

618. Synthetic Drugs 2 units First Term, 5 units Second term, 4 units Third Term

Relation of chemical structure and biological activity, pharmacological study of drugs (adsorption, distribution, excretion, toxicity and metabolism) Chemotherapeutic classification. Anaesthetics, Analgesics, Antimalarials, Drugs for the treatment of Cancer, Vitamins, Sulphonamides, Antibiotics, Antihistaminics, Sedatives, Hormones, Tranquilizing drugs, etc.

619. Natural Drugs. 2 units. Third Term.

Historical development of medicinal chemistry ; introduction to natural alkaloids, their isolation, elucidation of structure, synthesis. Proteins and amino acids, synthesis of peptides and sequence study. Nucleic acids etc.

621. Chemistry of water and Sewage. 2 units First Term, 1 unit Second and Third Terms.


(For Public Health Engineers)

622. Chemistry of Sands, Clays, and Binders. 4 units. Third Term.


Polymerisation and oxidation.

Minerology of sands, minerological testing. Indian sands and clays.

(For Foundry Engineers)
623. Physical Chemistry. 2 units. First Term and 1 unit. Second Term.


(For Mineral Engineers)

624. Assaying and analysis of minerals. 2 units First Term and 1 unit Second Term.

Dry assaying processes, fire assaying of gold, silver, tin etc. Wet assaying of minerals of iron, lead, zinc, copper, cobalt, manganese, chromium, tin etc. Silicate analysis. Micro-chemical tests. Colorimetry, Polarograph, Differential Thermal Analysis.

Laboratory Work.

(For Mineral Engineers)

CHEMICAL ENGINEERING (ChE)

601. Chemical Engineering Science I (Fluid Dynamics). 3 units (3-0). First Term.

Introduction to momentum theorem.

Viscous flow of Newtonian fluids, and concept of shear stress.

Multidirectional flow, continuity equation. Equations of motion, isothermal viscous flow around a sphere and stoke's law.

Macroscopic mechanical energy balance, potential flow and Bernoulli theorem.

Energy balance in the flow of compressible fluids, gas flow at high velocity.

Boundary layer theory, turbulent diffusion, universal velocity profile.

Non-Newtonian fluid flow, shear stress, consistency measurement and pipe line design.

Dimensional analysis in fluid flow problems and similarity criteria.

Properties and dynamics of particles.

Size and surface area of particles in two-phase flow. Pressure drop across banks of tubes.

Fixed, fluidized and moving beds, pneumatic conveyance of solids. Three phase flow systems.

602. Chemical Engineering Science II (Heat Transfer). 2 units (2-0) First Term.

Heat transfer by conduction in unsteady state. Heat transfer through furnace wall.


604. Chemical Engineering Science III (Mass transfer) 4 units (4-0) Second Term.

Diffusion and mass transfer, molecular transport properties, mass transfer in gas-liquid and liquid-liquid systems under laminar and turbulent flow conditions. Interphase mass transfer mechanism. Different theories—film, penetration and surface renewal.


Extraction: Extraction of solids and liquids. Design and calculations for co-current and counter-current liquid—liquid extraction systems.

Water cooling: Design of different types of water cooling towers.

Drying: Design and calculations of rotary and spray dryers and kilns.

607. Transport Phenomena. 2 units (2-0). First Term.


611. Advanced Thermodynamics. 2 units (2-0). First Term.


Simple and complex reactions.

Thermodynamic properties from molecular structure.

612. Advanced Applied Kinetics and Reactor Design. 2 units (2-0) Second Term, 1 unit (0-3) Third Term.

Second Term

Kinetic analysis of rate data from isothermal, batch and flow reactors.

Heterogeneous catalytic reactions, common properties of a solid catalyst and their evaluation, kinetics of chemisorption processes, formulation of rate expressions, experimental techniques, interpretation of rate data.

Uncatalysed heterogeneous reactions, selections of a model, development of rate expressions.

Third Term

Application of kinetics to reactor design for simple homogeneous reactions, adiabatic and programmed reactors, selection of reactor for complex reactions, multiple reactor systems, process optimization.

Non-ideal flow, residence time distribution, dispersion model.

Heat and mass transfer in a single catalyst pellet and in a catalyst bed. Process optimization for catalytic reactors.

Empirical methods for reactor design.

616. Process Development and Equipment Design. 3 units (0-8). Second and Third Terms.

A course involving the development of a practical process for the manufacture of an assigned product. It includes literature survey, laboratory, investigation, pilot plant study, process design, selection of equipment, design of equipment and manufacturing cost estimation. Optimization problems.

620. Material Technology. 1 unit (1-0) Second Term.

Crystal structure of pure metals, grain formation in metals, nucleation and grain growth. Structure of ceramic and organic materials and their effect on properties.

Phase equilibrium diagram. Multiphase alloys—non-equilibrium relationship.

Steel: Isothermal transformation diagram and transformation on continuous cooling.
Hardening of steel hardenability. Heat treatment of important non-ferrous alloys.

Effect of phases on micro and macro-structure of alloys. Effect of high and low temperature on ferrous and non-ferrous alloys.

Causes of corrosion-cracking of metals, types of corrosion and its prevention.

Study of metals and alloys with reference to their application in chemical industry.

Non-metals and their uses.

621. Chemical Engineering. 3 units (2-3).

Introduction to Unit Operations. Flow of fluids, friction in pipes and fittings, pumps and compressors, measurement of flow. Heat transfer by conduction, convection and radiation, heat exchangers and evaporators. Diffusional operations, distillation, absorption etc. Elementary treatment of other unit operations.

(For Applied Chemistry)

625. Instrumentation and Process Control. 2 units (1-3). Third Term.


Process dynamics of heat exchangers, level and flow control systems, distillation column and chemical reactors.

631. Fuel Technology I (solid fuel) 3 units (3-0). First Term.

Coal, its formation, occurrence, petrography, methods of sampling, analysis, classification. Recent concept of the chemical constitution of coal. Physical properties of coal, storage and processing of coal with special emphasis on coal washing, blending and deterioration. Coking and non-coking coals. Selection of coal for coking coals in India.

632. Fuel Technology II (Coal carbonisation and liquid fuels). 2 units (2-0) Second Term.

Coal carbonisation processes. Study of design and construction of H.T. coke oven. Factors influencing the operation of coke ovens. Coking properties with special references to metallurgical coke, domestic coke, etc. By-products recovery. Low-temperature carbonisation of coal.


Synthetic liquid fuels and chemicals from coal by hydrogenation and Fischer-Tropsch synthesis. Alternative fuels e.g. power alcohol and methane.

633. Fuel Technology III (gaseous fuels). 2 units (2-0) Third Term.

Classification of gaseous fuels, their composition, analysis, calorific value, methods of manufacture, purification and storage. Theory of gasification reactions. Operation and control of producer and water-gas plants. Extensive problem work dealing with mass and energy balances in gasification plants. Recent development on complete gasification of coal with oxygen and steam. Design problems on modern gas generators.

640. Gas Chemical Technology. 2 units (2-0) First and Second Terms.

Elementary composition and physical characteristics of crude petroleum. Chemical composition of crude oil and its products. Modern methods of separation and analysis of petro-
leum hydrocarbons. Physical and chemical principles of oil refining relating to deep thermal and catalytic reactions.


641. Petro-chemical Processes. 2 units (2-0) Third Term.
Development of petrochemical industries in different countries.

Studies on production of petrochemical raw materials, paraffins, olefins, aromatics, acetylenes and synthetic gas by partial oxidation, cracking and reforming, etc. of petroleum feed stocks.

Process details including reaction kinetics, operating variables and special design problems in production of typical petrochemicals for synthetic polymers, plastics, rubbers, fibres, explosives, detergents, oxo-compounds, etc.

645. Petroleum Refinery Engineering. 1 unit (1-0) First Term, 3 units (3-0) Second and Third Terms.

First Term
Properties of crude oil and its fractions, their importance for evaluation and designing of refinery equipments.

Characteristics and classification of crude oil and oil products. Evaluation and preparation of crude oil for processing (desalting, dehydration and stabilisation) and designing.

Principles of distillation and rectification as applied to petroleum refinery operations. Distillation of crude and heavy oils.

Second Term
Destructive distillation of crudes. Fundamentals of thermal cracking, thermal cracking under low and high pressures.

Catalytic cracking processes, their theory and factors governing the catalytic cracking process. Typical industrial processes for manufacture of high quality gasolines and aromatics. Technological schemes of catalytic reforming units.

Destructive hydrogenation of heavy oil residues. Processing of hydrocarbon gases. Desulfurisation of gases. Basic methods of gas fractionation, e.g. rectification, absorption and adsorption.

Alkylation of isobutenes with butylene, alkylation of benzene with propylene and ethylene. Polymerisation of butylene and propylene fractions. Hydrocracking and its application for middle distillates.

Third Term

Methods of improving the quality of lubricants with additive agents. Manufacture of special products and utilisation of the residual stock of refining.

650. Combustion Engineering I. 2 units (2-0) Second Term.
651. Flame Physics I. 1 units (1-0) Second Term.

Elements of optics as related to flame physics.


Schlieren, shadow, interferometry and diffraction mapping methods of study of flames, their principles and application to flame study and interpretation of records.

Physical measurements of burning velocity. Flame temperature by sodium line reversal method, two colour method.


652. Petroleum Refinery Equipment Design. 1 unit (0-3).

Estimation of physical properties of petroleum and petroleum products.

Material and energy balances for typical petroleum refinery operations, straight run distillation, thermal and catalytic cracking, reforming and alkylation, etc.

Process and equipment design for various refinery operations.

653. Combustion Engg. II. 2 units (2-0) Third Term.

Mechanism of combustion and design of pulverised coal burners. Study of various fuel burning units. Design and constructions of fuel and electrically heated furnaces used in metallurgical and process industries. Applications of the principles of fluid flow, heat transmission and combustion in furnace design.

654. Boiler Technology I (Boiler Engineering). 2 units (2-0) Second Term.

Design and installation of various types of boilers, economisers, air preheaters, superheaters and desuperheaters. Modern boiler furnaces and feeding mechanisms for burning fuels, blow down technique, back fires and ash disposal. Saturated, superheated and high pressure steam for power generation and process work. Water treatment, corrosion and its prevention.

655. Boiler Technology II (Power Station Practice). 2 units (2-0) Third Term.


656. Steam Utilisation. 1 unit (1-0) First Term.

Distribution of steam in a chemical plant. Power and process steam, principles of steam economy.

661. Engineering Economics. 2 units (2-0) Third Term.


666. Course Project. 1 unit (0-3) Second and Third Terms.

Every student will present a detailed survey including experimental investigation and calculations of an assigned problem and also present a critical review of the same which will be followed by discussions.
667. Fluid Dynamics. 3 units (3-0), First Term.


Two phase and three phase flow. Fixed, fluidised and moving beds. Principles of pneumatic and hydraulic conveyance. Laboratory work.

(For Mineral Engineers)

668. Fluid handling. 2 units (2-0), Second Term.

Handling of homogeneous fluids and slurries, pumps, compressors, blowers, ejectors, etc., their design, construction and operation. Thermodynamics of fluid flow. Laboratory work.

(For Mineral Engineers)

669. Principles of Heat and Mass Transfer. 2 units (2-0), Second Term.


(For Mineral Engineers)

670. Advanced Mineral Dressing. 3 units (3-0).

Unit operations used in comminution and mechanical separation of minerals—physical principles involved and application to design of equipment. Principles relating to particle size distribution, surface area measurement, fracture of material and energy distribution during comminution. Design and construction of various comminution and screening equipments.

Application of hydrodynamic behaviour of solid and liquid systems and solid, liquid and gaseous systems. Unit operations covering classification, gravity concentration, hydrocyclones, etc.

Dust separation—gravitational and inertial separation, cyclones, filtration, electrostatic separation etc. Jigging and film sizing—their principles and design considerations. Magnetic and electrostatic separation.

Principles of flotation and its application to typical systems. Physical variables affecting design and operation of continuous flotation process.

Dewatering processes. Filtration, batch and continuous filtering equipment.

Theories of filtration and washing. Centrifuges.

Briquetting and pelletisation.

(For Mineral Engineers)

671. Mineral Dressing Laboratory. 2 units (0-6), First Term.

Laboratory experiments on the topics covered in ChE 670.

(For Mineral Engineers)

672. Coal Preparation. 2 units (2-0), Second Term and 3 units (3-0), Third Term.


(For Mineral Engineers)
673. Surface Phenomena. 2 units (2-0), Second Term.


(For Mineral Engineers)

674. Process Control. 1 unit (1-0), Third Term.

Control systems, block diagrams and functions, mathematical formulation of control problems. Devices for measurements and control of variables in mineral dressing operations like pressure, flow, concentration, sizes, etc.

(For Mineral Engineers)

675. Plant Design and Ore Processing. 1 unit (1-0), Second Term and 4 units (4-0), Third Term.


Study of major mineral beneficiation plants in India. Project work on Plant design.

(For Mineral Engineers)

676. Applied Heat and Mass Transfer in Mineral Engineering. 2 units—Third Term.

Dewatering, drying, humidification, dehumidification, chemical extraction, electrochemical concepts, cyanidation, leaching, ion exchange, continuous and batch processes. Roasting, sintering, calcination, chlorination etc., their particular application to gold and uranium bearing materials.

The following two subjects will be taught in the 2nd year of P.G. (ChE) course for which there is no examination.

1) Recent Developments in Chemical Engineering. Recent developments in the field of mass, momentum and energy transfer, rockets and rocket fuels, nuclear reactors, new experimental techniques, etc.

2) Computer Programming:

Fortran programming techniques and application to chemical engineering problems.

(For Mineral Engineers)

CIVIL ENGINEERING (CE)

601. Advanced theory of Structures. 2 units (1-2), First Term.

Analysis of Statically indeterminate structures by classical and numerical procedures. Continuous beams, frames and arches. Response of beams and frames to dynamic loading. Analytical, numerical and graphical procedures for calculating deflection of frames. Secondary stresses.

602. Advanced Strength of Materials. 2 units (2-0), First Term.

Relationship between stress and strain, strain energy, rupture, yield and fatigue, theories of failure, pressure between elastic bodies, bending of beams, torsion, beams on elastic foundation, stresses in thick cylinders.

603. Stability of Structures. 2 units (2-0), Second term.

Buckling of columns, Stability of built up columns and column with varying stiffness, lateral buckling of beams, stability of frame works, effective length of compression members in trusses, stability of web plate girder, buckling of plates.

604. Experimental stress analysis. 2 units (1-2), Third Term.

Introduction to some of the common experimental methods of analysing stress distributions, photo elasticity, Eney’s & Beggs’s deformeter, electrical resistance strain gauge, the brittle lacquer method.
605. Concrete Technology.  2 units (1-3) First Term.

Admixture and addition in concrete; design of concrete mixes—brief review of early theories, compressive strength laws, theories of aggregate grading, modern methods of mix design, light weight concrete, quality control of concrete—causes and measurement of variation control procedures, non-destructive testing of concrete.

606. Advanced Reinforced Concrete Design.  2 units (1-2) First Term.

Review of elastic design methods, Creep and shrinkage phenomena and problems related thereof; Ultimate load method of design of reinforced concrete members and structures; R. C. arches.

607. Steel Design I.  2 units (2-0) Second Term.

Elastic and plastic design principles as applied in design of multistoreyed buildings, industrial building and bridge members; design of rigid frames by plastic theory including influences of secondary effects (Viz. shear, axial force, local buckling etc., ); current design specifications for steel structures other than bridges—discussion and criticism, design of tall buildings for wind and earthquake forces.

608. Steel Design II.  2 units (2-0) Third Term.

Discussion and criticism of current design code for steel bridge structure, basic design principles for plate girder—type, truss—type and long span bridges, design of bridge bearings, design specifications for light-gauge steel structures, light-gauge sections and their use; Aluminium alloys.


Comprehensive study of physical characteristics of soils, basic principles of soil behaviour under stress applications, Flow through soils, Earth pressure theories, Soil Laboratory exercises.


Sub-surface soil conditions; Selection of the type of foundation; settlement analysis, principles and design of foundations—spread footing, rafts and piles.

611. Prestressed Concrete I.  2 units (2-0) First Term.

Methods, materials and allowable stresses; elastic design of simple beams for flexure and shear; critical span; losses in prestressing force; Design of anchorage zones; composite beams; General design considerations.

612. Prestressed Concrete II.  2 units (2-0) Second Term.

Analysis and design of indeterminate structures, concordant and transformed profile, secondary moments, ultimate load method of design.

613. Shell Structures I.  2 units (1-2) Second Term.

Differential equation of circular cylindrical shells, review of various theories, Edge disturbances, Extension to the analysis of cylindrical containers; shell reinforcements, approximate design methods.

614. Shell Structures II.  2 units (1-2) Third Term.

General theory of thin elastic shell of double curvature, differential equations; comparison with cylindrical shells, membrane theory and its application to special surfaces.

615. Bridge Engineering I.  2 units (1-2) Second Term.

Review of Bridge Codes (I.R.C. & I.R.S.); bridge foundations (well, caisson, pile and open); piers and abutments, bridge approaches, bridge economics, bridge bearings.

616. Bridge Engineering II.  2 units (1-2) Third Term.

R.C. Superstructure (Slab and different types of girder bridges—Cantilever and continuous spans—Arch bridges) prestressed concrete bridges; introduction to long span steel bridges and composite structures; Launching and erection of bridge spans.
617. Bridge Engineering III. 2 units (1-2) Third Term.
Steel superstructure, cantilever and continuous spans arch bridges, long span steel bridges, fabrication and erection problems.
(For D.I.I.T. Structural Steel Design)

618. Advanced Structural Analysis. 2 units (1-2) Third Term.
Application of matrix methods to structural analysis of indeterminate structures, gridworks & space frames.
(For D.I.I.T., in Structural Steel Design and Concrete Technology and Design)

619. Industrial Buildings 2 units (2-0) First Term.

620. Design and Drawing. 2 units (0-6) All Terms.
Guided design and preparation of detailed drawings for specific structures pertaining to subjects CE 606, CE 611 & 612, CE 613, 614 and CE 615 and 616.
(For D.I.I.T., in Concrete Technology and Design)

621. Fluid Mechanics I. 3 units (2-2) First Term.

622. Fluid Mechanics II. 3 units (2-2) Second Term.
Dimensional Analysis & similitude, Typical applications; One Dimensional Method of flow Analysis, Fundamental Equations of viscous Flow, Navier-Stokes equations, Problems in Laminar motion; General Concept of Fluid Turbulence, Momentum transport & Reynolds Stresses, Mixing length & velocity distribution in Turbulent Flow; Boundary Layer concepts.

623. Fluid Mechanics III. 3 units (2-2) Third Term.

624. Dams and Dam Construction I. 3 units (2-2) First Term.
River Valley Project Planning, Multipurpose Projects, Gravity Dams low and high, Stability analysis, Gravity analysis, Twist analysis, Spillways, Gates, Openings in Dams, Grouting, Contraction Joints, Low Dams on Permeable foundations, Principles of design of regulators, Dam appurtenances, Outlet structures.

625. Dams and Dam Construction II. 3 units (2-2) Second Term.
Arch Dams—Design by cylinder theory—Types and classifications. Trial load method for design of arch dams, Double curvature arch dams.
R.C. Buttress Dams—types and classification. Design of Flat Slab type Buttress Dam, Hollow gravity or pier head Dams, Temperature Control of Concrete, Masonry versus concrete for Dams, River Diversion and Cofferdam, Instrumentation in Concrete Dams.

626. Dams and Dam Construction III. 3 units (2-2) Third Term.
Earth Dams—Stability of slopes, design for seepage flow, other design criteria, Uplift pressure and settlement studies.
Rock fill Dams—classification and design criteria, Timber and Steel dam, Spillways—Special Types—Siphon, Shaft, Chute and side channel types, criteria for the choice of the type of a Dam.

627. Water Power Engineering I. 3 units (2-2) Second Term.


628. Water Power Engineering II. 3 units (2-2) Third Term.

Intakes, Tunnels, Parstocks, High pressure valves, Relief valves. Draft tubes, Tailraces, Water hammer, Surge tank, pressure control, control & Governing Design of hydropower facilities, single & Co-or-dinated plants Switch yards & Transmission Towers.


Climate, Precipitation, Measurement & analysis of data, Storm studies, & Transposition; Runoff, Evapo-transpiration, Infiltration, stream flow—hydrographic analysis, Runoff distribution, unit hydrograph.

630. Advanced Hydraulics II (Hydraulics of Open channels). 2 units. (2-0). Second Term


632. Advanced Hydraulic Laboratory. 1 unit (0-3). First Term.

Discontinuous flow problems in open channels, Gradually varied flow problems, Flow studies by Analogy models ; seepage flow problems. Model studies of flow over spillways, Weirs, Transitions, Gravity Waves, use of various hydraulic measurement instruments, steady or transient conditions.

633. Irrigation and Drainage. 2 units (2-0). Second Term.

Land classification. Types of crops & water requirements ; quality of water, special irrigation methods, Tubewell and sprinkler irrigation, Design exercise, Arid zone problems.

Land Drainage—Surface & subsurface drainage, Design of drainage system, Tidal outfall works, Land reclamation.

634. Flood control. 3 units (2-2). Third Term.

Estimation of spillway design storm, spillway design flood, flood routing through reservoir & channels, Reservoir operation & flood forecasting. Flood protection measures, & practice. Reservoir siting, Flood control & multipurpose projects planning, Flood damages and benefit studies.

635. Construction. 3 units (3-0). Third Term.

Earth moving equipments, Quarrying & Transport, Concreting plant, Drilling, sheet piling & cofferdam—construction, Caisson & Well sinking, underwater construction problems, Tunnelling, works organisation, construction schedules & economics.

636. Hydraulics Laboratory I. 2 units (0-3). First Term.

Orifices and Mouthpieces—Notches and weirs—Pitot tubes and current Meters—Ventury Meters and Orifices Meters—Experiments on pipe Friction Losses.

(For D.I.I.T. in Non-Linear Mechanics)
637. Hydraulics Laboratory II. 2 units (0-3). Second Term.

(For D.I.I.T. in Non-Linear Mechanics)

638. Water Power Engineering. 3 units (2-3) First Term.


641. Advanced Soil Mechanics I. 3 units (3-0) First Term.


642. Advanced Soil Mechanics II. 3 units (3-0) Second Term.

Theory of consolidation, shear strength of soils, earth pressure theories, stability of slopes, elastic stresses in soil mass, soil stabilisation.

643. Foundations I. 2 units (2-0) Second Term.

General survey, different exploration methods, sampling and disturbances, sampling tools and equipment, stress strain characteristics of disturbed and undisturbed soil samples, special problem associated with sampling—ground water, proximity of existing foundations, exploration data and interpretation of results.

644. Foundations II. 3 units (2-2) Third Term.

Bearing capacity of soils, planning of foundations, settlement calculations, design of foundations, spread footings, rafts, piles, caissons and wells, design of conduits and tunnels. Foundation construction methods.

645. Soil Mechanics Laboratory I. 2 units (1-3) First Term.

646. Soil Mechanics Laboratory II. 1 unit (0-3) Second Term.

Laboratory testing of physical and mechanical properties of soils.

651. Design of Highways I. 2 units (2-1) First Term.

General features of highway design. Vehicle characteristics affecting road design, traffic conditions affecting road design. Grades, curves, camber and super-elevation. Intersection at grade and grade separations, drainage of roads, roadside improvements.

652. Design of Highways II. 2 units (2-1) Second Term.

Structural design of pavements, critical review of the different methods of design of flexible and rigid pavements.

653. Design of Highways III. 4 units (2-4) Third Term.

Highway materials, Geology of road aggregates, general discussion on the properties, testing and use of bituminous and non-bituminous materials, soils and aggregates. Mix design methods, technique of soil stabilisation, laboratory testing procedures and exercises.

654. Transportation Planning and Economics I. 2 units (2-1) First Term.

Planning and location of highways. Historical development of Highways, highway system in India, road statistics, benefits of improved highways, financing of highways, Central road fund.
Reconnaissance, principles of photogrammetry, and its use in the location of highway routes, preparation of highway projects.

655. Transportation planning and Economics II. 2 units (2-1). Second Term.

Urban roads, layout of roads in built-up areas, choice of pavement types and their relative economics. Treatment of intersection: drainage problems, traffic control, traffic surveys, street lighting, road furniture.

656. Transportation Planning and Economics III. 2 units (2-1). Third Terms.

Airports, growth of air transportation and development of airports, present air craft types and characteristics, classification of airports, Survey preceding airport location, studies of a proposed site, layout and design of an airport and its phased development, airport lighting system and control, operation, choice of pavement types, grade requirements and earthwork calculations, surface and subsurface drainage, air-port buildings and facilities.

657. Municipal Engineering. 2 units (1-0) Second and third terms.

Introduction and Scope of the subject
Ground water and surface water resources, their utilisation—estimating demand for water—treatment of water—distribution system—consumption.

Sewerage and sewage disposal estimation of quantities of flow—layout of sewerage system and design criteria sewage treatment plants.

Refuse collection and disposal—provision of services in industrial estates.

(For City Planners)

658. Track Surveying and Overhead Equipment. 2 units (2-0) Second Third Terms.

Theodolite, curve-setting, transition curves, route surveying, longitudinal and cross sections, and earthwork measurements.

Design of overhead and supporting equipment, wind effects overhead structures, and foundations.

(For Electrical Engineers)

660. Elasticity and Plasticity. 2 units (2-0).


661. Water supply and Design. 2 units (1-2) First and Second Terms 3 units (2-2) Third Term.

Water Supply systems—estimate for the requirements of water—the development and conservation of sources of water supply—Ground water—yield and development—Design, specification and construction of intake works, storage works, pumping stations, etc. Transmission and distribution of water supply to buildings—Principles of economic design.


662. Sewerage and Design. 2 units (1-2) First and Second Terms : 3 units (2-2) Third Term.

Sewerage systems—Estimate of waste waters—Flow in sewage and their appurtenances—layout and hydraulic design of sewerage systems—Design of sewage pumping station and
equipment—Construction and maintenance of drains and Sewers. Drainage of buildings, Composition of Sewage—Examination of waste water and their significance—B.O.D., Sedimentation of Sewage, chemical treatment, biological flocculation and precipitation of water—sludge treatment and disposal—Self purification of water—Disposal by dilution and irrigation gas analysis—industrial waste-water disposal.

663. General Sanitation. 1 Unit (1-0) Second Term.

Refuse collection and disposal including incineration, Heating, Ventilation, air conditioning, dust, smoke and noise control.

Illumination—natural and artificial, street lighting Milk and Food Sanitation.

Pest Control.

Industrial Hygiene.

Rural Sanitation problems—including composting.

Market, School, Eating Establishments, Slaughter houses, Swimming Pool, disinfection etc.

Sanitary Survey & reporting.

Malaria Engineering.

Principles of Town planning and Housing.

664. Epidemiology. 1 unit (1-0) Third Term.

Origin and spread of more common diseases such as Malaria, Small-pox, Cholera, Typhoid, Plague etc. Relation between environment and health. Port health and quarantine.

665. Sanitary Engineering Laboratory, 1 unit (0-6).

Mineral and Routine analysis of water and sewage.

Treatment plant control experiments.

666. Pumping Machinery. 2 units (2-0) First Term.

General requirements—theory of suction lift and energy expand in pumping—various types of pumps design, utility and limitations, choice of pumps—pump control—electric motors—location of motors and control—location of pumping station—surge control operation and maintenance.

667. Engineering Seminar I. 1 unit (1-0) First Term.

668. Engineering Seminar II. 1 unit (1-0) Second Term.

669. Engineering Seminar III. 1 unit (1-0) Third Term.

Literature studies on Industrial waste, Biological waste treatment and unit processes like settling, filtration etc.

670. Principles of Economic Construction. 1 unit (1-0) Second Term.

General problems, Methods of comparing costs, capitalisation and annual expenses, Methods of calculating depreciation, Income, return and yield—Financing Endowment principles, Engineering economic analysis—Economic comparison of manual & Mechanical labour, Economic size of pipes—Economic characteristics of power using equipment and pipe line—pipe net work—Cost of construction, and treatment for water supply and sewage works.

671. Structural Design and Drawing I. 2 units (0-4) Second Term.

Guided design and drafting assignments as related to Steel Design (CE 607).

(For D.I.I.T. in Structural Steel Design)

672. Structural Design and Drawing II. 2 units (0-4) Third Term.

Guided design and drafting assignments as related to Steel Design II (CE 608).

(For D.I.I.T. in Structural Steel Design)
681. Hydrographic Surveying. 2 Units (1-2) First Term.


682. Wind Waves and Tides. 3 Units (2-2) First Term.


683. Harbour Engineering I. 3 Units (2-2) Second Term.


684. Harbour Engineering II. 3 Units(2-2) Third Term.


685. Port Facilities and Administration. 2 units (2-0) Third Term.

Layout and facilities of ports with special reference to type of cargo. Dock and wharf buildings—Transit sheds, ware-houses and other buildings. Cargo handling—appliances and methods. Transportation within the port boundaries. Factors making for rapid turn around and reduction of cargo handling costs.

Organisation and Management—Natural importance of harbours. Management and working of harbour undertakings of State ownership, municipal ownership, company ownership, port commissioner or port trustee ownership. Advantages, and disadvantage Internal organisation—Functions in board and out-board of ships, piloting, dredging, buoying, dry docking, customs etc.—Function and duties of various departments.

Administration—Indian Practice. Continental practice. Port of London system, London and Indian dock system. System of small ports. Department and organisation to deal with air, and inland transport. Importance of separation of engineering and general stores. Port planning and port charges, Accountancy and cost keeping. Dock labour. Passenger traffic working—safety measures, hygiene, comfort etc.

686. Seminar in Harbour Structures. 2 Units (0-2) Third Term.

Case histories and current advanced topics in harbour engineering.
611. Advanced Machine Theory. 2 Units.


612. Power System Stability. 2 Units, (Second and Third Terms).


613. Electromagnetic Fields. 2 Units.


614. Tensor: Analysis of Electrical Machines. 4 Units, (Third Term).


615. Energy Conversion. 2 Units, (First and Second Terms).


616. Principles of Automatic Control. 3 Units.


617. Electrical Engineering Materials. 4 Units (First Term).


619. Laboratory. 2 Units.

Experiments covering 611 to 617.

621. Control System I. 3 Units.


622. Control System II. 3 Units.

623. Control System Components. 3 Units.


629. Laboratory. 2 Units.

Experiments covering 621 to 623.

631. Advanced Machine Theory. 2 Units (First and Second Terms).


632. Power System I. 4 Units.


633. Power System II. 2 Units (Second and Third Terms).


634. High-voltage Engineering. 4 Units (Third Term).


635. Energy Conversion. 2 Units (First Term).


636. Principles of Automatic Control. 3 Units.


639. Laboratory. 2 Units.

Experiments covering 631 to 636.
641. Fundamentals of Electric Traction. 3 Units (First Term).


642. Electrical Equipment. 2 Units.


643. Power Supply. 2 Units.


644. Electric Locomotives. 2 Units (Second and Third Terms).


645. Signalling. 2 Units (Third Term).

Outline of the principles of block system and colour signalling such as track circuits, interlocking methods and automatic block signalling. Automatic train control.

646. Principles of Automatic Control. 2 Units.


649. Laboratory. 2 Units.

Experiments covering 641 to 646.

691. Utilisation of Electric Power. 2 Units (Second Term).

Transformers, motors and motor starters. Measuring instruments. Distribution and utilisation of power in chemical plants.

(For Chemical Engineers).

692. Electrical Technology. 2 Units.

Circuit theory, measuring instruments and measurements. Principles of operation of electrical machines and transformer.

(For Industrial Physicists).

ELECTRONICS AND ELECTRICAL COMMUNICATION ENGINEERING (Comm)

601. Fields and Waves. 4 Units, First Term.

602. Circuit Theory. 4 Units First Term.

Network matrices and topology, generalised network equations; Applications of Fourier Integrals and Laplace Transforms including signal analysis and transmission. Transient solutions including Transmission lines and filters: Convolution Integral—impulse method of solutions, Z-transforms, numerical techniques; Four terminal networks—matrices; Network functions, Nyquist and Bode plots, approximations, integral relations; Realizability criteria: Simple synthesis of immitances and transfer functions.

603. Electronic Control and Servomechanism. 3 Units, Second Term and 4 Units, Third Term.

Basic theory of automatic control, Servo elements and their equivalent networks. Block diagram analysis. Different types of servo amplifiers and their theories of operation. Magnetic amplifier. Some typical examples of electronic control, e.g. speed control of motors. Welding control, temperature control etc.


604. U.H.F. and Microwave Technique. 3 Units, Second Term. 4 Units, Third Term.


605. Communication Theory. 3 Units, Second Term.

Information and Entropy: Properties of Discrete signals—optimum coding methods, intersymbol influence; Code capacity, Language capacity and Channel Capacity; Message through noisy Channels, Redundancy—error correcting codes; Bandwidth and speed of signalling, sampling theorem and corollaries; signalling speed; power requirements, error probability and threshold. S/N ratios in digital systems; Continuous signals—properties of ergodic ensembles and random noise. Entropy, Rate of transmission and capacity. Information efficiency in analogue and digital modulation systems—comparisons.

606. Semiconductor Electronics. 3 Units, Second Term.

Electronic properties of semiconductor materials; energy distribution, Fermi level; current flow in semiconductors; theory of p-n junctions; thermoelectric, optical and magnetic effects; surface properties; Semiconductor devices; Semiconductor diodes; SCR; junction transistor—direct current theory and small signal theory; noise considerations; transistors in high frequency and switching circuits; special structures of transistors; tunnel diodes and related devices, other semiconductor devices.

607. Active Networks. 3 Units, Second Term.

Active elements—negative impedance converters, gyrators; Two-port networks—matrices, signal flow graphs, root loci, stability and physical realizability; Feedback theory, synthesis of Feedback amplifiers and serve systems—single loop and multiloop; Design of Pulse amplifiers; bandpass and wideband amplifier, D.C. amplifiers. Nonlinear and Time varying networks.

608. Audio Engineering (Electives). 3 Units, Third Term.

Vibrating systems—uniform strings, bars and membranes, Plane and spherical waves of sound. Free and forced vibrations. Sound propagation and transmission. Radiation from spheres and pistons. Analogy between electro-mechanical acoustic systems. Helmholtz resonator; acoustic filters,
Electro-acoustic transducers and instruments—their operation, design characteristics and measurements. Recording and reproduction of sound. Stereophonic systems; high fidelity systems. Hearing and speech—essential characteristics.

Architectural acoustics—normal modes, reverberation and articulation. Sound absorption and insulation, noise control and measurements. Studio and auditorium design.

Studio and control room equipment, Limiter amplifier, Broadcast programme sources, Monitoring.

Ultrasonics and its industrial applications. Recent developments.

609. Radar Engineering (Elective) 3 Units, Third Term.

Introduction, radar equation, Radar transmitter, microwave transmitting tubes (only functional approach), modulators; Radar receivers, noise considerations, R. F. amplifiers, crystal mixers, displays, Duplexers; Detection of Radar signal in presence of noise; Radar antennas, effect of broad-band signal on antenna patterns, Radomes; CW and FM radar, the Doppler effect; Airborne Doppler navigation, multiple frequency CW radar; Moving Target Indicator and Pulse-Doppler radar; Tracking radar sequential lobing, conical scan, monopulse, range tracking; Radar beacons, extraction of information from radar signals, phase and amplitude measurements, angular accuracy; propagation of radar waves, radiation hazards; clutter, weather and interferences, electronic, counter measures (ECM and ECCM); detailed study of one modern radar system.


Properties of Physical networks and their inter-relations-two-terminal networks and four terminal networks; Approximation in frequency domain and time domain; Synthesis of two terminal RLC networks; Synthesis of four terminal ladder, lattice and Bridge-T networks; Insertion loss theory; Special equalizers and filters; Synthesis with active elements—negative impedance converters, Tunnel diodes and gyrators.

611. Theory of Communication Systems (Elective) 3 Units Third Term.

Theory and technique of Modulation and multiplexing—quantization and code transmission; Efficient modulation systems—analogue and digital; Comparison of multiplexing methods—S/N ratios, information efficiency; Representation and design of signals, coding and decoding; Statistical dynamics-stationary random processes, linear correlation, optimum filtering and optimum prediction; Statistical decision theory and communications—reception of Radar signals; communication using Satellites.

612. Gas Discharge and Plasma (Elective) 3 Units Third Term.

Introduction of Kinetic theory of gases, ionization and deionizations; emission of electrons by ionic bombardment; Townsend discharge, glow discharge, arc discharge; gas-discharge lamps; High frequency field gas ionisation.

Plasma physics; thermonuclear plasma; Pinch effect, magnetic confinement of plasma; oscillations; e.m. wave interaction with plasma; ion and plasma Propulsion; thermionic energy conversion; elementary theory of magnetohydrodynamics.

613. Switching and Computation (Elective). 3 Units Third Term.

Analogue computers; Operational amplifier as an adder and an integrator, Solution of linear equations; Function generators and function multipliers; solution of nonlinear equations Digital Computers: Organisation in digital computers, elements of programming, FORTRAN.


614. Antennas (Elective). 3 Units Third Term.


615. Radio Wave Propagation (Elective). 3 Units Third Term.


616. Television (Elective). 3 Units Third Term.


617. Non-linear Control System (Elective). 3 Units Third Term.


618. Microwave Devices and applications. (Elective) 3 Units Third Term.


619. Pulse Techniques (Elective) 3 Units Third Term.

Linear wave shaping—pulse transformer, delay line, Nonlinear wave-shaping—multi-vibrators, blocking oscillator, trigger circuits and comparators, counters, multiplexing and demultiplexing. Analogue to digital and Digital to analogue converters, comb filters; applications to T.V., Radar, Computers and Telemetry.

620. Communications. 2 Units Second Term.

Principles of transistors, saturable reactors and magnetic amplifiers. Interference between power and communication circuits. Brief descriptive outline of the telephone and telecommunication arrangements.

(For Electrical Engineers)
652. Electronic Circuits and Applications. 3 Units.


(For Electrical Engineers)

653. Introduction to Electronics. 2 Units First Term.

Electron emission—different methods of emission ; Fundamentals of Vacuum tubes and their applications. Audio frequency voltage amplifiers; Simple analysis of R-C coupled amplifier; transformer coupled amplifier, R.F. Voltage amplifier ; Basic principles and applications.

Principles of power amplifiers, oscillators and power supplies ; Principles and simple application of C.R.T. and V.T.V.M. Gas analysis, temperature measurement and liquid level measurement.

(For Civil Engineers)

654. Electronics. 2 Units First Term.

Principles of Thermionic Emission ; Vacuum and gas tubes ; Transistor theory and characteristics ; Simple applications of thermionic tubes and transistors ; Transducers ; Simple control problems and related topics.

(For Mineral Engineers)

GEOLOGY AND GEOPHYSICS (Ge)

(a) Applied Geology

602. Photogeology. 3 Units.

Introduction to aerial photographic technique. Study of air photos of all prominent land forms. Interpretation of terrain conditions etc. from air photos. Techniques of preparing geologic maps from aerial photographs. Prerequisite. Ge 502.

610. Clay Mineralogy. 3 units.


611. Advanced Sedimentation. 3 Units.

Detailed study of different agents and environments of sedimentation.

613. Ground Water Geology. 2 Units (2-0) First Term.

Study of hydrologic cycle. Geology and occurrence of groundwater, Quantitative geohydrology ; pumping, determination of permeability and groundwater inventory. Development of groundwater well types and yield. Quality of water. Occurrence of groundwater in India.

(For Civil Engineers).

614. Engineering Geology. 2 Units (2-0) Second and Third Terms.


(For Civil Engineers).

621. Principles of Ore Deposition. 2 Units.

A generalised review of the theories of ore genesis ; Foremation of minerals ; Formation of mineral deposits ; Controls in mineral localisation.
622. Selected topics in Pre-cambrian Stratigraphy. 3 Units.

Special stratigraphic methods for Pre-cambrian rocks. Precambrian stratigraphy of Singhbhum, Mysore, Rajasthan, Madhya Pradesh and other important areas. Precambrian palaeogeography.

625. Mineral Economics. 1 Unit.


630. Selected topics in ore deposition. 3 Units.

Mode of occurrence and theory of origin of the main types of ore deposits. Geochemical approach to the problem of ore genesis. 'Controls' of ore localisation.

632. Studies in metallic and non-metallic deposits. 6 Units.

Intensive studies on the occurrence, distribution, geology, genesis and exploitation of metallic and industrial non-metallic minerals, with special reference to Indian deposits. Intensive laboratory work, assaying, mineral investigation, testing for their suitability for standard specifications.

633. Subsurface geologic methods. 4 Units.

Advanced techniques of investigation and interpretation of complex geologic features in the field. Physical, electrical and mechanical methods of logging. Subsurface mapping. Different techniques of subsurface correlation.

634. Coal Geology. 6 Units.


635. Petroleum Geology. 3 Units.


635A. Geology & Geochemistry of Petroleum. 3 Units.


636. Selected topics in Exploration & Prospecting methods and in Mining Geology. 6 Units.


(B) Geophysical: review of the basic principles of Gravity, Magnetic, Electrical and Seismic methods. Integration of geology and geophysics. Mining and oil geophysics—choice of methods. Limitations.

636A. Geological Prospecting. 3 Units.


637. Selected studies in Groundwater Geology. 4 Units.

638. Selected Studies in Engineering Geology. 6 Units.

639. Exploration planning. 1 Unit.
Plans for different types of survey. Organisation, cost, personnel, duration and field technique. Party programme. Safety and other regulations.

640. Selected topics in post-Precambrian Stratigraphy. 3 Units.
Stratigraphic details of significant areas of Palaeozoic; Mesozoic and Tertiary rocks. Problems of interregional correlation. Stratigraphic record as key to environment. Palaeo-geographic regions. Coal and petroleum-bearing stratigraphic units.

641. Selected topics in Structural Geology of ore deposits. 4 Units.
Localisation of syngenetic and epigenetic ore bodies in rock structures of different scales. Examples of structural controls of ore deposits from well-worked districts of the world. Time relations between formation of different structural elements and the origin of the ore-forming fluids.

642. Hydrology. 2 units.

650. Field Mapping (at least two weeks of professional training and project based on roughly 8 weeks of field work and 10 weeks of laboratory work).

652. Seminar. 3 Units.
Presentation of a published paper, summarising some papers or presenting original work in the form of a talk. Each student is required to give a talk once a term.

655. Thesis/Project.

656. Geotechnics. 4 Units.
Mechanical properties of rocks, porosity, adsorbed water, unit weight of rocks, compressive and tensile strength of rocks; compression of rocks, moduli of elasticity and compression.

657. Special studies. Units by arrangement.
Advanced study on some selected topics of geology under the guidance of a teacher.

658. Techniques of Mineral Investigation. 2 Units—First Term. 2 Units—Second Term.
Principles and techniques of investigation of opaque minerals in reflected light.
Identification of ore minerals, their texture and paragenesis.
Ore microscopy as an aid to ore-dressing: Examination of milling and flotation products at all stages.
Coal petrography.
X-ray diffraction, flame photometry, spectro-chemical analysis and fluoroscopic investigation of minerals.
(For Mineral Engineers).
(b) Exploration Geophysics

660. Tectonophysics. 4 Units.

Tectonic framework of the earth's crust. The pattern, space and time relations of mountain chains and island arcs. Structural features of continents and ocean basins. Analytical treatment of the forces leading to the deformation of the earth's crust.

661. Introduction to Physical Oceanography. 2 Units—Second Term.


662. Theoretical Geophysics. 4 Units.

Selected topics in theory of fields as applied to geophysical problems. Theory of electromagnetic and seismic wave propagation in the earth. Assigned reading according to student's need. Contents of the course may vary from year to year.

663. Advanced Seismology. 4 Units.

Brief review on earthquakes and seismic waves. Seismic rays in an earth model. Velocity distribution from travel-time curves. Amplitude of surface motion and energy of the waves. Interpretation of seismograms for various types of earthquakes.

664. Nuclear Geophysics. 2 Units.

Continuation of Ge 464. Selected topics of Radiation Physics and their application to geophysical problems including investigations within bore holes. Recent developments.

665. Nuclear Geology. 3 Units.


666. Physics of Solids. 4 Units.


668. Mathematical methods in Geophysics. 6 Units.


672. Petrophysics. 2 Units.

Analysis of physical properties of rocks. The mechanical, electrical, magnetic, elastic, thermal and nuclear properties of rocks under various geological and physical conditions. Assigned reading. Laboratory and field measurements. Integration and relationship among various physical properties.

675. Subsurface Geophysical Methods. 4 Units.

Selected topics in well-logging in its various aspects. Recent developments in field procedure and technique. Subsurface mapping.
678. Reservoir Geophysics. 3 Units.


682. Surface Geophysical Methods. 6 Units.

Selected advanced topics in Gravity, Magnetic, Electrical and Seismic methods of geophysical prospecting. Recent developments.

684. Analysis and Interpretation of Geophysical Data. 6 Units.


685. Exploration Planning and Case Histories. 2 Units.

Planning for geophysical exploration in oil industry, mining and other projects. Integration of various exploration methods. Typical case histories.

686. Geophysical Instrumentation. 4 Units.

Theory of instrumentation in all branches of exploration geophysics. Laboratory work including design and construction of basic instruments.

692. Special Studies. (Units by arrangement).

Advanced studies on some selected topics of general or exploration geophysics under the guidance of a teacher.

695. Seminar II. 3 Units.

Review of topics and papers on Geophysics. Each student is required to give a talk once a term.

696. Field Geophysics III. (Units by arrangement).

698. Research and Thesis (Units by arrangement.)

A student is required to take up an independent investigation in some branch of Exploration Geophysics under the guidance of a teacher. A properly supervised and accepted technical report on the investigation has to be submitted.

Facilities for research exist in the following lines:

(a) Petrophysics
(b) Gravimetry and Magnetometry
(c) Geoelectricity and Prospecting
(d) Applied Seismology & Prospecting
(e) Radiometry
(f) Geophysical Instrumentation and Models.
(g) Theoretical Geophysics.

(c) Geochemistry

612. X-ray Crystallography—4 Units.

Theory and practice of X-ray diffraction methods as applied to minerals and rocks.

615. Introductory Geochemistry. 2 Units.

Elements of cosmochemistry. Introduction to distribution of elements with emphasis on the lithosphere. Principles of thermodynamics and crystal chemistry and their application to geochemistry.
616. Theoretical Petrology. 3 Units.
Thermodynamics, Crystal Chemistry and silicate phase equilibria, their application to petrology.

617. Geochemistry I. 3 Units.
Abundance and distribution of elements. Detailed consideration of the geochemistry of lithosphere—geochemical processes.

618. Geochemistry II. 4 Units.
Phase equilibria in systems of importance to economic geology and petrology, e.g., in common carbonate, sulphide and oxide systems.

626. Inorganic Chemistry for Geochemists. 2-4 Units.
Discussion of the chemistry of Li, Be, B, rare earth elements, Ti, Zr, Si, Ge, V, Mo, W, U, Mn, Ni, Co, Fe, Al.

627. Physical Chemistry for Geochemists. 2 Units.
Thermochemistry, Chemical Kinetics, Solutions, Electrochemistry, Colloids.

628. Analytical Chemistry for Geochemists. 6-8 Units.
Chemical analysis of ores, rocks, and minerals.

643. Geochemical Prospecting (Theory). 2 Units.

644. Geochemical Prospecting (Field / Lab.). 3 Units.
Soil sampling in an unknown area. Semiquantitative estimation of the elements concerned. Processing and interpretation of obtained data.

667. Special studies in Geochemistry. Units by arrangement.
Advanced study on some selected topic in geochemistry under the guidance of a teacher.

655. Thesis/Project

HUMANITIES AND SOCIAL SCIENCES (Hu)

601. Introductory Psychology. 3 Units (3-0) First Term.
Use of basic psychological concepts from everyday life to give the student a practical understanding of the behaviour of people in organisations—Study of principles underlying motivation, perception, personality etc.

602. Industrial Economics. 3 Units (3-0) First Term.
Characteristics of Indian Industrial Structures—Market structure—Economic planning—Principles of Governmental control and regulation of industry—Industrial revolution—Public sector and private sector—Standards and cost of living etc.

603. Psychology of Industrial Relations (including Human Relations). 3 Units (3-0) First Term.
Broad treatment of industrial relations problems like supervision, wage incentives, industrial conflicts etc. with emphasis on their psychological aspects.
604. Social Psychology (Group Dynamics). 2 Units (2-0) First Term.

Study of influence of the group on the individual personality—Group formation and group standards in an industrial setting—Study of Principles underlying leadership management, organized group effort etc.

605. Selection and Placement of Personnel. 2 Units (2-0) Second Term.

Selection and Placement of Workers. Matching of workers' abilities with job requirements—job analysis—Traditional selection procedure and its drawbacks. The application form and psychological problems of learning—Psychological tests—Interview and its technique—Usefulness of Board and person to person interview—Training—Placement of handicapped.

606. Physiology of Work. 2 Units (2-0) Second Term.

Nature of human work—variation in production and their psychological and physiological causes—Means of counteracting fatigue factors by proper adjustment of hours of work, rest pauses, environmental conditions of work, human engineering and its practical aspects.

607. Labour Movement and Labour Organisation. 3 Units (3-0) Second Term.

History and development of the Indian labour movement—National trade union organisations—The employers' organisation—Discussion of their policies and practices—A comparison of origin, development and present status of labour movements in selected countries with particular emphasis on England, Russia and United States. Industrial Conflict and Union-management relations—characteristics and trends of industrial co-operation. Worker's participation—problems of collective bargaining etc.

608. Industrial Hygiene. 3 Units (3-0) Second Term.

Human physiology with special reference to central nervous system, voluntary and involuntary musculature—autonomic nervous system etc.—General problems of industrial hygiene—its physiological, psychological and chemical aspects. Discussions of chemical hazards like lead, Physiological hazards of heavy work and psychological hazard like accident—proneness, monotony etc.

609. Consumer Research and Mass Media. 3 Units (3-0) Third Term.

Discussion of underlying principles—Study of attention, interest, desire, Psychology of volition and other processes involved in response to advertisement—Application of these principles. Public opinion—market research, propaganda etc.

610. Governmental Labour Policy and Labour Legislation in India. 2 Units (2-0) Third Term.

The India Government's labour policy before and after 1947. General characteristics of labour legislation in a welfare state—Study and discussion of Specimen aspects of the Factory Act—Industrial conciliatory machinery like the Industrial Tribunal etc.

611. Research Methodology. 3 Units (3-0) Third Term.

Techniques of ranking, rating paired-comparison, attitude measurement etc. Present day procedure of sampling, interview design, question formulation, interviewing—Their application to merit rating, for measuring job-satisfaction and morale and securing worker's opinions and attitudes regarding diverse issues. Psychometrics—Statistical methods like mean, mode, median standard deviation, correlation-analysis, analysis of variance, elements of factor analysis etc.

612. Personnel Administration. 3 Units (3-0) Third Term.

Objectives and methods of personnel administration. Discussion of post-war trends in personnel administration—Discussion of specific personnel problems in connection with Works Committee, Joint Productivity Council, Grievance procedure etc.

613. Labour Welfare and Social Security. 1 Unit (1-0) Third Term.

614. Laboratory Practical.  1 Unit (0-2).
615. Project work.  14 Units Fourth Term.

713. Urban Land Economics.—1 Unit—Third Term.

Institution property—an over-all survey of land as a resource and demand for land due to various activities of main characteristics of urban land—forces in estate market—supply and demand—competition for land uses.

Land values—existing use—value and development—value variation trends—effects of land—uses and planning proposals on land values—betterment levy and compensation. Principles of variation of properties.

Economics of redevelopment and evaluation of alternative Schemes—density pattern for city. Public revenue and expenditure in relation to land development—Metropolitan explosion and agricultural interests.

716. Urban and Rural Sociology.—1 Unit—First Term.

Introduction and scope of the subject—General characteristics of modern society as contrasted with rural society.

Demography and migration.

Development of modern cities—city as political, economic and cultural centre.

The ecological patterns of urban development—the social and institutional structure of urban communities—characteristics of highly developed cities with special emphasis on the problems of social control in urban society—Agencies of social and control in rural community.

717. Economics of Development.—1 Unit—First Term.


Growth of Urban Economy.

Industrial location policies—Economic base of a settlement—Economics of public borrowings—public undertaking—India’s Five year Plans—Economic development in relation to regional planning.

MATHEMATICS (Ma).

611. General Mechanics.  2 Units (2-0), Second Term.

Rigid dynamics, three dimensional statics, Lagrange’s equation and related topics.

612. Mechanics of Continuous Media.  4 Units, First Term, 2 Units Second and Third Terms.


613. Mathematical Methods in Engineering.  2 Units (2-0), First and Second Terms or 4 Units, one term.

614. Engineering Mathematics. 2 Units (2-0), First and Second Terms.


618. Advanced Techniques in Mathematics. 2 Units, First and Second Terms.

Tensors, Transforms, Selected Special Functions.

619. Non-linear Vibration. 4 Units (4-0), Third Term and Gyrostatics.

Ordinary non-linear differential equations, The simple pendulum, Non-linear spring control with and without viscous damping, Simple gyroscopic phenomenon, Tops, Gyrocompass, Ship stabilizers, applications to aircrafts and stability effects.

620. Selected Topics in Non-linear Mechanics. 4 Units (4-0), Third Term.

Non-linear problems in elasticity and fluid mechanics arising out of (1) Body stress equations, (2) Boundary conditions, (3) Strain components, (4) Stress strain relations.

621. Selected Topics in Plasticity and Rheology. 4 Units (4-0) Third Term


626. Partial Differential Equations. 2 Units (2-0), First Term.

Classification of Partial differential equations and their solutions, Power series solutions and existence theorems, Characteristics surfaces, Bicharacteristics, Discontinuities and singularities, Initial value problems and Boundary problems.

627. Classical Theory of Electrodynamics. 2 Units (2-0), Second Term.


628. Mechanical Properties of Materials (2-0), 2 Units, Second Term.

Relation of structure to mechanical behaviour of bodies, Real Engineering materials, Ideal materials, mechanical properties of Ideal plastic bodies, Work-hardening bodies.

629. Selected topics from Magnetofuidodynamics. 4 Units (4-0), Third Term.

Fundamental equations of Magnetohydrodynamics and their applications, Hydro-magnetic effects in Boundary layer theory and Heat transfer problems.

630. Theory of Hydromagnetic stability and Wave Motion, 2 Units (2-0), Third Term.

Study of Hydromagnetic rotational and Thermal instability and some related problems.

631. Transition theory in continuous media. 2 Units (2-0), Third Term.

The fundamentals of transition theory and its application to cylinders under uniform pressure, bending of a rectangular sheet and torsion of a circular cylinder.

632. Plasma Dynamics and Relativistic fluid dynamics. 4 Units, Third Term.

633. Analog Computation and Simulation. 2 Units (2-0), Second and Third Terms.

635. Mathematical Methods. 4 Units (4-0), First Term.


641. Numerical Methods and High Speed Computation. 2 Units, Second and Third Terms.

Numerical differentiation and integration, Numerical solution of algebraic equations, Numerical solution of ordinary, partial and integral equations, Harmonic analysis, Elements of programming on Analog and Digital computers.

642. Theory of Probability and Statistical Methods. 2 Units, Second and Third Terms.

Probability : Fundamental theorems on probability, Bayes’ theorem, Expectation, Runs and renewal theory, Markov chains and stochastic processes, Entropy and Information.

Statistical Methods : Summarisation of data, characteristics of frequency distribution, Moments and Cumulants, Binomial, Poisson and Normal distributions, Bivariate and multivariate normal distributions, Correlation and Regression, Sampling Theory of estimation and tests of significance.

643. Statistical Methods for Agriculture and Biology. 2 Units.

Frequency distribution, Histogram, Measures of location and Measures of dispersion, Co-efficient of variation, Binomial, Poisson and Normal distributions.


644. Statistical Methods. 2 Units, Third Term.


646. Statistics for Chemical Engineers. 2 Units, Third Term.

Probability theory and statistical methods, Design and analysis of experiments, Principles of sampling.


647. Computational Techniques. 2 Units, Third Term.


648. Statistical Methods for Municipal Engineers. 2 Units, First and Second Term.


652. Engineering Statistics. 4 Units, First Term.

657. Mathematics (including Analogue Computation and Simulation).  2 Units, Second and Third Terms.


(For Electric Traction students).

680. Theory of Shells and Plates.  2 Units (2-0), Third Term.

The Applications of the fundamental equations of Shells and Plates to some problems of practical interest.

681. Mathematics.  (For Soil Technologists and Farm Management Technologists). 2 Units, First and Second Terms.

Simple properties of Trigonometric functions Limits, Continuity, Differentiation of simple functions, Successive differentiation, Integration of simple functions. Ordinary differential equations.

682. Selected Topics in Statistics.  (Units to be determined by the needs of Research Workers).


683. Data Analysis and Programming.  1 Unit, First and Second Terms.

Introduction to statistical methods—Data, Variables and attributes—concept of population and sample—presentation techniques—figures, diagrams and tables—frequency distribution, measures of average and scatter, Correlation and regression.


Allocation models, linear programming, the assignments problems, computation techniques. Introduction to waiting time models. The theory of games related to urban economic phenomena. Storage and interpretation of data by use of computers. Other simulation techniques.

684. Vector Analysis and Matrices.  3 Units, First Term.


685. Theory of Complex Variables.  2 Units, Second Term.


686. Ordinary and Partial Differential Equations.  3 Units, Second Term.

687. Operational Methods. 2 units, Third Term.


MECHANICAL ENGINEERING (ME)

6021. Foundry Technology (I). 4 Units Second Term.

Design of patterns, Moulds and mould forming. Foundry Sands—testing and control.
Design of cupola and refractories.

6022. Foundry Technology. 4 Units Second Term.


6031. Foundry Metallurgy : 4 Units Third Term.


6032. Foundry Equipments and Controls. 4 Units—Third Term.

Design of Foundry Machines—Moulding, core making, sand conditioning, etc. (Detail design of any one of the machines). Baking ovens and Heat Treatment furnaces. Instruments and controls for foundry equipments.

6033. Foundry Technology II. 4 Units Third Term.


6034. Chemistry of sands, clays and binders. 4 Units Third Term.

Classification of clay minerals. Origin of clays.


6111. Advanced Engineering Economics. 4 Units First Term.


6112. Work Study-I. 4 Units First Term.


6121. Design and Operation of Controls in Industry—I. 4 Units Second Term.

Analysis and decision for production target. Production Planning. Design and operation of internal communication control for production—Control of inventory. Distribution planning and control.


6123. Work Study—II. 4 Units Second Term.


6124. Principles and Practice of Management. 4 Units Second Term.


6125. Industrial Engineering : 4 Units Second Term.


6131. Design and Operation of Controls in Industry—II. 4 Units Third Term.


Acceptance of quality: various sampling techniques and their o.c. curves. Analysis for the selection and design of optimum scheme. Organising for quality.

6132. Design and Operation of Controls in Industry—III. 4 Units Third Term.

Productivity—concepts and measurements. Productivity analysis and controls—personnel, inventory, equipment, capital, control of internal transport and mechanisation and cybernetics in management control, automation, administration of wages plans.

6133. Factory planning and plant engineering. 4 Units Third Term.


6134. Personnel Management and Industrial Relations. 4 Units Third Term.

6181. Plant Management. 3 Units—Third Term.


6191. Elements of Industrial Engineering. 3 Units Third Term.


6192. Quality Control. 3 Units Second Term.


6211. Production Engineering. 4 Units First Term.


6221. Metal Cutting Sciences. 4 Units Second Term.


6222. Welding Principles and Techniques. 4 Units Second Term.


6231. Advanced Metrology. 4 Units Third Term.


6232. Machine tool engineering. 4 Units Third Term.


6233. Metal forming sciences. 4 Units Third Term.


6234. Tool Engineering. 4 Units Third Term.

Design of form tools, reamers, milling cutters, broaches and form generating tools. Tooling of automatics. Jigs and fixtures. Standardisation,
6271. Production Engineering—I. 3 Units First Term.


6272. Mechanical Technology. 3 Units First Term.


6281. Production Engineering II. 3 Units Second Term.


6311. Advanced Engineering Thermodynamics I. 4 Units First Term.


6312. Heat Transfer I. 4 Units First Term.


6313. Advanced Fluid Mechanics. 4 Units First Term.

Incompressible flow without friction. Continuity and momentum equations. Flow past bodies. Infinite and finite wing theory.

Compressible flow. Isentropic flow with area change. Shock flow in one dimension. One-dimensional flow with friction and heat transfer. Gas injection and combustion.

Flow with friction. Navier-Stokes equations, and exact solutions, Boundary layer theory, laminar and turbulent; boundary layers; drag; boundary layer control.

Applications to fluid machinery, lubrication, propulsion system and aerodynamics.

Laboratory exercises.

6321. Advanced Engineering Thermodynamics—II. 4 Units Second Term.


6322. Heat Transfer—II. 4 Units Second Term.

6323. Fluid Mechanics and Heat transfer. 4 Units Second Term.


6331. Gas Dynamics. 4 Units Third Term.


6332. Air Conditioning. 4 Units Third Term.


Fans—laws and characteristics and drive selection. Elementary acoustics. Typical air conditioning equipment and evaporative coolers with automatic controls and accessories considered in relation to particular problems.

6333. Low Temperature Refrigeration. 4 Units Third Term.


6381. Steam Power Engineering. 3 Units Second Term.

Fuels: Position in India—combustion principles, problem in burning low grade fuels.

Steam generators and auxiliary plants, steam turbines, condensers, fuel and ash handling equipment, oil and water circulation system, cooling towers. Nuclear steam power plant.

Performance, testing and control of steam generators and turbines. Layout of typical steam power plant. Economics of steam power.

6431. Gas Turbines and Compressors. 4 Units Third Term.

Open and closed cycles, effect of variables, turbojet analysis and characteristics, thrust augmentation.

Axial and radial inflow turbines, axial and centrifugal compressors, combustion chambers, heat exchangers.

Blade stresses, vibration and cooling, dynamic similarity and noise, materials.

Characteristics of gas turbines for application to aircraft, automobile, locomotive, marine, etc.

6432. Internal Combustion Engines. 4 Units Third Term.


6433. Combustion, Fuels and Lubricating oils. 4 Units Third Term.

Combustion of solid, liquid and gaseous fuels, combustion theories, reaction kinetics, heat and mass transfer. Pre-flame reactions, flame propagation, stability and quenching.

Lubricating oil characteristics, friction and wear, solid, liquid, gaseous lubrication. Testing and specification of lubricating oils.

6434. Refrigeration Applications and Cold storage of Products. 4 Units Third Term.


Calculation of heat gains through insulation, product loads and air infiltration. Warehouse design. Maintenance of refrigeration systems and conditioned chambers.

6435. Refrigeration Units. 4 Units Third Term.

Air cycles and their applications. The vapour compression cycle including its many modifications and different applications. Details of the different components of vapour compression systems—compressors, condensers, evaporators and expansion devices. Steam jet systems. Absorption systems. Auxiliary equipment and automatic controls for refrigerating systems.

6436. Steam Turbines : 4 Units Third Term.


Special problems of large steam turbines. High pressure, high temperature expansion. Blade vibration. Design of condensers and accessories.

6437. Steam Generators. 4 Units Third Term.


6438. Nuclear Power Stations. 4 Units Third Term.

Survey of world power resources. Importance of nuclear power with special reference to India. Economics of nuclear power.


Reactor heat transfer, Reactor instrumentation and control.

Engineering properties of special materials. Analysis of power cycles incorporating nuclear heat sources and various working media. Layout of nuclear power stations.

Special operational problems.

6439. Fuels and Combustion. 4 Units Third Term.


Combustion principles—combustion of solid, liquid and gaseous fuels—combustion equipment—suspended combustion in radiant furnaces.

6511. Structural Design of Handling Equipment—I. 4 Units First Term.

Analysis of stresses and strains in three dimensions. Curved Beams; Beam columns; Torsion of non-circular members; Buckling of column and plates; Stress concentration. Analysis, basic principles and design of crane structures; Detailed study of plane frames. Influence line diagrams due to travelling loads, elastic deformation of framed structures. Assumptions of various types of loads and dead weights of different structures. Calculation of the allowable maximum stresses. Construction of lattices and plate structures of rivetted and welded types.

6512. Machine Elements Design. 4 Units First Term.


6521. Structural Design of Handling Equipment II. 4 Units Second Term.

Analysis of forces of determinate, indeterminate and redundant framed structures. Detailed force analysis and design of overhead travelling crane structures. Analysis of forces and detailed design of the jib of fixed and luffing types of rotary jib cranes. Design of structures pertaining to derricks, gantries and columns.

6522. Principles of Material Handling and Handling Devices 4 Units Second Term.

Principles of materials handling, classifications of the materials handling equipment—their characteristics and application principles, packaging and storage of materials, operation analysis and study of travel diagrams and flow process charts. Preparation of a new proposal.

6531. Design for Fatigue and Creep. 4 Units Third Term.


6532. Design of Gears and Hydraulic Drives. 4 Units Third Term.


Hydro-kinetic drive, fluid coupling, torque convertor, fluid dynamometer.

Hydro-static drive, positive displacement pumps and motors, controlling valves like relief valve, by-pass valve, throttle valve, direction control valve, etc., filters, hydraulic servomotor, different hydraulic circuits. speed control, hydraulic copying devices.

6533. Design of Machines and Machine Tools. 4 Units Third Term.

Individual finished designs by students of selected machine components applying the fundamentals covered in the other courses and also taking into account such factors as form, utility, cost and reproducibility.


6534. Cams and Tooth outlines and multiple gear drives. 4 Units Third Term.


Tooth gearing—plane gearing, involute and cycloidal gearing, non-circular gears, space gearing, Bevel gearing, cylindrical gears with screw type teeth, worm gearing with cylindrical form of worm, cycloidal worm gearing. Kinematics and design of multiple gear drives.
6535. Mechanics and Design of Hoisting and Lifting Equipment. 4 Units Third Term.

Kinematics and dynamic analysis of the various component mechanism and design procedure of: (a) screw jacks, pulley blocks, winches and hoists, (b) hand operated and electric overhead travelling cranes and telpers, (c) stationary and travelling rotary jib cranes with fixed and level-luffing arrangements, (d) portal and semi-portal cranes, (e) tower cranes, derrick cranes, and mobile cranes, etc.

6536. Mechanics and Design of Conveyors and Elevators. 4 Units Third Term.

Kinematics, dynamics analysis and design procedures of various component mechanisms of (a) Scraper Apron, Plate and Belt conveyors (b) Belt and Chain Bucket elevators, (c) Screw and ribbon conveyors (d) Overhead Chain trolley conveyors, (e) vibrating rough conveyors and (f) Pneumatic conveyors.

6537. Mechanics and Design of Special cranes. 4 Units Third Term.

Kinematic analysis, functioning principles and design procedure of different constituent members of Underhung slewing cranes, Locomotive cranes, Ladle cranes, Ingot moulding cranes, Charging cranes, Stripper and soaking pit cranes, Annealing cranes, Scrap yard cranes and various types of Cable cranes.

6571. Machine Elements Design. 3 Units First Term.

(Same as ME 6512 but LDF of one unit only to suit the particular course).

6572. Engineering Drawing. 3 Units First Term.

Drawing standards and practice orthographic and Isometric projection. Freehand sketching, Drawing of machine elements, Reading of blue prints of detail and assembly drawing of machines.

6611. Machine Vibrations. 4 Units First Term.

Kinematics of vibration of single, two and multi-degree freedom systems, vibration, forced vibration, vibration with and without damping, transient and steady state vibration. Solutions of vibration problems by classical method, energy method, Lagrange equation, numerical method, matrix method and phase plane method. Vibrations of continuous systems.

6612. Theory of Elasticity and Plasticity. 4 Units First Term.


Plastic deformation and plastic stress strain relationships. Yield criteria. Problems in plastic flow of ideally plastic materials. Application to bars, beams, tubes, rotating discs, etc. Problems in plastic flow of strain-hardening materials.

6621. Mechanisms. 4 Units Second Term.


6622. Experimental Stress Analysis. 4 Units Second Term.


6623. Advanced Strength of Materials. 4 Units Second Term.

Three dimensional stresses, theories of failure. Stresses and deformation in thick walled cylinders. Compound cylinders, stresses and deformation in rotating discs of constant and varying thickness—analytical and graphical solutions. Unsymmetric bending, Shear centre, Curved beams circumferential and radial stresses, deformation of curved machine members,
stresses and deformation in closed rings and links. Beams on continuous elastic support. Theory of thin shells. Beam-columns-analytical and graphical-solutions. Bending of flat plates—stresses and deformation in circular and rectangular plates. Contact stresses—point and line contacts. Stress concentration due to geometric discontinuities.

6624. Instruments and controls. 4 Units Second Term.

Design principles of instruments for measuring temperature, pressure, level of liquid, velocity of flow, mechanical displacement, velocity and acceleration, etc. Accuracy and sensitivity. Dynamic behaviour of the Instruments.


Application of the theory to the problems of designing automatic controls for temperature, pressure, level of liquid, mechanical dimensions, etc.

6625. Vibration and Shock Isolation. 4 Units Second Term.

Absorbers; transmissibility, isolation, shock mounting. Dampers: friction, hysteresis magnetic, Construction, materials and measurements.

6626. Analysis of Stresses. 4 Units Second Term.

Three dimensional stresses, Theories of failure. Elements of elasticity theory. Stresses in thick cylinders, curved beams and of symmetrically loaded beams. Thermal stresses.


6631. Theory of Lubrication and Bearings. 4 Units Third Term.

Hydrostatic lubrication. The generalised Reynolds' equation and its application to analysis of sliders, tilting pad, journal bearings, partial bearings, thrust bearings, externally pressurised bearings and dynamic loading.

Heat balance in bearings.
Theories of dry friction and boundary lubrication.
Effect of materials and lubricants on wear.

6632. Non-Linear Vibrations. 4 Units Third Term.

Non-Linear systems. Undamped, amped, self-excited, forced and parametrically excited non-linear vibration of single and two-degree of freedom and continuous systems. Isolators and non-linear characteristics, Stability theory and criteria of non-linear systems.

6633. Noise and Random Vibrations. 4 Units Third Term.


6681. Analysis of Stresses. 3 Units Second Term.

(Same as 6626 but I.DF of 1 unit only to suit particular course).

METALLURGICAL ENGINEERING (Met.)

601. Experimental Methods in Metallurgy. 1 Unit.

Methods of obtaining high temperatures, temperature control, in furnaces, controlled atmosphere, vacuum systems, vacuum melting and casting, heat treatment techniques, powder metallurgy, preparation of pure metals and single crystal, advanced microscopic techniques, phase contrast, interference fringes, lineal analysis, point counting, electron microscopy and diffraction, use of strain gauge. Different methods of measuring activity of solid and liquid
603. Ferroalloy production. 2 Units.

Basic concepts of thermodynamic principles governing carbothermic, silicothermic, and aluminothermic reduction of oxides. Role of ferroalloy industry in iron & steel making. Technology of some typical ferroalloy production incorporating recent advances in technology.

604. Plant layout and Furnace design. 2 Units.

General plant layout in an integrated steel plant-functional relationship among different units. Impact of modern improvements of the technology on the layout of an integrated steel plant. Essential features of design of iron & steel making units—blast furnace, converters, open hearth furnaces, recent advances in the theories of design of such units. Suitability and limitations of application of operational data in design.

605. Recent trends in Ferrous Metallurgy. 2 Units.

Critical appraisal of improved techniques in iron & steel making to increase productivity of units and quality of product, based on recently developed technology. High top pressure operation of blast furnace fuel injection in blast furnace, oxygen steel making in converters, open hearths and other units, vacuum and continuous castings, casting under pressure, application of tracer techniques.

606. Pyrometallurgy of Non-ferrous metals. 2 Units.

Theoretical aspects of roasting and sintering, sintering machines and its design, non-ferrous blast furnaces and reverberatory furnaces, thermodynamics of blast furnace and reverberatory furnaces smelting, theoretical foundations of slag and matte formation, constitution of slags, matte-slag equilibria, converter processes, design of converters, thermodynamics of converting, refining techniques—Theoretical aspects, electrosmelting process.

607. Hydrometallurgy and Electrometallurgy. 2 Units.

Leaching process—temperature and kinetics, leachants, high temperature and high pressure leaching of sulphide and oxide ores, oxidative leaching. Metal recovery from leach liquors—ion exchange methods, high temperature and high pressure reduction by molecular gases, H₂, C, SO₂, use of catalysts, homogeneous catalytic reactions. Reversible and irreversible electrode processes in aqueous solutions and melts, electroconductivity and transport phenomena, decomposition potential in melts, their determination, polarization, metal recovery from molten electrolyte, electrode efficiency.

608. Recent advances in Non-ferrous Metallurgy. 2 Units.

Application of oxygen in non-ferrous metallurgy, modern processes for roasting, smelting, refining in non-ferrous metallurgy, fluidised bed roasting, flash roasting, cyclone melting, zone refining, hydrogen reduction of oxides, metallothermic reductions etc.

609. Physical Metallurgy. 3 Units.

Thermodynamical consideration of liquid-solid and solid-solid reactions in metals and alloys, application to phase diagrams and important alloy systems, kinetics of nucleation and growth in such transformations, application to precipitation phenomena. Decomposition of Austenite—Pearlitic, Bainitic and Martensitic reactions, modern theories, pro-eutectoid precipitation—growth and morphologies, review of recent work, tempering of plain carbon and alloy steels—precipitation of different types of carbides, effect of stress, precipitation phenomena in important non-ferrous alloys. Grain boundary, polygonised boundary, surface free energy, importance of dihedral angles—critical review of recent work.

The approach is primarily theoretical rather than descriptive—a substantial amount of reading to be assigned.
610. X-Ray Metallography and Electron diffraction. 3 Units.

Review of topics covered in the undergraduate level, different X-Ray diffraction methods, reciprocal lattice, intensity of diffraction lines, absent reflection and structure determination. Fourier method, effect of particle size, shape, strain, and stacking faults on diffraction lines. Applications—orientation determination of single crystals and its application in plasticity methods, powder methods, precision parameter determination, phase boundary, percentage of small quantities of other phases in a structure. Low angle scattering—structure of precipitation handed alloys, stress measurements, preferred orientation. Image formation and contrast from crystals, kinematical theory of diffraction contrast, effect of beam divergence, absorption etc., elements of electron optics, deflection in electrostatic and magnetic fields, magnetic lenses, spherical and chromatic aberration, resolving power, depth of field and focus, magnetic electron microscope—general description, electron gun, condenser, objective and projection lenses, calibration of microscope, selected area of diffraction, preparation of specimens, application.

611. Physics of Metals. 2 Units.

Review of topics of the undergraduate level, crystal structure, electrical and magnetic properties, transition metals, resonating valence bond theory, anti-ferromagnetism semiconductors. Specific heat of metals, different theories formation of vacant atomic sites, long and short range order, anti-phase domain. General alloy theory—factors operative, size factor, and influence of ionic radii alloy structures, applications, theory of electron compound super lattice formation, lattice spacing and effect of electron energy, effect of compound formation on solid solubilities in binary and ternary systems, application to commercial alloys. Anelastic phenomena in metals and alloys, stress-induced ordering, effect of cold work, point defects etc., Anisotropy of metals and alloys, modulus of elasticity and other properties, effects on phase transformations and plastic flow.

612. Dislocation theory and Mechanism of plastic flow. 2 Units.

Development of the theory, stresses due to edge and screw dislocations, strain energy of dislocations, interaction of dislocations, Lomer-Cottrell Barrier, partial dislocations, dislocation climb, jog formation, effect of solute atom on the energy of dislocation. Mechanism of plastic flow in single and polycrystalline metal, critical stress for dislocation movement, effect of crystal structure on crystallography of twinning, deformation bands. Stacking faults and their energy, energy stored in cold worked metal recovery, recrystallisation, and sub-boundary formation, energy of grain boundary. Deformation during creep and fatigue, anelasticity, internal friction in metals and alloys, Snoek's effect, stress induced ordering, Bauschinger effect, fracture—types of fracture, including cleavage, creep and fatigue, theories of fracture, brittle failure. Precipitation hardening, role of dislocations and precipitates, effect of plastic deformation.

613. Magnetic materials. 2 Units, Third Term.

Experimental methods for evaluating the magnetic properties Theory of ferromagnetism and paramagnetism. magnetostriiction. Preparation of ferromagnetic material by powder metallurgy methods. Different types of ferromagnetic materials and their uses.

614. High temperature materials. 1 Unit.

Creep and fracture at elevated temperature, metallurgical variables influencing properties of heat resistant alloys production and fabrication of heat resistant alloys, selection of high temperature materials for aircraft, gas turbines, steam power plant etc.

615. Mechanical working of metals—theory and applications. 2 Units.

Review of the topics of undergraduate level, detailed study of rolling, wire drawing, extrusion, deep drawing. Internal stress developed in different forming operation and its measurement. Critical review of the different theories of rolling, and their application, calculation of rolling load, torque, and their experimental measurement, power requirement in a rolling mill. Modern physical methods in control and inspection, optical methods, non-destructive testing, dimensional measurement, instrumentation of plant.

616. Powder Metallurgy. 2 Units.

Physical and chemical methods for production of metal powders. Compacting and sintering of alloy powder compacts and resulting properties of the finished compacts. Problems of adhesion, diffusion, recrystallisation, and grain growth as applicable to the field. Recent advances in powder metallurgy, dispersion strengthening, theories of compacting and sintering. Powder Metallurgy products—Cermets, Porous bearings, etc., industrial application of powder products with special reference to materials available in India.
617. Diffusion in metals. 2 Units.
Formal basis of diffusion theory, mechanism of diffusion, diffusion in alloys, and Kirkendall effect, grain boundary and surface diffusion, migration of grain boundaries, diffusion and high temperature oxidation of metals, gas-metal diffusion and internal oxidation, diffusion of sintering.

618. Advanced Phase diagrams. 2 Units.
Determination and interpretation of complex phase diagrams with emphasis on ternary systems. Familiarity with conventions used in representation of phase equilibria. Development of space perception with the help of mechanica aids like three-dimensional models, applications to important industrial alloys.

619. Theory of Metallurgical Processes. 3 Units.

620. Metallurgy of rare metals and atomic reactor metals. 2 Units.
General introduction to the rare metals and atomic reactor metals—classification of rare metals—survey of technological methods of obtaining rare and atomic reactor metals from their ores—metallurgy of W, Mo, V, Ti, Zr, Nb, Ge, U, Th, etc., properties of the metals and their compounds, fields of application of Physico-Chemical aspects of the reduction of the compounds, reduction by carbon, hydrogen, metallothermic reduction. Production of compact and ductile metal by metallothermic method, electrosmelting.

621. Foundry Science and Engineering. 3 Units.
Molding materials and sand compactions, special methods of molding and core making, solidification, risering and gating, gases in metals, mold-metal reactions, physical chemistry of melting and metallurgical control, metallurgy of cast iron and other casting alloys, malleable and ductile iron, special foundry practices.

Met 622. Material Technology. 4 Units, First Term.
(a) Crystal structure of pure metals, grain formation in metals, nucleation and grain growth, cold working of metals, deformation mechanisms, role of dislocations, effect of cold working on properties, annealing, structure of alloys, solid solutions etc., binary and ternary diagrams of simple systems, study of Fe-C, Cu-Zn, Cu-Sn, Cu-Ni, Al-Cu, Al-Mg systems, heat treatments and properties, T-T-T diagrams and their use, low alloy structural steels, heat treatment of alloy steels in general, special steels—stainless steel, special tool steel, spring steels, Hadfield Mn steel, alloys for high temperature use.

(b) Structure of atom, periodic classification of metallic and non-metallic elements, electronic configuration of important elements and its influence on the properties, bonds in metals and non-metals, free electron theory and Zone theory of metals, applications, electrical and thermal conductivity of metals, dia and para magnetism, specific heat of metals with special reference to those in transition group, ferromagnetism and magnetic materials, different types of bands in solids and their distinctive properties, Fermi energy, band theory of solids.

(For Mechanical Engineers).

624. Engineering Physical Metallurgy. 2 Units, Third Term.
The origin of a metallic structure by the freezing of a liquid e.g. grain formation, equiaxed and columnar grains, dendrites, behaviour of insoluble impurities during grain formation and effect on the properties of metals. Elastic and plastic deformation of single crystal and polycrystalline materials. Recovery, recrystallisation and grain growth of deformed material. Grain refinement, cold working and hot working, finishing temperature, elements of dislocation theory. Binary alloys—structural changes with temperature, equilibrium phase diagrams,
different methods used to determine the phase boundaries, thermal analysis, metallographic, electrical resistivity, X-Ray diffraction, magnetic analysis, dilatometry. Eutectic reaction structure of eutectic alloys, complete solid solubility and effect of incomplete diffusion during freezing cored dendritic structures, elimination of coring, partial solid solubility, structures of partially soluble alloys by slow cooling and rapid cooling, Widmanstatten structure, intermetallic compounds, peritectic reaction, some typical cases, ternary diagrams. Study of important ferrous and non-ferrous alloys.

(For Chemists and Physicists).

625. Corrosion. 2 Units, second and Third Terms.

Fundamental background with emphasis on special topics like Pourbaix diagrams, kinetics of corrosion processes, inhibitors, passivation, potential time, and polarization studies. Stress corrosion, environment effect and material aspect, role of stress and corroding media, minor impurity in materials. Hydrogen embrittlement, accelerated testing, modern methods of corrosion studies. Oxidation of metals and alloys, mechanism of oxidation processes, alloying elements, effect on the rate processes.

630. Seminar. 1 Unit.

MINING ENGINEERING (Min.)

611. Plant Design and Ore Processing. 1 Unit—Second Term and 4 Units—Third Term.

Ore handling equipment—Conveyors and elevators; Pneumatic and hydraulic transport. Storage and stockpiling of minerals. Design of mineral dressing plants, selection and layout of major equipment. Cost analysis. Economics of mineral beneficiation.

Study of major mineral beneficiation plants in India.

Project work on plant design.

612. Advanced Mineral Economics. 2 Units—Third Term.

Study of Mineral market, Trends of production and consumption.

World and Indian mineral resources.

Mineral conservation—its need and enforcement.

Optimum exploitation of mineral resources for industrial development.

Sampling—theory and techniques.

Theories of mine valuation, taxation.

PHYSICS AND METEOROLOGY (Ph.)

601. Applied X-rays. 2 Units (2-0).


602. Solid State Technology. 2 Units (2-0).


Experimental Techniques and applications of Semi-conductor Devices, Thermoelectric Refrigeration, surface properties, thin films and catalyses on Semiconductors.
603. Experimental Methods in Physics. 2 Units (2-0).

Kinematical method in design of experiments, High vacuum Technique, electronic measurements. Servo Mechanism. Low temperature Physics, experimental spectroscopy, high temperature—production, measurement and control, electric and magnetic measurements.

604. Industrial Physics Laboratory. 3 Units (0-9).

605. Applied Optics. 2 Units (2-0).


606. Mathematical Physics. 2 Units (2-0).


607. Nuclear Radiations and their applications. 2 Units (2-0).

Experimental techniques in Nuclear Physics and Nuclear Instrumentation, Mass spectrometry, Nuclear reactions and models, Selected topics in nuclear physics e.g. coulomb excitation, Stripping reactions, c opalations etc.

622. Material Technology. 4 units, First Term.


(For Mechanical Engineers)

661. Physics. 2 Units.


(For Electrical Communication Engineers)

662. Physics of materials. 2 Units, Third Term.

Introduction to crystal structures of solids, classification of solids, nature of binding and general characteristics of the physical properties of crystals. Lattice defects, structure-sensitive properties, energy levels of real crystals. Dielectric properties, molecular mechanism of polarisation, electronic, atomic and orientational polarisation, dipole relaxation and dielectric losses, Mossotti catastrophe and local fields short discussion of Piezo-electricity and Ferro-electricity, conduction and dielectric breakdown, Dia-, para-, Ferro-, Antiferromagnetism,

(For Electrical Communication Engineers)

671. Physics. 2 Units. First Term.

General properties of liquids and gases, elements of kinetic theory of gases and transport phenomena, motion of liquid, Bernoulli’s equation, viscosity, conductivity and diffusion. Electrical measurements of A.C. and D.C.

(For Soil Technologists)

681. Physics. 2 Units. First and Second Terms.

Kinetic theory and transition to mechanics of continua, advanced topics in general properties of matter; Maxwell’s equations and its relation to circuits, selected topics in modern physics; experiments involving interferometry, spectroscopy, measurement of fundamental physical constants, and physical constants of solids.

(For Mathematicians)

691. Physical measurements. 2 Units. Second Term.

Principle of measurement, measurement of fundamental physical quantities.

Measurement of particle size, sq. surface of powders and colloids, Thermal measurements —temp. measurement and control, thermal conductivity; Measurement of electrical quantities —current, voltage, resistance, inductance, capacitance, Q; Measurement of transients; Non-distructive test of materials by ultrasonics, X-ray diffraction interferometry etc. special measurements.

(For Civil Engineers)

692. Quantum Mechanics for Metallurgists. 2 Units.

Review of the basic postulates and working rules of Quantum Mechanics—Their applications to Solid Physics and Metallurgy.

693. Imperfections in Solids. 2-6 Units.

2 to 6 units by arrangement, on some of the following or related topics: Lattice vibrations, Order disorder phenomena, radiation damage, Theory of dislocation, study of X-ray diffraction, line broadening, colour centres, structure of liquids, structure and properties of amorphous substances, low angle scattering etc.

694. Special topics in Theoretical Physics. 2-6 Units.

2 to 6 units by arrangement, on some of the following or related topics: Functional analysis with applications, Lie group with applications, groups with special reference to Elementary particles, continuous groups, dispersion relations, Fourier integrals and integrals transforms etc.

695. Special topics in Crystal Physics. 2-6 Units.

2 to 6 units by arrangement, on some of the following or related topics: Crystal Morphology and Crystallography, Derivation and determination of space and point groups, direct methods on crystal structure determination, physical properties of crystals. Optical properties of crystals, crystal elasticity, cohesion in crystals, properties of thin films, theory of semi-conductors etc.

696. Quantum Mechanics III. 2-6 Units.

2 to 6 units by arrangement, on some of the following or related topics: Dirac Formalism, Hartree Fock Method, Interaction of radiation with matter, Quantum Mechanics on Solid State Physics, valency problems and molecular orbitals, Relativistic Field Theory, Elementary particles etc.
PART V

REGULATIONS

RESEARCH FACILITIES, RESEARCH TRAINING.
DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D.)
DEGREE OF DOCTOR OF SCIENCE (D.Sc.)
385

SCHEDULE XXXV

REGULATION No. 41

Research Facilities and Training

Doctorate Degrees

1. The Institute shall provide facilities for research and training in Research Methods in the various disciplines in the different teaching departments. A duly qualified candidate may supplicate for the following Research Degrees of the Institute:

(a) Doctor of Philosophy (Ph.D.) and

(b) Doctor of Science (D.Sc.).

2. A research student or a member of the staff of the Institute may register for the Degree of Doctor of Philosophy in any of the subjects mentioned below:


3. In order to supplicate for the Degree of Doctor of Philosophy, a research student must have a Bachelor of Technology or Bachelor of Architecture or Master of Science Degree of the Institute or qualification deemed equivalent and must have devoted at least three years on study and research from the date of registration for the Degree except that a candidate who has either received the degree of Master of Technology of this Institute in the appropriate branch or possesses equivalent qualification may be allowed to supplicate for the Degree of Doctor of Philosophy after two years of research training at the Institute. In exceptional cases, the Senate may reduce the minimum period to two years also for a candidate who has received the postgraduate Diploma (DIIT) of the Institute.

4. The Senate may, however, grant special dispensation to a teacher of the Institute in recognition of his previous work elsewhere and his contribution to the advancement of engineering, technology or science and reduce the prescribed period, provided he has put in a minimum of one year's work at the Institute.

5. The Senate may permit a candidate to submit his thesis three months earlier than the stipulated date if the Doctoral Scrutiny Committee recommends that the work has been completed in all respects to its satisfaction.

6. A candidate who has obtained a degree of Doctor of Philosophy of a recognised University or a Master's Degree in the appropriate branch of engineering, technology, science and arts may offer himself for the degree of Doctor of Science provided he has devoted not less than five years to research in the subject of his specialization.

SCHEDULE XXXVI

REGULATIONS No. 42

Admission to Research Training

(a) Educational Qualifications: Admission to Research Training course shall be made on the result of an Entrance test as laid down in Schedule XXXVII on the recommendation of an Admission Committee of the department concerned with at least two teachers from allied departments.

Candidates seeking admission to Research training in Engineering and Technological subjects must have a Bachelor’s Degree in engineering or technology preferably with some industrial/teaching/research experience or a Master’s Degree in engineering or technology.
Candidates seeking admission to Research Training in Science subjects must have a Master's Degree in the appropriate branch of Science or qualifications deemed equivalent.

(7) **Age Limit:** To be eligible for admission to Research Training, a candidate should be below 27 years of age on the date of his joining the training. Director may, however, relax the age limit provided he is satisfied that the candidate is otherwise suitable for Research Training.

(c) **Standard of Physical Fitness:** To be eligible for admission to these courses a candidate should fulfil the prescribed standard of physical fitness as given below:

- **Height** ... 1.6 metre
- **Weight** ... 46 Kilogram
- **Chest Measurement** ... 76 cm. with satisfactory limit of expansion.
- **Heart and lungs** ... There should be no abnormality.

Hernia, Hydrocele, Varicocele and Piles are temporary disqualification to be rectified before joining.

- **Vision** ... Better eye  
  - 6/9 or
  - 6/6  
  - Worse eye  
  - 6/9 Corrected  
  - 6/12 with glass.

Eyes should be free from congenital or other diseases.

Decision of the Institute Medical Officer in regard to the fitness of a candidate shall be final and no appeal to a higher authority shall be allowed.

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**SCHEDULE XXXVII**

**REGULATION No. 43**

**Graduation Requirement**

**DEGREE OF DOCTOR OF PHILOSOPHY** *(Ph. D.)*

1. A candidate for the Degree of Doctor of Philosophy must comply with the requirements as prescribed in Schedule XXXVI.

2. **Registration:** A candidate desirous of entering on the curriculum for the Degree shall apply to the Registry in the prescribed form with prescribed fee stating his proposed major field of study. Registration shall ordinarily be made on the basis of a written test or interview or both as may be decided by the Doctoral Scrutiny Committee after considering the application. Registration with retrospective effect earlier than six months from the date of application shall, ordinarily, be permissible. On the recommendation of a Doctoral Scrutiny Committee the Senate may permit a teacher of the Institute to supplant for the Degree on getting himself registered six months prior to submission of thesis provided he fulfils all other requirements.

3. **Supervisor:** The Head of the Department shall recommend for each candidate a supervisor from amongst the members of the teaching staff who shall be responsible for guiding the candidate in his study and research. The Supervisor is required to report periodically to the Head of the Department on the progress of the candidate. In special cases joint supervision even by teachers of more than one department may be permissible.

In the case of a member of the academic staff of the Institute having sufficient experience in the field of his specialisation, the appointment of a supervisor shall not be obligatory and he may be permitted by the Senate to work independently on the recommendation of Doctoral Scrutiny Committee.

4. **Minimum Period of Research:** After registration, a candidate shall be required to devote a minimum period of three years to advanced study and research except as otherwise provided in Schedule XXXV, of which a minimum of twelve months must be spent in residence at the Institute.
On the recommendation of the Supervisor(s) and the Doctoral Scrutiny Committee, a candidate may, as a special case, be permitted by the Senate, to conduct a part of his research work in the field or in recognised establishments.

5. **Language Requirement**: A candidate shall be required to show proficiency by examination or otherwise in one of the foreign languages (besides English), namely, French, German, Russian, as may be decided by the Senate at the time of registration. The proficiency shall be attained preferably within one year of registration.

6. **Qualifying Examination**: Any time prior to submission of the thesis a candidate shall be required to show evidence of advanced study, by oral or written examination or otherwise, as may be decided by the Senate on the recommendation of the Doctoral Scrutiny Committee, in three subjects, equivalent to a minimum of 12 units of postgraduate course; of these two shall be chosen from his field of study and one from any allied field. The Senate may, however, on the recommendation of the Doctoral Scrutiny Committee, grant exemption in one or more subjects if the candidate has previously acquired proficiency in those subjects. A candidate may, if considered necessary, attend with prior permission an appropriate postgraduate course at the Institute without payment of any additional fee. It is expected that every candidate should meet these requirements as soon as possible after registration.

7. **Synopsis**: A candidate who, in the opinion of the Supervisor(s) has made adequate progress in his research may apply for permission to the Head of the Department to submit the thesis enclosing two copies of the synopsis of the thesis. The synopsis shall be considered by the Doctoral Scrutiny Committee. In the case of a member of the academic staff permitted to work independently he may apply for permission to the Head of the Department to submit two copies of the synopsis of the thesis.

8. **Submission of Thesis**: A candidate shall be required to submit through the Head of the Department in triplicate or quadruplicate as the case may be and in the approved form his thesis within a maximum period of two months from the date of submission of the synopsis.

9. **Thesis Examination**: If the Doctoral Scrutiny Committee is of the opinion that the synopsis is of the required standard, it shall recommend to the Senate a panel of names of at least five specialists to adjudicate upon the thesis under consideration. The Senate shall then appoint three or four examiners—one of whom shall be the supervisor, if any. These examiners shall constitute the Board of Examiners. The Senate shall also appoint a Viva-voce Board comprising the Supervisor, one Examiner and the Head of the Department and at least two teachers from allied Departments. In case, all the Examiners are foreigners an Indian Specialist shall be appointed as the second member of the viva-voce Board. In the case of a member of the staff of the Institute permitted to work independently the Board of Examiners and the Viva-Voce Board shall include, in the place of Supervisor, a senior teacher of the Institute in the allied field of specialisation or an outside expert to be appointed by the Senate on the recommendation of the Doctoral Scrutiny Committee. All correspondence with the Examiners shall be made by the Registry. The names of the members of the Board of Examiners shall be kept strictly confidential.

10. The thesis shall be examined separately by two or three external examiners and the supervisor or the third/fourth examiner, as the case may be. Each examiner shall report separately on the thesis and forward his recommendation to the Registry which shall place the reports together before the Doctoral Scrutiny Committee.

11. **Viva-voce examination**: Reports of the examiners shall be final. On receipt of the reports from the Registry, the Doctoral Scrutiny Committee shall consider them and recommend, if the reports are unanimous and favourable, that the candidate be required to appear before the Viva-voce Board appointed for the purpose. The Viva-voce Board shall test the depth and breadth of knowledge of the candidate in the special field of research or Design or Development and also in allied fields of study. The Viva-voce Board shall report on the competence of the candidate and submit its recommendation for consideration of the Doctoral Scrutiny Committee which shall place before the Senate the reports of the Examiners of the thesis and of the Viva-voce Examination.

12. In case the two External Examiners of the Thesis differ in their opinion on the merit of the Thesis the Senate, may on the recommendation of the Doctoral Scrutiny Committee, refer the Thesis to a third External Examiner whose verdict shall be deemed as final.

13. If the majority of the examiners report that the thesis is not up to the standard for the Degree, the Senate may, on the recommendation of the Doctoral Scrutiny Committee, permit submission of a revised thesis on payment of the prescribed fee after a suitable time to be fixed by
the Senate. In no case, however, resubmission of a work without modification along the line of criticism made by the examiners of the thesis shall be allowed, nor shall there be a case of resubmission of a thesis rejected for the second time.

14. If the members of a Viva-voie Board are not satisfied with the oral examination, the Senate may, on the recommendation of the Doctoral Scrutiny Committee, and of the Viva-voie Board permit the candidate to appear again.

15. The standard of the Thesis: The thesis shall be a piece of research work characterised either by discovery of facts or fresh approach towards interpretation of facts and theories or an independent design or development. It should bear evidence of the candidate’s capacity for practical examination and judgment and also his ability to carry out independent investigation, design or development.

16. The thesis shall have a preface in which the candidate shall state whether the thesis is based on the discovery of new facts by him or of new relations of facts observed by others or whether it constitutes mainly an exhaustive study and criticism of the published work of others or a design or development work undertaken, and how it contributes to the advancement of knowledge in the particular field of research chosen. The candidate shall further forward a statement indicating the sources from which his information has been derived and the extent to which he has based his work on the work of others and shall indicate which portion or portions of his thesis he claims as original. Where a candidate presents a joint-work, he shall state clearly the portion which is his own contribution as distinguished from the portion contributed by his collaborator. The candidate may also submit copies of original publication in support of his candidature.

17. Before the thesis is sent to the examiners including the Supervisor for examination the synopsis as incorporated in the thesis and the preface should be scrutinised by the Doctoral Scrutiny Committee and approval of the Chairman of the Senate taken.

18. A thesis submitted for the degree of Doctor of Philosophy shall not be one for which a Degree, or Diploma, has already been awarded.

19. Nothing contained in these Regulations shall preclude a candidate from publishing, either independently or jointly with others, the results of the work incorporated in his thesis, at any time before submitting the thesis for examination provided that three copies of the paper shall be submitted with the thesis.

20. Subject to the provisions of the Ordinances and Regulations the Degree of Doctor of Philosophy (Ph.D.) in engineering, technology, science and arts shall be conferred on a candidate who has undertaken research work for a period as laid down in Schedule XXXV and has attained the requisite standard in the particular field of study as approved by the Senate.

21. Requirement for the Degree: A candidate shall be deemed to have attained the requisite standard for the Degree of Doctor of Philosophy, if in the thesis and subsequent Viva-voie test he has given evidence of originality, a thorough grasp in the special field of research or design or development and a fair knowledge in the allied fields of study.

22. On the recommendation of the Doctoral Scrutiny Committee and after considering the reports of the Board of Examiners and of the Viva-voie test the Senate shall decide whether the candidate may be recommended to the Board of Governors for the award of the Degree of Doctor of Philosophy.

23. Under special circumstances, the Senate may authorise its Chairman to recommend, to the Board of Governors, a candidate for the award of the Degree of Doctor of Philosophy, if the reports of the Board of Examiners and the Viva-voie Board are unanimous and favourable and are approved by the Doctoral Scrutiny Committee, and report the case to the Senate at its subsequent meeting.

24. The Senate may, on the recommendation of the Doctoral Scrutiny Committee, deviate from the prescribed Ordinances and Regulations relating to registration, submission of the thesis and its adjudication and consider special cases of candidates on merits.

25. For the Degree of Doctor of Philosophy in any branch of study the graduate shall receive a Diploma wherein shall be set forth the branch in which he has qualified.
389

SCHEDULE XXXVIII

REGULATION No. 44

Graduation Requirement

Degree of Doctor of Science (D.Sc.)

1. The Senate shall determine in respect of a candidate for the Degree of Doctor of Science the eligibility for submitting the thesis on the recommendation of the Doctoral Scrutiny Committee set up for the purpose and after considering the synopsis of the thesis.

2. After the synopsis of the thesis has been found to be of the required standard, the Doctoral Scrutiny Committee shall recommend to the Senate a panel of names for appointment as examiners to adjudicate upon the thesis.

3. The Senate shall appoint, ordinarily from the panel of names recommended by the Doctoral Scrutiny Committee, at least three experts to examine the thesis and adjudicate upon the merit of the thesis.

Ordinarily acceptance of a thesis for adjudication is contingent on important parts of it having been published either as a book or in Journals of standing.

4. A candidate for the degree of Doctor of Science shall, on the recommendation of the Doctoral Scrutiny Committee and with the approval of the Senate, submit for examination, in triplicate or quadruplicate as the case may be, a thesis or a published memoir of work. When published papers are submitted these should be as documents to which reference has been made in a brief but comprehensive account in the form of a thesis. The thesis shall be a record of original research undertaken by the candidate and actually carried out by him. It shall be accompanied with a declaration signed by him that the work has been done and the thesis prepared by him for the D.Sc. degree.

5. Each Examiner shall be required to examine the thesis independently and forward his report with recommendations separately to the Registry. All the reports together shall first be considered by the Doctoral Scrutiny Committee which shall make recommendations thereon to the Senate.

6. Ordinarily, a candidate for the Degree of Doctor of Science shall not be required to appear at a Viva-voce Examination unless the examiners make a special recommendation to that effect.

7. Subject to the provisions of the Ordinances and Regulations, the Degree of Doctor of Science shall be conferred on a candidate when the Senate is satisfied that the thesis is of distinction as a record of original research undertaken by the candidate or of an important engineering work or applied art designed by himself or an original contribution to learning and that the Examiners' reports are unanimous and favourable.

8. If any one of the Examiners do not consider the thesis to be of the standard for the Degree of Doctor of Science but recommend that the thesis be accepted for the degree of Doctor of Philosophy, the Doctoral Scrutiny Committee shall consider the recommendations of the examiners after obtaining a written consent from the candidate that he is agreeable to be considered for the degree of Doctor of Philosophy and send their recommendations to the Senate. In such a case, it shall be necessary for the candidate to appear at the Viva-voce Examination by a Viva-voce Board constituted for the purpose.

9. In the event of a thesis being found inadequate by the examiners the Senate may, on the recommendation of the Doctoral Scrutiny Committee, permit resubmission of revised thesis on payment of the prescribed fee, after a period to be fixed by the Senate.

10. For the Degree of Doctor of Science in any branch of study the graduate shall receive a Diploma wherein shall be set forth the branch in which he has qualified.

11. The Senate shall be competent, on the recommendation of the Doctoral Scrutiny Committee to deviate from the prescribed Ordinances and Regulations and consider special cases of candidates on merits.
SCHEDULE XXXIX
REGULATION No. 45
Admission

Intake, Eligibility, Reservation of Seats

A. Admission:

1. Admission shall not ordinarily be granted except to the First Year of the undergraduate and postgraduate courses of studies. On the recommendation of the Admission Committee, a student with advanced academic background may be admitted at a higher stage of the course.

B. Annual Intake:

1. The number of students to be admitted to the undergraduate and postgraduate courses and for Research Training shall be, as may be fixed by the Board of Governors from time to time, either on its own initiative or on the recommendation of the Senate. On the recommendation of the Admission Committee, students in excess of the number, fixed for a particular Branch or Course, may be admitted, provided that such admission shall not create teaching difficulties and entail lowering of the standard of education, that there are seats in the Halls of Residence, and that this shall not adversely affect admission in future years.

2. A member of the teaching staff possessing requisite qualifications and having adequate preparation for undergoing a postgraduate course may be permitted to enter upon the curriculum for postgraduate Degree or Diploma on a part-time basis, but the number of such part-time students shall not, ordinarily, exceed twenty-five per cent of the regular students admitted to a course.

C. Eligibility:

1. For admission to the Institute a person shall fulfil the requirements regarding age and academic qualifications as may be prescribed by the Senate from time to time and shall be medically fit, the fitness to be judged by the Institute medical staff in accordance with the prescribed medical standards.

2. On the recommendation of the Admission Committee a foreign student or an Indian student who may be residing outside India at the time of the Entrance Examination or test may be granted admission without a written and/or oral test.

D. Reservation of Seats:

1. Twenty percent of admission to the undergraduate courses may be kept reserved for candidates belonging to the Scheduled Castes and Scheduled Tribes—fifteen percent for Scheduled Castes and five per cent for Scheduled Tribes—provided they possess requisite qualifications as prescribed in Schedule I and qualify in the Entrance Examination. On the advice of the Senate the Board of Governors may permit relaxation of the qualifying standard in favour of such candidates.

2. A proportion of seats, as may be fixed by the Board of Governors from time to time may also be kept reserved for qualified candidates belonging to the States where, in the opinion of the Board of Governors, adequate facilities for studies in appropriate branches of study do not exist.

3. When qualified candidates in the above categories are not available the reserved seats shall be deemed open to be filled on general competition.
SCHEDULE XL

REGULATION No. 46

National Cadet Corps, Physical Education and Social Service

A. National Cadet Corps:

1. Fresh enrolment to the National Cadet Corps shall be made every year within two weeks of the commencement of the session. A senior member of the teaching staff of the Institute nominated by the Director shall be associated with the enrolment of the Cadets.

2. The Cadets shall be subject to the discipline of the National Cadet Corps.

B. Physical Education and Social Service:

1. The Institute shall provide facilities for Physical Education or Social Service for all undergraduate students.

2. Fresh enrolment shall be made every year within two weeks of the commencement of the session.

3. During the Third, Fourth and Fifth sessions a student belonging to an undergraduate course shall be encouraged to take part in Physical education or Social Service Programme as may be organised by the Institute and may receive such additional credit over and above his total marks in the obligatory subjects in the Examination as may be decided by the Senate from time to time.

SCHEDULE XLI

REGULATION No. 47

Examination results, Grade Card and Cross List

A. Undergraduate courses:

1. A student may obtain, on application with requisite fee as prescribed in the Statutes a Grade Card indicating his performance in the various examinations and a Cross List indicating the subject(s) of his failure in an examination.

2. The results of each examination shall be considered by the Board of Examiners. The marks secured by the students in the First and Second Terminal Examinations may be announced by the Head of the Department after these are considered by the Board of Examiners. The marks of the End-Sessional, Viva-Voce and Thesis examinations shall not be given out.

B. Postgraduate Course:

1. A Postgraduate student may obtain, on application with the requisite fee as prescribed in the Statutes, a Grade Card indicating his performance in the various examinations.

2. The result of each examination shall be considered by the Board of Examiners. The grades obtained by a student in the Terminal Examinations and Industrial Training may be announced by the Head of the Department after these are considered by the Board of Examiners.

SCHEDULE XLII

REGULATION No. 48

Scholarships, Fellowships, Free-studentships and Practical Training Stipends

1. The value of Institute Scholarships and Fellowships shall be as prescribed in the Statutes.

2. All Institute Scholarships, Fellowships and Free-studentships, shall be awarded in accordance with the Rules framed by the Senate. Other Scholarships and like awards shall be made in terms of the endowment or the rules of the respective awarding authorities.
3. The Senate may constitute each year a "Scholarship Committee or Committees" to make recommendations to the Senate for the award of Scholarships and free studentships both to the new entrants and to the students who are already at the Institute.

4. Undergraduate Scholarships:

(a) The Scholarships for the students belonging to all undergraduate courses and post-graduate courses leading to the Master of Science Degree shall be awarded on merit and on consideration of merit as well as means.

(b) Unless otherwise decided by the Board of Governors the merit Scholarships shall be awarded to seven per cent of the students admitted each year and the merit-cum-means Scholarships to a further eighteen percent of the students.

(c) The Scholarships shall be awarded on the results of written examination, and written examination and Means Test, provided that if no written Entrance Examination is held for admission to any of the courses the award shall be made on the results of the First Terminal Examination which the students take at the Institute after admission.

(d) In recommending the award of merit-cum-means Scholarships, the Scholarship Committee will take into consideration the examination results, examine the documents the applicant may submit for such Scholarships and interview the applicant.

(e) The Scholarship Committee shall also consider the results of the Institute Examinations of the students who have been in residence at the Institute, with or without scholarships in the preceding academic session and recommend to the Senate for:

(i) award of fresh merit scholarships on the results of the Institute examination;

(ii) renewal or discontinuance of merit-cum-means Scholarships;

and

(iii) award of merit-cum-means Scholarships against vacancies.

All awards shall be subject to the following stipulations:

The Institute scholarships shall be open only to the regular students of the Institute. The Scholarships may be withdrawn at any stage by the Senate without assigning any reason.

The merit scholarships awarded to new entrants shall be tenable for one academic year and, thereafter, fresh award shall be made on the results of the subsequent Institute examinations. In the case of students following the same curriculum during the first year, award of merit scholarship during the second year shall be made in order of merit of the First examination and not branchwise. Thereafter, the merit scholarships shall be awarded branchwise each year to 7 per cent of the students in the respective branches.

Subject to good conduct and satisfactory performance in the examinations as may be laid down by the Senate the merit-cum-means scholarship shall be tenable for the duration of the course of study.

(f) The following conditions shall be complied with in regulating the award, its continuance or otherwise, leave of absence etc.

(i) Scholarships will not be awarded to a student who has failed or been allowed to repeat the class.

(ii) All scholarships shall be liable to forfeiture partially or wholly or be withheld temporarily in case of misconduct, irregular attendance, neglect of work in classes, laboratories, studios, workshops, or on field, or unsatisfactory performance in an examination.

(iii) A scholar has to refund the amount of scholarship if he leaves the Institute on his own accord before the conclusion of the session during the tenure of the Scholarship.

(iv) If an Institute scholar is awarded any other stipend or scholarship he may draw in full such stipend or scholarship, provided the total amount from all sources including the Institute does not exceed Rs. 1,500/- per annum; otherwise, he
shall cease to enjoy the Institute scholarship. Fresh award of the vacated scholarships shall be made.

(c) Leave of absence without loss of scholarship up to 15 days in a year for reasons other than illness may be authorised by the Director. Director may also, under exceptional circumstances, grant leave in excess of it.

Absence on account of illness up to 10 days in an academic year, when certified by the Institute medical officer, will entail no loss of scholarship.

Director may, in addition, in special cases, grant short leave of absence in combination with holidays or vacation.

(vi) Institute and Hall dues shall be the first charge on the Scholarship and shall be deducted at the source and the balance, if any, paid to the Scholar. Payment of Scholarship shall not be made except to the holder who must present himself personally at the office and give a receipt in the prescribed fee book.

5. **Free Studentships:**

All Institute scholarhipholders in the Undergraduate courses shall enjoy free tuition. In addition, 10 percent of the students shall be awarded free studentship on grounds of means.

6. **Postgraduate Scholarships:**

(a) All postgraduate students of the Institute shall be eligible to Institute postgraduate scholarships unless the Admission Committee recommends admission without Scholarship or the postgraduate student is a deputed student.

Students admitted to a course preparatory to a postgraduate course shall not ordinarily be entitled to any Institute Scholarship.

(b) Postgraduate Scholarship shall be awarded for one year in the first instance renewable at the end of it if the course is of duration longer than one year.

(c) If a postgraduate student is awarded an Institute Scholarship it shall be permissible for him to draw Scholarship from other sources provided the total amount received by the Scholar including the Institute Scholarship, does not exceed the amount of the Institute Scholarship. In case it does, the Institute Scholarship may be suitably reduced.

(d) Postgraduate students, who are in receipt of salary from and/or are sponsored and supported by any organisation, are not ordinarily permitted to draw Institute Scholarship.

7. **Research Scholarships:**

(a) All Research Scholarships shall be awarded by the Senate on the recommendation of the appropriate Admission Committee.

(b) Research scholarships shall, ordinarily, be tenable for a period not exceeding three years, subject to satisfactory progress and good conduct. The award will, however, be made for one year at a time. On the special recommendation of the Head of the Department Research Scholarship may be renewed by the Director for short periods beyond 3 years.

8. **Post-Doctoral Fellowships:**

Post-Doctoral Fellowships shall, ordinarily, be awarded by the Senate on the recommendation of a Special Committee set up for the purpose. It shall be tenable for a period of 2 years, subject to satisfactory progress and good conduct, the award being made for one year at a time. On the special recommendation of the Head of the Department, a Fellow may be permitted by the Director to enjoy the Fellowship for further period.

9. **General conditions for Postgraduate Scholarships, Research Scholarships, and Post Doctoral Fellowships:**

(a) A Research Scholar or a Post-Doctoral Fellow shall report to the Head of the Department regularly on his progress and submit an annual report on his work for consideration of the Director.
Post-Doctoral Fellowships, Research Scholarships and Postgraduate Scholarships are terminable without any notice within 3 months of the award on grounds of unsuitability or poor progress.

Fellowships/Scholarships shall be liable to forfeiture partially or fully or be withheld temporarily in case of misconduct or unauthorized absence or unsatisfactory progress.

No student enjoying Scholarship or Fellowship may apply for employment without the prior permission of the Director.

A Postgraduate student or a Research Scholar or a Post-Doctoral Fellow enjoying the Institute Scholarship or Fellowship shall be required to refund the entire amount of money paid to him as Scholarship or Fellowship in the event of his leaving the Institute without completing the course of study or before the end of one year from the date of award or renewal.

A Research Scholar/Post-Doctoral Fellow if appointed to any post at the Institute or to a teaching or research post elsewhere with prior approval of the Director, shall not be required to refund the Scholarship/Fellowship drawn by him.

Research Fellows, Research Scholars and Post-graduate students may be allowed by the Director, leave of absence for reasons other than illness, for a maximum period of 15 days in a year without loss of Fellowship/Scholarship. Director may also, under exceptional circumstances, grant leave in excess of it.

Absence on account of illness up to 10 days in an academic year, when certified by the Institute medical officer, will entail no loss of scholarship.

Director may, in addition, in special cases, grant short leave of absence in combination with holidays or vacation.

Payment of Fellowship/Scholarships shall be made only to the recipients of the award who must present themselves at the Cash Section on the specified date and give a receipt as required under the Rules.

Institute and Hall dues shall be the first charge on the Fellowships/Scholarships and shall be deducted at the source, the balance, if any, shall be paid to the Scholar.

10. **Practical Training Stipends**:

Practical Training Stipend shall be awarded by the Senate on the recommendations of the Training and Placement Committee to selected graduates who may apply for it on consideration of merit and means to enable them to take one year of practical training subject to the conditions that

(i) the stipendiary does not receive during the same period a sum exceeding Rs. 250.00 per month including the Institute stipend.

(ii) The stipendiary shall conform to the rules of the establishment where he receives training and submit such practical training reports as may be prescribed by the Institute.

REGULATION No. 49

**Medals and Prizes**

1. The Senate may constitute each year a Medals and Prizes Committee for award of medals and prizes.

2. The following medals and prizes instituted by the Board and endowment shall be awarded each year for the Undergraduate courses of study:

A. **Medals**:

(i) **Institute Medal**: President of India Gold Medal: One gold medal named 'President of India Gold Medal' may be awarded to the best student among the B.Tech. and B.Arch. graduates of the year. The award shall be made by the Board of Governors on the recommendation of the Senate. In lieu of the Gold Medal the Board may make the award in any other form.
(ii) **Endowment Medal:**

Dr. Bidhan Chandra Roy Gold Medal: One Gold Medal named ‘Dr. Bidhan Chandra Roy Gold Medal’ may be awarded to a graduate adjudged to be the best all-rounder in a particular session. The award shall be made out of the interest of the fund created for the purpose on the recommendations of the Senate. In lieu of the Gold Medal the award may be made in any other form, as may be decided by the Senate.

**B. Institute Prizes:**

(i) Every year three general proficiency prizes of values shown below, be awarded to students in each branch of the undergraduate courses:

- 1st Prize of the value of Rs. 100
- 2nd Prize of the value of Rs. 50
- 3rd Prize of the value of Rs. 25

provided that the number of students in the branch exceeds 50; only two prizes (1st and 2nd prizes) when the number is smaller but exceeds 25 and only one prize (1st prize) when the number is 25 or less.

(ii) Two prizes each of the value of Rs. 50 in the 1st and 2nd year for proficiency in workshop practice.

(iii) One prize of the value of Rs. 25 for each of the optional subjects.

(iv) One prize of the value of Rs. 25 for the Humanities subjects in each class (all branches together).

(v) One prize of the value of Rs. 100 for design, project work and thesis and sessional work for each branch of study in the Final year class.

(vi) One prize of the value of Rs. 200 to be awarded every year to the undergraduate student of the Institute who enter an English essay competition held by the Department of Humanities and is adjudged to be the best writer of the essay.

**Endowed Prizes:**

'Sarat Memorial Prize', out of an endowment from a donor who wishes to remain anonymous to be awarded to a women graduate adjudged to be the best undergraduate passing out during an academic year. The award shall be made on the recommendation of the Senate.

**SCHEDULE XLIII**

**REGULATION No. 50**

**Senate Committees**

*(Ordinance XI)*

The Senate shall constitute each year the following Committees at appropriate time, as mentioned below:

1. **Advisory Committee.**

The Senate shall constitute each year, within March, an Advisory Committee for each of the teaching departments comprising educationists and experts from research and industrial organisations and the academic staff of the Institute. The Committee shall advise on curricula, syllabi, the standard of instruction and research and other matters for the efficient working of the departments.

2. **Admission Committee (Undergraduate courses).**

The Senate shall constitute each year, within August, an Admission Committee for the following session. The Entrance Examination for admission to the undergraduate courses shall be conducted by the Committee. The Committee shall recommend to the Director panels of names for appointment of paper setters, scrutineers, code-markers and decoders, tabulators, and others for the Entrance Examination as also for the Interview Boards. The Chairman of the Committee shall submit a report on the Entrance Examination and admission for the consideration of the Senate.
3. Admission Committees (Postgraduate Courses).

The Senate shall constitute each year, within April, an Admission Committee for each of the Departments offering Postgraduate courses to consider applications for admission to the postgraduate courses. The Committee shall hold an Entrance Test written and/or oral and/or practical for final selection of students for the Postgraduate courses and also recommend the award of scholarships.

4. Admission Committees (Research).

The Senate shall constitute each year an Admission Committee, within March, for each of the Departments to scrutinise the applications from candidates seeking admission to carry out research at the Institute. The Committee shall consider applications and recommend conditions under which the applicants may be granted facilities for research and also recommend award of Institute Research scholarship.

5. Post-Doctoral Fellowship Committee.

The Senate shall constitute each year before August a Committee with the Director as Chairman for the award of Institute Post-Doctoral Fellowships.


The Senate shall constitute each year, within April, a Scholarship Committee for the following session to make recommendations for the award of Undergraduate scholarships of the Institute. Admission Committees for the Postgraduate courses and Research shall also recommend award of scholarships to Postgraduate students and Research scholars.

7. The Examination Committee.

The Senate shall constitute each year before April an Examination Committee for the following session. The Examination Committee shall be responsible for the conduct and supervision of all undergraduate examinations. The Committee shall, in consultation with the Heads of Departments and the Registry, frame the time-tables for the examinations, make seating arrangements, arrangements for supervision and invigilation. The Chairman of the Committee shall submit a report on each examination for consideration of the Senate.

8. Boards of Examiners (Bachelor's Degree Examination).

The Senate shall constitute each year, before August, a Board of Examiners for each examination for the Bachelor's Degree. The Head of the Department concerned shall be the Chairman of the Board of Examiners. It shall appoint paper-setters, examiners, scrutineers, and tabulators for each examination and shall consider the results of the examinations and make recommendations to the Senate in the prescribed manner.

9. Examination Results Review Committee.

The Senate may constitute each year, before August, a Committee to review the results of the undergraduate examinations, as reported by the various Boards of Examiners and recommend norms for consideration of the Senate.

10. Boards of Examiners (Postgraduate Degree and Diploma Examination).

The Senate shall constitute each year, before August, a Board of Examiners for each of the postgraduate courses. The Head of the Department shall be the Chairman of the Board of Examiners. It shall appoint paper-setters, examiners, scrutineers and tabulators for each examination and shall consider the results of the examinations and make recommendations to the Senate in the prescribed manner.

11. Doctoral Scrutiny Committees.

The Senate shall constitute a Doctoral Scrutiny Committee for each application for candidature for a Doctorate Degree. The Head of the Department concerned shall be the Chairman and the Committee shall comprise Professors in the Department, Supervisor or Supervisor and other experts in the Department and at least two teachers from allied departments. The application for registration for a Doctorate Degree shall be considered by the Doctoral Scrutiny Committee and its recommendations submitted for the consideration of the Senate. The Committee shall also consider the synopsis of the thesis to be submitted by the candidate and recommend a panel of names to the Senate for appointment as examiners. While con-
sidering the synopsis the Committee shall ensure that the candidate has complied with the requirements as stipulated by the Senate at the time of registration. The Doctoral Scrutiny committee shall also consider the reports of the Board of Examiners on the thesis and also of the Viva-Voce Examination of the candidate and make suitable recommendations for consideration of the Senate.

12. **Training and Placement Committee.**

The Senate shall constitute each year, within April, for the following session a Committee to arrange for the practical training of the students—both undergraduate and postgraduate and to render assistance to find them employment. The Committee shall also recommend award of Practical Training stipends.

13. **Medals and Prizes Committee.**

The Senate shall constitute each year, before April, a Committee for the following session to recommend award of Medals and Prizes.

14. **Convocation Committee.**

The Senate shall constitute each year, within July, a Convocation Committee for making arrangements for holding the Annual or Special Convocation.

15. **Conduct and Discipline Committee.**

The Senate shall constitute each year, within April, a Committee for the following year to examine cases of violation of the code of conduct and recommend suitable disciplinary measures.

16. **Social and Welfare Committee.**

The Senate shall constitute each year, before April, a Committee comprising a senior teacher as Chairman, and the Chairman of the Council of Wardens, the President and the Vice-President of the Technology Students’ Gymkhana, and two representatives of the Gymkhana one representative from each Hall of Residence, as members. The Committee shall advise, on the general welfare of the students and examine the cases of student(s) involved in any social offence and recommend suitable disciplinary action or punishment.

17. **Library Committee.**

The Senate shall constitute each year, in April, a Library Committee which shall be responsible for general supervision of the Library. The Librarian shall be the ex-officio Member-Secretary of the Committee.

18. **Workshops Committee.**

The Senate shall constitute each year, before July, a Committee to advise on the working of the Workshops and recommend measures for improvement. The Superintendent of Workshops shall be the Member-Secretary of the Committee.

19. **Central Instruments Services Section Committee.**

The Senate shall constitute each year, before July, a Committee to advise on the working of the Central Instruments Services Section and recommend measures for improvement.

20. **Journal and Publications Committee.**

The Senate shall constitute each year, before March, a Committee which shall be responsible for bringing out the Institute Journal and other publications of the Institute.

21. **Ordinances Review Committee.**

The Senate may appoint a Standing Committee to review the existing Ordinances and Regulations and make recommendations for any changes for the consideration of the Senate.

**Secretary of the Committees.**

The Deputy Registrar or Assistant Registrar (Academic) shall be ex-officio Secretary of all the Committees constituted under Ordinance XI other than the Library Committee, the Journal and Publications Committee, the Workshops Committee, the Central Instruments Services Section Committee.
1. It shall be incumbent on every student studying for the B.Tech., B.Arch., B.Sc. and M.Sc. Degrees to participate in the educational tours arranged for them. Exemption from the tour may be granted by the Head of the Department concerned on medical grounds.

2. Tours subsidised by the Institute will be arranged by the Head of the Department and ordinarily not more than twice for the 5-year and 5½-year B.Tech. and B.Arch. students and not more than once for B.Sc. and M.Sc. students. These tours shall, normally, be arranged in continuation of or within the Puja vacation of the Institute and the duration shall not exceed 2 weeks. Tours, as far as possible, should be intensive rather than extensive.

3. Each undergraduate student shall submit to the Department for examination within a fortnight from the date of conclusion of the tour a report on the tour undertaken by him. Students exempted from the tour may be assigned special work in lieu thereof.

4. Normally, one teacher will look after a party of 25 undergraduate students and the teacher accompanying the party shall be treated as being on duty.

5. Educational tours for the M.Tech., D.I.I.T., M.R.P., M.C.P. students may be arranged by the Department concerned.

6. The subsidy per student to partially meet conveyance charges shall not exceed Rs. 20.00 per tour.
RULES

RULE No. 1

Advertisement

Admission to undergraduate and postgraduate courses and research training shall be advertised each year through such newspapers and advertising media as the Director may decide.

RULE No. 2

Admission

1. A candidate shall have to produce documents to the satisfaction of the Admission Committee that his guardian is in a position to pay regularly tuition and other fees, boarding, lodging and other charges payable for the entire course of study at the Institute.

2. He is to give an undertaking to comply with the Institute Rules and Regulations relating to residence, discipline, health and hygiene.

No one shall be admitted who is unwilling to be inoculated and vaccinated annually as public health measure in accordance with the Rules framed by the Institute from time to time.

3. He shall fulfil all other requirements for admission as prescribed in the Ordinances and Regulations.

RULE No. 3

Application Fees

Applications for admission to all courses, both undergraduate and postgraduate, and also to research training must be accompanied with the requisite fees, as prescribed in the Statutes. The present rates of fees are:

(i) For admission to all undergraduate courses and the M.Sc. Degree courses ... ... ... Rs. 15.00
(Payable with the application as application and registration fee).

(ii) For admission to the postgraduate courses leading to the M.Tech., M.C.P., and M.R.P. Degrees and Postgraduate Diplomas ... Rs. 5.00
(Payable with the application as registration fee).

(iii) For admission to Research Training ... ... ... Re. 1.00
(Payable with the application).

RULE No. 4

Travelling Allowance for Appearing at Interview

1. Candidates called for interview and medical examination and/or written/practical test for admission to the undergraduate or postgraduate courses are not eligible to receive any travelling expenses.

2. Candidates appearing for interview at the Institute for research scholarship may be paid only single 3rd class railway fare bothways from the nearest railway station.

RULE No. 5

Exemption from payment of Seat Rent in the Hall of Residence including charges for Water and Electric Supply

Students, Scholars and Fellows may be granted exemption from payment of seat rent in the Hall of Residence including charges for water and electric supply for the period of their stay outside the Institute for practical training or field work which forms a part of the curriculum and is arranged by the Institute, provided they hand over charge of the rooms to the Warden concerned before they leave for such training or field work—when the period of such training is one month or more.
They are, however, required to meet their lodging expenses at the place of practical training of field work.

RULE No. 6
Withdrawal from the Institute

A student may discontinue his studies and withdraw from the Institute with prior permission. A student desirous of leaving the Institute shall be required to submit an application in the prescribed form at least fifteen days before the contemplated date of leaving stating therein the reasons for leaving. He shall be required to obtain clearance certificate from the Department(s) concerned, the Library, the Warden and the Accounts Section and submit the same to the Accounts Officer before permission may be granted to him for leaving the Institute. His name will then be removed from the rolls.

Failure to comply with these requirements shall render a student liable to pay all the dues till the date of formal removal of his name from the Institute Rolls and the payment of caution money, etc., shall be withheld till the dues are cleared.

RULE No. 7
Issue of Migration Certificate

A student desirous of joining another Institution either before the completion of the course or on completion of the course may be issued a migration certificate in the prescribed form on payment of the fee as laid down in the Statutes and submission of a formal application.

RULE No. 8
Issue of Grade Card

1. A graduate may obtain, on application to the Registry with the prescribed fee and two passport size photographs, a Grade Card indicating his performance in the examinations he has taken at the Institute.

2. A student may obtain, on the recommendation of the Head of the Department concerned even before graduation, on application to the Registry with the prescribed fee and two passport size photographs, a Grade Card indicating his performance in the examinations that he had taken.

3. Duplicate Grade Card may be issued on application to the Registry on payment of the prescribed fee.

RULE No. 9
Issue of Diploma

1. A graduate shall present himself at the first Convocation held after he becomes eligible for Degree or Diploma and receive it in person. It may also be issued to him if he is unable to attend the Convocation; in that case he has to apply for it to the Registry with the fees as prescribed in the Statutes for receiving the Diploma in absentia.

2. In the event of loss of a Diploma a duplicate may be issued with the permission of the Director on payment of the prescribed fee.

RULE No. 10
Issue of Cross List

A student failing in any complete examination may be supplied with a Cross List showing the subject(s) of failure on payment of the prescribed fee.

RULE No. 11
Rechecking of Answer Scripts

A student may get any one of his answer scripts rechecked on application to the Registry along with the prescribed fee, provided such application is made within 15 days of the announcement of the results.
RULE No. 12

Disposal of Old answer scripts, rejected applications and sundry papers

Answer scripts of all examinations, rejected applications for admission, etc. shall be preserved for a period of one year; thereafter, these shall be disposed of.

RULE No. 13

Fees payable to Additional Examiners

(a) Undergraduate courses including M.Sc.

Each Additional Examiner for the Undergraduate courses (including M.Sc.) shall be paid a sessional fee of Rs. 300 and travelling allowance in accordance with the provisions made in the Statutes.

(b) Postgraduate courses.

An Additional Examiner for a Postgraduate course shall be paid remuneration at the rate of Rs. 25 per thesis or dissertation or Project report subject to a minimum of Rs. 50 for evaluation of thesis or dissertation or Project report, in addition he shall be paid a sessional fee of Rs. 100 and Travelling Allowance in accordance with the provisions made in the Statutes.

RULE No. 14

Library Rules

1. The Library shall remain open on all days including Sundays but excluding closed holidays at such hours as may be fixed by the Director from time to time.

2. The Library may be used by all students including research and special students during the hours the Library is open.

3. Undergraduate and postgraduate students can take out on loan two books at a time from the Library. A student taking short term course can take out two books through the Department to which he is attached.

4. All members of the Academic staff and the Officers of administration may take out on loan 10 volumes at a time. For the purposes of this rule Academic staff includes Research Scholars/Fellows and Research Assistants.

5. Other members of the staff of the Institute can take out two books only at a time.

6. Apprentices attached to this Institute may take out one book at a time on furnishing a deposit of Rs. 10.00.

7. All important reference books such as Encyclopaedia, Dictionary, Directory, Handbook, Calendars, illustrated books, valuable books, rare publications which cannot be replaced and books in the Reserve Section shall not ordinarily be issued.

8. Books and journals can be issued on inter library loan system on the basis of reciprocity.

9. Each volume shall be considered as a separate book for the purpose of issue.

10. Books taken out of the Library must be returned to the Library and must not be transferred to any one else.

11. Latest issues of journals may be taken out by the respective Heads of Departments for reference by the members of the staff, if and when required.

12. The period of loan will be one whole term for members of the staff excepting for students, apprentices and for persons covered by paragraph five unless required by others.

13. The period of loan for students, apprentice and for persons covered by paragraph five will be 14 days. Books may be recalled earlier, if necessary.
14. After the expiry of the specified time, books may be reissued to a student for a further period of 7 days provided there is no other requisition for them. The retention of books beyond this extended period shall not be permitted.

15. A student defaulter will be charged ten paise per volume per day if the volume is not returned when due.

16. Sub-Libraries may be set up in every Department with a maximum limit of 100 volumes including journals taken out on loan from the Main Library, the Heads of Departments being responsible for their management and proper safeguard.

17. All materials must be returned to the Library at the end of the academic year.

18. Verification of stock will be carried out once a year and in the month of May or June and for this purpose no books shall be issued for a fortnight.

19. Library Bulletin containing the latest additions to the Library will be forwarded to the Departments regularly.

20. New books and latest issue of journals will not normally be issued for one month after receipt.

21. Personal belongings such as books, attache cases, umbrellas should not be brought inside the Library without permission.

22. Spitting and smoking inside the Library are strictly prohibited.

23. Borrowers are requested to keep the books and journals issued to them clean, protect them from rain and not in any way injure and deface them. Any damage caused to the book will have to be made good. Borrowers must at once report any defect in the books and journals issued in order that they may not be charged. The borrower shall be required to replace or to pay the cost of the replacement of any book or journal lost by him while it is in his custody.

24. Silence should be strictly observed in the Reading Rooms.

25. For any serious breach of library discipline the offender may be expelled from the Library and his privilege of using the Library withdrawn.

26. Any Rule may be added, amended or deleted by the Library Committee with the approval of the Director.

RULE No. 16

Rules for the Regulation of the Halls of Residence.

1. The management of a Hall of Residence shall be the joint responsibility of the Warden and the Assistant Wardens or the Lady Superintendent. The Warden or the Lady Superintendent shall be the principal authority and executive in all matters relating to students' residence, welfare, discipline and messing, as well as administration and security of the common properties of the Institute and the Hall of Residence. He or she shall be responsible to the Deputy Director for the proper maintenance and management of the Hall of Residence and the mess attached to it.

2. The Wardens, the Assistant Wardens and the Lady Superintendent of the Halls of Residence together shall constitute a Council of Wardens which shall, within the rules, take decisions on matters of common interest to all Halls of Residence and act thereon and shall make supplementary rules and bye-laws for the administration of the Halls of Residence and their messes. Such rules, however, shall be subject to review by the Chairman of the Senate.

The Deputy Director and the President of the Students' Gymkhana shall be ex-officio members of the Council of Wardens.

3. The Warden or the Lady Superintendent shall constitute one or more Committees comprising elected and nominated student-representatives to assist him or her in matters relating to the health, hygiene, general welfare and corporate life of the students of the Hall and in the running of the mess.

4. All staff employed in the Hall of Residence are employees of the residents of the Hall concerned. They are, however, under the administrative control of the Warden or the Lady Superintendent.
5. The Warden or the Lady Superintendent on behalf of the residents of the Hall shall have the power to appoint or employ out of the mess fund of the Hall such staff as may be required for room service, service in the dining hall, common rooms and determine in each case the remuneration to be paid and to terminate their services for sufficient reasons.

6. The Warden or the Lady Superintendent shall, in consultation with such Committee or Committees as he or she may think fit, ensure that—

(a) there is no wastage of food nor any lavish expenditure on entertainment;
(b) there is no undue expenditure of electricity and water;
(c) the kitchen, pantry, lavatories, bathrooms, etc. are inspected regularly and kept clean and in hygienic condition;
(d) the rooms for general use, the corridors and the surrounding ground are kept neat and clean;
(e) consumable articles are purchased at the most economical rate consistent with quality, and rules are framed and observed so as to run the messes with the utmost economy; quantities purchased and vouchers for payments are properly checked and the accounts audited systematically and regularly.

7. The Warden or the Lady Superintendent shall ensure that the students in his or her charge observe the rules framed for their guidance and behave with decorum.

He or she may, in exercise of his or her authority, take disciplinary action against a student for breach of rules or indecorous behaviour and impose penalties such as withdrawal of privileges, fines, expulsion from the Hall, under intimation to the guardian and the Registry.

8. All men students shall reside in and shall be members of the Hall of Residence meant for men students to which they are assigned; all men research students shall reside in the Hall of Residence specially provided for them.

All women students and women research students shall reside in the Hall of Residence meant for women students.

With prior permission of the Deputy Director part-time women students and scholars may also be permitted to stay in the Hall of Residence meant for women students. Such admission shall, however, not interfere with the studies and other activities of the regular inmates of the Hall.

Such allottees may be asked by the Lady Superintendent to vacate the Hall at 15 days' notice.

9. There shall be a roll call every evening by the Prefect and absentees shall be reported to the Warden.

No boarder shall leave Kharagpur without the prior permission of the Warden or the Lady Superintendent.

10. The mess of each Hall of Residence shall function as a single unit and shall not, under any circumstances, be sub-divided into regional, communal or any other kind of groups or sub-groups. Only two types of meals should be served, viz., vegetarian and non-vegetarian.

11. No student shall come into residence in any Hall nor give up residence in the Hall nor leave the Institute without the prior permission of the Warden or the Lady Superintendent.

12. A student shall keep to the hours set down for the meals, study and rest. He or she is expected to be in his or her room before 8 p.m. and he or she may not remain outside the precincts of the Hall after 9 p.m. without the prior permission of or leave of absence from the Warden or the Lady Superintendent.

13. For overnight leave of absence or leave for a longer period from the Hall the student shall apply to the Warden or the Lady Superintendent in time stating the reasons therefor and he or she shall not leave the Hall till leave has been sanctioned by the Warden or the Lady Superintendent. Application for leave of absence for a longer period should be supported by the Head of the Department concerned. All such permission shall be entered in the Register to be kept with the Warden or the Lady Superintendent. Such Register shall be available for inspection by the Dy. Director or an officer deputed by him.
14. A student shall reside in the room allotted to him or her and may shift to any other room only under the direction or permission of the Warden or the Lady Superintendent of the Hall.

15. A student shall be responsible for the furniture and fittings of the room allotted to him or her and shall, when shifting from or vacating that room, hand over the furniture and fittings intact to the Warden of the Lady Superintendent or any other person duly authorised by him or her. No furniture may be removed from the room without the permission of the Warden or the Lady Superintendent.

16. A student shall be required to make his or her room available whenever required for repairs, maintenance, disinfection or inspection by the Warden or the Lady Superintendent or any other person authorised by the Warden or the Lady Superintendent. A student shall be required to vacate his or her room when leaving for the summer and Puja Vacations.

17. No extra electric connections shall be taken from the points already existing in any room, nor shall any additional fittings be installed, without the specific permission of the Warden or the Lady Superintendent in each case.

18. When the use of additional electrical appliances, such as, an additional light or a small table fan, is permitted, the student shall pay the cost of an extra point and charges for electricity consumed at a rate as may be fixed by the Institute. The fixture shall not be removed when the student vacates the room permanently.

19. At the time of admission to a Hall of Residence for the women students, the father or the guardian of a boarder may appoint, in writing on the prescribed form, a local guardian whose appointment will be subject to the approval of the Dy Director. The local guardian should ordinarily be a resident in this campus or at a place within a radius of five miles of the Institute.

20. Every student shall deposit at the time of his or her admission to the Institute, Hall caution money of Rs. 30.00 to cover any damage to or loss of Hall property and any other outstanding Hall dues. The balance of Hall caution money after deduction of outstanding dues shall be refundable to the student on his or her leaving the Institute. Claims for refund of the balance of the caution money shall be lodged with the Registry of the Institute by the student within four years of his or her leaving the Institute.

21. Every student shall, in addition, be required to pay a mess advance of Rs. 150.00 on admission to the Institute, which is refundable or adjustable at the time of leaving the Institute.

22. Institute dues (tuition fees, seat rent, and other charges) shall not be accepted unless a student has cleared the Hall dues, or he or she has been specifically exempted by the Warden or the Lady Superintendent in writing from paying or deferring payment of these.

23. A student failing to clear his outstanding dues of the preceding month on the expiry of the fixed date of the succeeding month, may be liable to be removed from the Hall of Residence and the Institute under intimation to Registry. The defaulter may be permitted to resume residence at the discretion of the Warden or the Lady Superintendent, on payment of the arrears and a readmission fee of Rs. 5.00.

24. The boarders shall not keep any guest in the Hall. In exceptional circumstances, guests of a boarder may be allowed to stay for a day or two only with the prior permission of the Warden or the Lady Superintendent. Female guests may be permitted to stay only in the Women's Hall of Residence and male guests in the Hall of Residence for men students.

25. The guest fee shall be an amount as may be fixed by the Warden or the Lady Superintendant. No special party or entertainment shall be held in the students' rooms or public halls except with the prior permission of the Warden or the Lady Superintendent.

26. A student may be permitted on application to change his residence from one Hall to another at the end of an academic session but before the commencement of the following academic session. Only in exceptional cases shall a student be permitted to change his or her residence from one Hall to another during the academic session. Such transfer shall not be permitted except on the last day of the month.
27. For purposes of taking transfer a student shall apply through the Warden or the Lady Superintendent of the Hall of Residence, where he or she is a resident, to the Warden or the Lady Superintendent of the Hall of Residence to which he or she wishes to move and shall lodge his or her application with the former at least one week before the end of a month. The transfer will be decided on jointly by the two Wardens or Lady Superintendents concerned; the notification is to be issued by the Dy. Registrar, with intimation to the Halls of Residence, Cash Section, Accounts Section, Academic and other administrative sections of the Institute.

28. All students shall comply with the rules and supplementary rules and bye-laws as may be framed from time to time. Ignorance of any of these shall not be accepted as an excuse for its non-observance on the part of a boarder.
SENATE INSTRUCTIONS
1. **Additional Examiners.**

(a) **Undergraduate courses:**

1. There shall be one Additional Examiner for each branch of study (including Humanities) in which a Bachelor's Degree is provided. The Additional Examiner should be associated with the work of examinations at all stages including the *Vice-Voce* examination.

2. For the B.Tech. and B.Arch. Degree *Vice-Voce* examination, there shall be a second Additional Examiner who should be a distinguished engineer or architect practising the profession.

3. The Additional Examiners are expected to take part in the setting and moderation of question papers or reviewing these and also to advise on the standard of examination. They should be available at the Institute to review the question papers, the work of the students in lectures, tutorials and other classes. The Institute will expect them to deliver a lecture or two for the benefit of the members of the department concerned. They are also expected to tender such advice as they consider necessary for the improvement of the work of the department.

4. The Additional Examiner shall be expected to send to the Director a report on the work of the students and the department and make such recommendations as he may think fit.

(b) **Postgraduate courses:**

1. One Additional Examiner shall, ordinarily, be appointed for each postgraduate course of study unless otherwise decided by the Senate.

2. As a member of the Board of Examiners each Additional Examiner will be associated with the work of setting and moderation of question papers or reviewing these, valuing answer-scripts, conducting *Vice-Voce* examination and examining thesis/dissertation/project report; these should be made available to him 15 days before the *Vice-Voce* examination.

3. The Additional Examiner shall be expected to review the work of the students and teachers in lectures and other classes and deliver a lecture or two at a seminar specially organised for the benefit of the staff and students.

4. The Additional Examiner shall send to the Director a report on the work of the students and the Department and make such recommendations as he may think fit.

2. **Membership of the Doctoral Scrutiny Committee (Ph.D. Degree).**

1. No member of the staff of the Institute who has registered for the Degree of Doctor of Philosophy of the Institute but has not been admitted to the Degree shall be appointed a member of the Doctoral Scrutiny Committee or a Supervisor.

2. A member of the staff who has acted as supervisor or as a member of the Doctoral Scrutiny Committee may, however, supplicate for the Degree of Doctor of Science.

3. The Doctoral Scrutiny Committee for the Degree of Doctor of Science (D.Sc.) shall be under the Chairmanship of Director.

3. **Maximum period for submission of thesis.**

A candidate shall be required to supplicate for the Degree of Doctor of Philosophy within a period of not more than 6 years from the date of his registration,

Provided that a candidate failing to fulfil this requirement may be permitted to re-register on payment of fresh registration fee and on condition that he shall submit the thesis within a maximum period of 2 years from the date of fresh registration.

4. **Requirement for Submission of Thesis.**

A research student may not apply for permission to submit his thesis unless—

(i) he has been regular in his work;

(ii) he has satisfied his Supervisor about his progress;
(iii) he has fulfilled all the requirements as stipulated by the Senate at the time of his registration.

5. Submission of Thesis.

The thesis shall be written in English and shall be submitted in triplicate either typewritten or printed.

Two copies of all accepted theses shall be retained by the Institute, one in the Library and the other in the Department concerned.


The Examiners of a thesis shall be expected to forward their reports with their recommendations preferably within two months after receiving the thesis.

7. Notice for Viva-Voce Examination.

On favourable and unanimous report from the adjudicators of a thesis a candidate for the Degree of Doctor of Philosophy shall be required to appear before a Viva-Voce Board appointed for the purpose. The candidate shall ordinarily be given one month's notice to appear before the Viva-Voce Board.

8. Academic Session.

1. The academic session for the undergraduate courses shall commence on the 1st July unless it is a Sunday or holiday declared by the Board of Governors in which case it shall commence on the next working day. The academic session shall end on 30th June of the following year. The Senate may, however, under special circumstances, fix a date for the commencement of the session for a particular course.

2. The academic session for the postgraduate courses and the Special Three-Year courses for the B.Tech. Degree shall commence on the 1st August or soon thereafter as the Senate may decide. The academic session shall, normally, conclude on 31st July of the following year unless otherwise decided by the Senate.

3. The academic year for a research worker working for a doctorate degree shall normally commence from the date he joins the Institute.

9. Length and Duration of Term.

The Terms and the dates of examinations shall, ordinarily, be announced by the Senate in January each year for the following academic session.

10. Last Date for Joining the Course.

A student shall not be permitted to join the Institute or resume residence after the expiry of a fortnight from the date of commencement of the academic session. In exceptional cases, the Director may, with the approval of the Senate, permit a student to join later after recording reasons and with the appropriate stipulation that granting of such permission to take up residence shall not imply relaxation of requirements in respect of attendance, standard of examination, class, promotion or graduation.

11. Institute Examinations

A. Undergraduate Courses:

(a) Paper-setting

1. The Registry shall issue necessary instruction to the Papersetter through the Head of the Department concerned. The Head of the Department shall arrange for the moderation of the question paper and send it to the Deputy Registrar, by name, in a sealed cover within the date to be fixed by the Senate, normally, six weeks before the commencement of the Terminal examinations and eight weeks before the End-Sessional examination. All sketches in the question papers shall be drawn on separate tracing paper with Indian Ink.

2. Security shall be observed in the printing of question papers.
(b) Putting Code Numbers on Answer Scripts

3. Code numbers shall be put down on answer scripts of the End-Sessional examination and the examination to decide scholarships.

(c) Evaluation of Answer Scripts.

4. Answer scripts shall be evaluated by the examiners appointed for the purpose and the work of evaluation shall, ordinarily, be completed within 10 days from the date of receipt of the scripts from the Examination Office.

(d) Submission of Marks.

5. Each examiner shall submit within the scheduled date to the Head of his department mark sheets, in triplicate, under his signature together with the relevant answer scripts.

(e) Scrutiny of Answer Scripts and Mark Sheets.

6. The Head of the Department shall arrange for the scrutiny of answer scripts and mark sheets. The scrutinised mark sheets shall bear the signature of the scrutineer, and, these shall be sent by the Head of the Department to the Head of the Department concerned with tabulation in sealed covers within 12 days from the date of the examination. Answer scripts, mark sheets, and tabulation sheet shall be sent to the Examination Office after the results of a particular examination are approved by the Senate.

(f) Tabulation of Results.

7. Two tabulators shall be appointed for each examination. Marks shall be tabulated in the prescribed form and carried out independently by two tabulators under the overall supervision of the Chairman of the Board of Examiners. Tabulators shall jointly draw up a summary of the results in the prescribed form. In considering the results the Board of Examiners shall be guided by the Special Senate Instructions on the standard of examination.

8. The results shall be considered by the Board of Examiners for report to the Senate in the prescribed manner.

9. The Senate shall consider the results, decide promotion, detention in a class or removal from the Institute and also make recommendations to the Board of Governors for the award of Degrees to the students who have passed in the final examination.

B. Postgraduate Courses:

(a) Paper-setting.

1. The Registry shall issue necessary instructions to the paper-setter through the Head of the Department concerned. The Head of the Department shall arrange for the moderation of the question paper and send it to the Deputy Registrar, by name, in a sealed cover within the date to be fixed by the Senate, normally, 6 weeks before the commencement of the examination. All sketches in the question papers shall be drawn on a separate tracing paper with Indian Ink.

2. Security shall be observed in the printing of question papers.

(b) Evaluation of Answer Scripts.

3. Answer scripts shall be evaluated by the Examiners appointed for the purpose and the work of evaluation shall be completed within five days of the examination.

(c) Submission of Grades.

4. All examiners shall submit to the Head of the Department concerned the grades obtained by each student, in duplicate, together with relevant answer scripts within a prescribed time.

(d) Scrutiny of Answer Scripts and Grade Sheets.

5. The Head of the Department shall arrange for the scrutiny of answer scripts and grade sheets. The scrutinised grade sheets shall bear the signature of the scrutineer, and, these shall be sent by the Head of the Department to the Head of the Department concerned with tabulation.
in sealed covers within 7 days from the date of the examination. Answerscripts, grade sheets and tabulation sheet shall be sent to the Examination Office after the results of a particular examination are approved by the Senate.

(e) Evaluation of Thesis/Dissertation/Project Reports.

6. All theses/dissertations/project reports shall be evaluated by the Additional Examiner or Examiners appointed by the Senate and the teacher guiding the thesis or dissertation or/project work. The theses/dissertations/project reports shall be submitted for evaluation within the date to be fixed by the Senate for each session. The Head of the Department shall arrange to send the theses/dissertations/project reports to the Additional Examiner for evaluation well in time so that the results are available at the time of the Viva-Voce examination.

(f) Tabulation of Results.

7. Two tabulators shall be appointed for each examination. Grades shall be tabulated in the prescribed form and carried out independently by two tabulators under the overall supervision of the Chairman of the Board of Examiners. Tabulators shall jointly draw up a summary of the results in the prescribed form. In considering the results the Board of Examiners shall be guided by the Special Senate Instructions on the standard of examination.

8. The results shall be considered by the Board of Examiners for report to the Senate in the prescribed manner.

9. The Chairman of the Board of Examiners shall place before the Senate the report of the Board of Examiners. The Senate shall decide whether a particular student shall be allowed to proceed to the next term or be promoted to the Second year class as the case may be. The Senate shall also consider the results, pass orders or make recommendation to the Board of Governors for the award of the Degrees and Diplomas to the successful students.

12. Instructions for the guidance of the Officer-in-Charge of Examinations.

1. The Senate shall appoint for each academic session an Officer-in-Charge of Examinations from among the members of the academic staff.

2. The Officer-in-Charge shall be responsible for the conduct of all undergraduate examinations.

3. He shall act as the ex-officio convener of the Examination Committee, which shall draw up the time-table for all the examinations and also the Invigilation list. He shall also make necessary seating arrangements in the Examination Halls.

4. Before the commencement of each examination the Officer-in-Charge of Examinations shall be provided with a list of students who are to appear at the examination and also a list of optional subjects taken by them including a statement showing the number of students with their roll numbers appearing at each of the optional subjects.

5. Before the commencement of the examination the Officer-in-Charge of Examinations shall have a list of students who have defaulted in paying their dues. He shall not admit any student who does not possess valid admit card for the particular examination issued under the signature of the Deputy Registrar and countersigned by the Warden concerned. In doubtful cases, the Officer-in-Charge of Examinations may allow a student to take the examination and shall immediately refer the matter to the Deputy Registrar.

6. The question papers for each examination shall be handed over to the Officer-in-Charge of Examinations in sealed covers at least one hour before the commencement of the examination. Blank answer books, supplementary sheets, graph papers, drawing sheets, log tables and other tables and sundry stationery for the examination shall also be placed with the Officer-in-Charge of Examinations.

7. The Officer-in-Charge of Examinations shall be in overall charge for the smooth conduct of the examination. He will be assisted in this work by one of the senior teachers to be designated as Professor-in-Charge for each session of the examination.

8. Ordinarily, one invigilator shall be appointed for every 25 examinees, but the Officer-in-Charge of Examinations shall have the discretion to appoint additional invigilators.

9. For the End-Sessional examination and the examination to decide scholarships the Officer-in-Charge of Examinations shall arrange to put down code numbers on each answerscript by teachers specially appointed for the purpose by the Examination Committee.
10. The Registry shall provide adequate number of attendants for the smooth conduct of the examination.

11. On reference from the Teacher-in-Charge of Examination Hall the Professor-in-Charge of the session may, after checking the manuscript and consulting the paper-setter concerned, if needed, announce necessary correction in the question paper and report to the Officer-in-Charge of Examinations.

12. The Officer-in-Charge of Examinations shall arrange to get the answer-sheets serially arranged and checked against the attendance sheet. Answer-sheets shall then be securely packed and sealed and despatched to the examiner concerned. The Officer-in-Charge shall forward to each examiner together with the answer-sheets two copies of the question paper and the required number of blank marksheets.

13. On receipt of a report from the Teacher-in-Charge of the Hall about adoption of unfair means the Professor-in-Charge shall forward it to the Chairman of the Discipline Committee along with the relevant papers under intimation to the Deputy Registrar.


1. Invigilators shall report to the Officer-in-Charge of Examinations half-an-hour before the commencement of the examination. They shall take charge of the packets of question papers, answer scripts, log tables and other stationery required for the examination.

2. An invigilator, who, for illness or other unavoidable reasons, is unable to be present should take leave of absence with 24 hours’ notice to the Head of the Department and the Officer-in-Charge of Examinations. In case of sudden indisposition he may send intimation to the Officer-in-Charge of Examinations well in time to enable the latter to make alternative arrangement in consultation with the Head of the Department concerned.

3. Invigilators shall make sure that instructions for the guidance of the examinees are strictly followed by all examinees. They shall distribute the answer-sheets in the Examination Hall 10 minutes before the start of the examination.

4. Invigilators shall distribute the question papers 5 minutes before the commencement of the examination. They should ensure that each examinee makes proper entries on the cover page of his answer-sheets. On the conclusion of the examination they shall collect the answer-sheets and arrange them according to roll numbers and hand them over to the Teacher-in-Charge of the Hall, who will make them over to the Officer-in-Charge of Examinations along with the surplus question papers, answer-sheets and other stationery.

5. Invigilators shall put their initials with date on each answer-sheets, supplementary sheet, drawing sheet and graph sheet issued to the examinees.

6. Invigilators shall check the admit cards of all the students and submit a report to the Officer-in-Charge of Examinations for the first three days only.

7. Invigilators shall note the roll numbers of the candidates present at the examination and submit them to the Teacher-in-Charge of the Hall after the examination.

8. Invigilators shall remain in the Examination Hall during the time allotted to each paper and shall not leave the Hall without the permission of the Teacher-in-Charge of the Hall. Invigilators shall also bring to the notice of the Teacher-in-Charge of the Hall any complaint or difficulty pointed out by any examinee regarding the question paper set for the examination.

9. An invigilator shall report to the Teacher-in-Charge of the Hall any case of indecorum or suspected malpractice. The Teacher-in-Charge of the Hall shall then take necessary action in accordance with the instructions issued by the Senate from time to time. He shall also inform the Professor-in-Charge of the session and the Officer-in-Charge of Examinations.

14. Instructions for the guidance of the students appearing at the examination.

1. The Examination Halls shall be opened on each day half-an-hour before the time specified for the commencement of the examination and the students shall be in their respective seats at least 15 minutes before the commencement of the examination. As a special case a student may be allowed to enter the Examination Hall with the permission of the Teacher-in-Charge within 15 minutes after the examination has started. No extension of time shall be granted to a student on grounds of his late arrival in the examination hall.
2. No student shall be allowed to enter the Hall unless he produces the valid admit card.

3. No student shall be allowed to leave the Hall during the first half hour of the examination. Thereafter, he may do so after handing over the answer script, question paper and other examination materials personally to the Teacher-in-Charge.

4. Each student shall occupy the seat particularly assigned to him and under no circumstances shall be allowed to change seat unless instructed to do so by the Invigilator concerned.

5. Students shall write their answer on both sides of the answer-scripts but must not write on the back of the cover page.

6. Students shall write their names and/or Roll Numbers only in the places specially provided for on the cover page. They shall write their names and Roll Numbers only at the bottom right-hand corner of the drawing sheet.

7. They shall remain in their seats till the answer-scripts are collected by the invigilator at the end of the examination hour. They may, however, submit their answer scripts at any time to the Teacher-in-Charge and only then leave the Hall.

8. Drawing and graph sheets and log tables shall be supplied by the Institute and no student shall bring with him any book, note, loose paper, etc. Students shall, however, be allowed to use their own instrument boxes. For examination in Freehand Drawing, no instruments of any kind shall be used not even scales. A student should come provided with his pen and ink.

9. For open book examination, only books and/or notes as specified on the question papers shall be allowed.

10. Students shall not tear off any page from the answer-script. In case a page in found torn, the matter shall immediately be brought to the notice of the Invigilator.

11. For non-observance of the code of conduct a student shall be liable to disciplinary action in terms of Ordinance VII.

12. To smoke in an examination hall, making noise, etc. are social offences and invite action under Ordinance VII.

15. Procedure for Admission.

A. Submission of Application.

Applications for admission to the undergraduate and postgraduate courses and for research training must be made on the prescribed application form and must be sent to the Deputy Registrar or Assistant Registrar (Academic) of the Institute by a date as may be announced each year in the advertisement inviting applications for admission to the various courses.

B. Enclosures with Application.

All applications must be accompanied with:

(a) three recent Passport size photographs of the candidates duly attested (must accompany each application);

(b) (i) for undergraduate courses including M.Sc. Crossed Indian Postal Orders for Rs. 15 payable to the Indian Institute of Technology, Kharagpur at Kharagpur Technology P.O. as application and registration fee;

(ii) for Postgraduate courses—

A Crossed Postal Order of Rs. 5/-

(iii) for Research Scholars of Re. 1/-

(there must not be any over-writing on the Postal Orders. Candidates shall carefully check that the Postal Orders bear the legible date-stamp of the issuing Post Office in the appropriate space on the right-hand side and the signature of the issuing Postmaster at the appropriate space. A Postal Order defective in any way shall be treated as invalid and an application accompanied with a defective Postal Order may be rejected without any reference to the applicant).
(c) If the candidate has already passed the prescribed qualifying examination, copies of pass certificates (final or provisional) and mark-sheet or grade card, duly attested by the Head of the Institution last attended, must accompany the application. If the candidate has appeared or is due to appear at the prescribed qualifying examination before the stipulated date or if the pass certificate or the mark-sheet or the grade card has not been received by the candidate, attested copies of these shall have to be produced at the time of interview and medical examination. In such a case, however, an appropriate certificate from the Head of the Institution from which he has appeared or will appear at the qualifying examination shall have to be submitted with the application. Only attested copies of pass certificates, mark-sheets or grade cards relating to the Public Examination other than the qualifying examination (i.e. High School Matriculation, I.Sc. examination etc.) shall have to be enclosed with the application.

(d) A document duly attested by the Head of the Institution last attended showing the age of the candidate as recorded in School (This is essential).

(e) A candidate belonging to a Scheduled Caste or a Scheduled Tribe shall be required to produce a certificate from the Head of the Institution last attended to that effect.

(f) A self-addressed stamped envelope (23 Cm × 10 Cm or 9" × 4") with 70 P postage stamp affixed on it and with the words "Registered Post" superscribed on it for sending the Admit Card (essential in the case of applicants due to appear at the written Entrance Examination).

Note: If these documents are not enclosed, the applications will not be entertained. Originals of certificates mentioned in (c), (d) and (e) above should not be sent. The Institute does not undertake the responsibility of returning original certificates if enclosed with the applications.

C. Declaration of Guardian.

Applications without the signed declaration of father or guardian in the column as may be provided in the Application Form accepting the financial responsibility of the applicant shall be regarded as incomplete.

D. Admit Card for the written Entrance Examination.

Applicants for the 5 and 5½-year B.Tech. and B.Arch Degree courses who fulfil all requirements in respect of educational qualification, age limit and physical fitness and have completed the application in all respects and submitted the same within the time limit shall be asked to appear at the written Entrance Examination, at the centre of their choice or at any other centre near their place of residence. Admit Cards for the Entrance Examination will be issued so as to reach the candidates usually within one week before the date of commencement of the examination.

E. Interview and Medical Examination.

Candidates successful in the written examination shall be required to appear, at their own expense, at an interview and medical examination at the Institute situated in the Zone in which the centre of Entrance Examination is located. The authorities of the Institute may, however, ask a candidate to appear for the interview at any other Institute.

The interview and the medical examination of candidates for admission to the 5 and 5½-year B.Tech. and B.Arch. Degree courses are normally held in the 3rd and 4th weeks of June unless otherwise decided by the Institute.

Written test and/or interview and medical examination for admission to other courses shall be held on dates as may be decided by the Institute.

F. Selection for a course of study.

Preference for a particular course as mentioned in the application will be given due consideration but the final selection for a course shall be made by the Institute taking into consideration previous attainment, performance in the Entrance Examination, aptitude and suitability of the candidate and availability of seats for the particular course. Decision of the Institute shall be final and no application for change of course shall be entertained.