International Centre for Applied Sciences
(A Constituent Unit of MAHE Manipal, India)

B. Sc. (APPLIED SCIENCES)
A Bachelors Degree Programme under MAHE, Manipal

ACADEMIC REGULATIONS, COURSE STRUCTURE AND SYLLABUS OF FIRST TO SIXTH SEMESTER
(2018 - 2021)

Applicable for the 2018 Admission Batch

ADDRESS : Academic Block - 5
           LG-2, MIT Campus,
           MANIPAL – 576104,
           KARNATAKA, INDIA

Telephone : +91 – 820 - 2571060 extn. 24018
            +91 – 820 – 2571083, 2924026

Fax : +91 – 820 - 2924018

E – Mail : office.icas@manipal.edu

Website : www.manipal.edu/icas.html
1. **INTERNATIONAL TRANSFER PROGRAM (ITP) IN ENGINEERING:**

   International Centre for Applied Sciences (ICAS), Manipal is offering a full time (three years), B.Sc.(Applied Sciences) Degree program with a provision for credit transfer to any of the foreign universities at the end of second year of studies.

   It is a unique program where the students usually spend the first two years in ICAS, Manipal and the following two years in a university abroad, of their choice (the full time, international engineering degree awarded by the foreign university only). The credit transfer will depend upon the academic policy of the respective foreign universities and can be up to 100%. This is made possible by adopting the high quality curriculum, teaching and evaluation methodologies that are followed by top universities abroad.

   Since 1994, about 1700 students have entered more than 100 foreign universities (spread across USA, UK, Australia, Germany, France, Canada & the like countries) through acceptable credit transfer from ICAS, pursuing their Bachelor/Master Degree in Applied Sciences/Engineering.

   The following streams are offered at ICAS under the International Transfer Program:

   - Aeronautical/Aviation
   - Chemical
   - Civil
   - Computer Science & Engineering
   - Electrical & Electronics
   - Mechanical
   - Mechatronics

   Students opting for Aviation/Aeronautical stream only can take credit transfer after the first year. All other students are required to complete two years of study at ICAS before getting their credits transferred to foreign universities. The academic year at ICAS is divided into two Semesters. Each Semester is of 14 to 16 weeks duration. During the first semester, the students of all the branches study common subjects. Adequate importance is given to English Communication, Basic Sciences and Humanities during the entire period of two years at ICAS, as required by the foreign Universities.

2. **CREDIT TRANSFER FLEXIBILITY:**

   Students can switch over from the above mentioned core streams to any of the allied streams/specializations at the university abroad, during credit transfer. For example, the students who studied at ICAS in the stream Computer Science can continue in the same discipline or can switch over to Computer Engineering or Information Science or related fields. Similarly, from Electrical & Electronics stream to core Electrical Engineering or Electronics & Communication specializations and from Mechanical to core Mechanical or Automobile or Production/Manufacturing/Industrial Engineering streams at the foreign university.

3. **ELIGIBILITY FOR ADMISSION**

   Pass in 10+2 (CBSE, ICSE, “A” level, IB, HSC, OSSD, American High School Diploma or Equivalent Examination) with a minimum of 60% (aggregate) or ‘C’ grade in English, Physics and Mathematics with Chemistry or Biology or Computer Science or Biotechnology or Electronics as optional subjects in the 12th standard.
4. **ACADEMIC CALENDAR**
The academic calendar will be prepared by ICAS in line with the academic calendar of MAHE, Manipal before the commencement of the classes for both Odd Semester and Even Semester of the Academic Year, containing the dates for:

- Commencement of the classes
- Internal Assessment tests and Student Feedback
- Last instructional day
- Start and End dates for the end semester examination
- Result declaration date
- Date for paper seeing & revaluation
- Date of declaration of revaluation results
- Make-up examination dates
- General Holidays and Co-curricular & Extra-curricular Events

5. **ACADEMIC/EXAMINATION REGULATIONS**

A) 75% attendance is compulsory to the classes of any subject under any circumstances. If a student is unable to satisfy this minimum attendance requirement he/she will not be permitted to attend the end semester examination of that subject and will get detained, as per the institute/university attendance regulations.

B) A student has to re-register for those subjects in which he/she was not allowed to write the end-semester examination due to shortage of attendance (less than 75% of the classes conducted for the subject). The institute will conduct special classes (crash course) in the evening (after regular teaching hours) for such re-registered students. The re-registered student has to attend internal assessment tests (which are conducted exclusively for them) and must fulfill the minimum attendance regulation (75%) to be eligible to write the End Semester Examination. No condoning of attendance for any reason is permitted during such crash courses.

C) Any student desirous of improving internal assessment marks in the subject(s) of the previous semesters has to reject the particular subject(s) of that semester/year and has to re-appear for the IA tests/submit assignments and write the end-semester exam. along with the regular students of that particular semester/year (Odd in Odd and Even in Even semesters, respectively) by paying the prescribed fees. Such a student cannot claim to revert to the old IA marks/end exam. marks if the new marks are lower than those of the former attempt.

D) The maximum duration for a student for passing/re-appearing in any subject offered, is twice the duration of the academic programme from the date of joining. This applies also to the students who discontinue the academic programme for any reason and rejoins the programme at a later date.

E) After the expiry of the above validity period, the student may get admitted afresh to the programme and repeat all semesters from the beginning. In such cases, the student will be governed by the rules, regulations, courses of study and syllabi in force at the time of re-admission.

F) Change of branch is allowed on prior written request, against vacancies, before the commencement of the second semester, based on the academic performance in the first semester at ICAS.
5.1 Internal Assessment

- A total weightage of 50 marks is reserved for internal assessment in theory subjects.
- Two internal tests, each of 20 marks, are conducted for all the courses registered in a semester.
- First test will be conducted after five weeks of the commencement of the program and the second test will be conducted after ten weeks of the commencement of the program.
- Ten marks are reserved for two assignments to be given during the program (each assignment carries five marks). The assignments will be given between the first test and the make-up test.
- If a student is unable to attend any one of the tests because of ill health or other genuine reasons or is desirous of improving his IA marks, a make-up test may be given after the second test.

5.2 End Semester Assessment

- The maximum marks for the theory examination are 100. Out of this, 50 marks are for the Internal Assessment and 50 for the end-semester examination. For convenience, end semester assessment will be conducted for 100 marks and then scaled down to 50.
- The minimum marks (cut-off) for passing a subject is 50% of the total, when the end-semester theory (or practical) & the Internal Assessment marks are put together, with a minimum of 35% marks to be scored in each subject (theory:18/practical:09), in the end semester examination.
- The student performance in laboratory courses is evaluated out of a maximum of 50 marks. It is based on in-semester assessment of 25 marks (reflecting the performance of the student in the conduct of the experiment, regularity and timely submissions) and end-semester lab. examination component (internal) of 25 marks. Completing all the prescribed experiments and attending the lab. examination at the end of the semester on the specified date & time, is mandatory. No change of date & time for the lab. examination is permitted, once notified.

5.3 Duration of the Examination & Tests

The end semester examination will be of three hours duration and the internal assessment tests will be of one hour duration each.

5.4 Mini Projects

Students need to take-up mini projects under the guidance of faculty in minimum one of their third as well as fourth semester laboratory courses. This will enable them to earn one additional credit.

6. GRADING, RESULT AND ISSUE OF GRADE CARDS

6.1 ICAS shall follow FOUR LETTER, Fixed Grading system which is as follows:

**Letter Grading System:**

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Percent Equivalent Marks</th>
<th>Grade Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Outstanding)</td>
<td>100 – 90</td>
<td>4.0</td>
</tr>
<tr>
<td>B+ (Very Good)</td>
<td>89 – 80</td>
<td>3.5</td>
</tr>
<tr>
<td>B (Good)</td>
<td>79 – 70</td>
<td>3.0</td>
</tr>
<tr>
<td>C+ (Above Average)</td>
<td>69 – 60</td>
<td>2.5</td>
</tr>
<tr>
<td>C (Average)</td>
<td>59 – 50</td>
<td>2.0</td>
</tr>
<tr>
<td>F (Fails)</td>
<td>Below 50</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA):
Each course grade is converted into a specific number of points associated with the grade. These points are weighted in accordance with the number of credits assigned to a course.

The weighted average of GPAs of all semesters that the student has completed at any point of time is the Cumulative Grade Point Average (CGPA) at that point of time. CGPA is updated after every semester the student completes.

Calculation of GPA and CGPA:
Example:

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Credits</th>
<th>Letter Grade</th>
<th>Grade Value</th>
<th>Credit x Grade Value</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATHS</td>
<td>4</td>
<td>C+</td>
<td>2.5</td>
<td>4x2.5</td>
<td>10</td>
</tr>
<tr>
<td>PHYSICS</td>
<td>3</td>
<td>C</td>
<td>2</td>
<td>3x2</td>
<td>6</td>
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<td>CHEMISTRY</td>
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<td>B+</td>
<td>3.5</td>
<td>3x3.5</td>
<td>10.5</td>
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<tr>
<td>EG – I</td>
<td>4</td>
<td>B</td>
<td>3</td>
<td>4x3</td>
<td>12</td>
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<tr>
<td>TOTAL</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td>38.5</td>
</tr>
</tbody>
</table>

In this case, GPA = \[
\frac{\text{total grade points}}{\text{total credits}}
\]

\[\frac{38.5}{14} = 2.75\]

Suppose the GPA in four consecutive semesters are 3.0, 2.91, 2.80 and 3.95 with 22, 22, 18 and 19 respective course credits, then the

CGPA = \[
\frac{3.0\times22+2.91\times22+2.80\times18+3.95\times19}{22+22+18+19}
\]

= 3.15

Generally:

\[
\text{GPA} = \frac{\sum_{i=1}^{n} Ci \times Gi}{\sum_{i=1}^{n} Ci} \quad \text{and} \quad \text{CGPA} = \frac{\sum_{j=1}^{N} GPA_j \times (\sum_{i=1}^{n} Ci)_j}{\sum_{j=1}^{N} (\sum_{i=1}^{n} Ci)_j}
\]

where \( n \) = number of courses

\( Ci \) = course credit

\( N \) = number of semesters

\( Gi \) = corresponding grade value

6.2 Results are declared by Director (ICAS) along with Examination Coordinator (ICAS) and a copy of same is sent to MAHE, Manipal.

6.3 Grade Cards are prepared and printed by MAHE, Manipal and signed by Registrar (Evaluation) of MAHE and Director (ICAS).
6.4 Consolidated marks cards: If a candidate has taken more than one attempt to pass in all the subjects of a semester examination, he/she can apply for consolidated marks card of the semester from MAHE. In this marks card, only the marks of the passed attempts are shown along with the month and the year of passing the subjects.

6.5 Any malpractice cases reported during the IA tests / End-semester examination / Make-up examination will be dealt with, as per university/institute guidelines.

7. APPEAL PROCESS

7.1 In only the Theory subjects of end-semester examination, students are allowed to request for paper seeing and/or revaluation by paying the prescribed fee. However, the marks scored in the revaluation of such theory subjects will be final and a binding on the student.

7.2 Scripts and scheme of evaluation are made available at the time of paper seeing.

7.3 ICAS will assign a different examiner for revaluation, as far as possible.

7.4 Fees will be refunded in case of Grade improvement.

8. MAKE-UP EXAMINATION

8.1 Make-up examinations will be held during every semester break (soon after the announcement of revaluation results) to help the regular students to pass the subjects in which they have got F/I grade, during the same semester.

8.2 A maximum of C+ grade only will be awarded in the make-up examination, irrespective of their performance in the F/I subjects. Make-up examination will be conducted on continuous days and there will be no paper seeing/revaluation options.

8.3 However, the students may appear for the end-semester examination in the subsequent semesters, if they are keen to get actual grades in the F/I subjects.

8.4 The above facility will also save a semester duration towards foreign university admission, for the outgoing fourth semester regular students having F/I grade in 4th Sem. subjects.

9. STUDENT ATTENDANCE REGULATIONS

All the students are expected to attend all the classes in each subject. However, it is mandatory for a student to have a minimum of 75% attendance in individual subjects, for being eligible to write the end-semester examination, in compliance with the MAHE Norms. In case of Laboratory classes, completing all the experiments is a pre-requisite for in-semester assessment.

The above 25% condoning of the attendance takes care of his/her absence due to any medical/personal reasons/purposes including writing eligibility exams, attending passport/visa related works, emergency & hospitalization cases etc. and there is no question of considering any medical certificate when a student has deficiency of attendance beyond 25%. Students are advised to take eligibility exams like TOEFL/IELTS/SAT during vacation period only.

Generally, the above 25% condoning of the attendance includes his/her absence in the class on account of representing the institute/university in the co-curricular/extra-curricular activities also. However, as an encouragement to the students involving in such activities, further condoning of attendance up to a maximum limit of 10% of the total classes held in the
individual course in that semester may be permitted (not applicable to crash courses), subject to the following conditions:

1. The desirous student must apply for the same and obtain prior permission (in writing, in the forms available in ICAS Office) from the Associate Director, without which no request for condoning of attendance will be entertained.

2. The student has to obtain authentication/endorsement in the same form, from the concerned authorities (listed below) authenticating his/her participation in the said activity and has to produce it at the ICAS office strictly within two weeks after the event. No letter received after this duration will be entertained for condoning of attendance.

3. Associate Director will further instruct the concerned teachers handling the course to consider such cases for condoning of attendance, subject to a maximum ceiling of 10% of the total classes held in that course.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Nature of Event</th>
<th>Authority for Endorsement</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Representing Inter-Institute / Inter-University Sports activity</td>
<td>Director of Physical Education, (MIT/MAHE)</td>
</tr>
<tr>
<td>02</td>
<td>Representing Inter-Institute / Inter-University Cultural activity / competitions</td>
<td>Faculty Coordinator, Student Activities, ICAS / Deputy Director, Student Affairs, MAHE</td>
</tr>
<tr>
<td>03</td>
<td>Presenting papers in Conferences / Tech. Fests / Research Colloquiums etc.</td>
<td>Faculty Coordinator of Student Counseling, ICAS</td>
</tr>
<tr>
<td>04</td>
<td>Writing Eligibility Exams like TOEFL/IELTS etc. and attending Passport/Visa related activities (only in exceptional cases, only for the days of exam/meeting, with proof)</td>
<td>Associate Director, ICAS</td>
</tr>
</tbody>
</table>

Students are advised to check their attendance position regularly from the respective teachers and try to make up for the attendance shortage, if any by attending all the remaining classes. Branch Faculty Coordinators / Subject Teachers shall display the student attendance position along with IA test marks, a week after the first & second tests respectively, monitor the attendance position of irregular students and initiate appropriate remedial steps.

**10. TEACHER GUARDIANSHIP (TG) and FACULTY ADVISER (FA) SCHEMES**

In order to monitor the academic progress of the students and to supervise their welfare, ICAS has arranged teacher guardianship/faculty adviser scheme. A batch of 10 to 15 students will be allotted to a subject handling teacher who will act as a friend, philosopher and guide to these students. The TGs will be in touch with the parents/guardians of the students to inform them the progress/welfare of these students.

In the second year, 20 to 25 students are allotted to each faculty handling respective branch classes and will act as Faculty Adviser (FA). The role of FA is almost same as TG, but in addition they advise / guide them towards their future academic plans in their respective chosen branches.

The parents/guardians are also advised to keep in touch with the respective TGs/FAAs of their wards.

The Associate Director of ICAS along with the Faculty Coordinator of Student Welfare will monitor these schemes and will counsel the students from time to time.
# COURSE STRUCTURE
## B.Sc. (CHEMICAL)

### FIRST YEAR - I SEMESTER

<table>
<thead>
<tr>
<th>SUBJECT CODE</th>
<th>SUBJECT</th>
<th>THEORY/TUTORIAL/LAB./ CREDITS</th>
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<tbody>
<tr>
<td>IMA 111</td>
<td>MATHEMATICS –I</td>
<td>3–1–0–4</td>
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<tr>
<td>IPH 111</td>
<td>PHYSICS - I</td>
<td>3–0–0–3</td>
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<td>ICE 111</td>
<td>MECHANICS OF SOLIDS</td>
<td>3–1–0–4</td>
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<td>ICS 111</td>
<td>PROBLEM SOLVING USING COMPUTERS</td>
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<td>IHS 111</td>
<td>A COURSE ON PSYCHOLOGY FOR ENGINEERS</td>
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<td>IHS 112</td>
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<td>IME 111</td>
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18–3-6-23

### SECOND SEMESTER

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<td>CHEMICAL PROCESS CALCULATIONS</td>
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<td>ICHM 122</td>
<td>CHEMICAL ENGINEERING THERMODYNAMICS-I</td>
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15–3–9-21

### SECOND YEAR - THIRD SEMESTER

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<td>ICHM 232</td>
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19- 2-6–23

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<td>ICHM 242</td>
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<td>MASS TRANSFER-I</td>
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18-2- 9- 23
### THIRD YEAR - FIFTH SEMESTER

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### SIXTH SEMESTER

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<td>CHEMICAL PROCESS INDUSTRIES</td>
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<td>ELECTIVE - I PETROCHEMICALS</td>
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# B.Sc. (CIVIL)

## FIRST YEAR - I SEMESTER

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<td>IMA 111</td>
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18-3-6-23

## SECOND SEMESTER

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15-3-9-21

## SECOND YEAR - THIRD SEMESTER

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18–2-6-22
# B.Sc. (ELECTRICAL & ELECTRONICS)

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# B.Sc. (MECHANICAL)

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## SECOND SEMESTER

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## SECOND YEAR - THIRD SEMESTER

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## FOURTH SEMESTER

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<td>THEORY OF MACHINES</td>
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<td>DESIGN OF MACHINE ELEMENTS</td>
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### SIXTH SEMESTER

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<td>HEAT TRANSFER</td>
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# B.Sc. (MECHATRONICS)

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<td>PROBLEM SOLVING USING COMPUTERS</td>
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## SECOND YEAR - THIRD SEMESTER

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## FOURTH SEMESTER

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<td>PROGRAMMABLE LOGIC CONTROLLER</td>
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<td>AUTOMATED MANUFACTURING SYSTEMS</td>
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### THIRD YEAR - FIFTH SEMESTER

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### SIXTH SEMESTER

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**Total Credits:** 18–2–6-22
# B.Sc. (Aeronautical/Aerospace/Aviation)

## First Year - I Semester

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**Total Credits:** 18–3–6–23

## Second Semester

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**Total Credits:** 15 – 3 – 9 – 21
DETAILED SYLLABUS
I SEMESTER
(COMMON TO ALL BRANCHES)

MATHEMATICS - I

IMA 111 3-1-0-4

Successive differentiation, polar co-ordinates, angle between polar curves, derivative of arc length, curvature, radius of curvature and evolutes. (12 hours)

Rolle’s Theorem, mean value theorems - Lagrange's and Cauchy's mean value theorems, Taylor's theorem, Maclaurin's series development, indeterminate forms and L'Hospital’s Rule. (6 hours)

Infinite series, series with positive terms - test of convergence, comparison test, D'Alembert's ratio test, Cauchy’s root test, Raabe's test, integral test, alternating series - Leibnitz's rule, power series, radius of convergence and interval of convergence. (6 hours)

Reduction formulae, curve tracing, application of integration to find arc length, area of the plane regions, surface area of revolution, volume of revolution. (10 hours)

Analytical solid geometry – Planes and Straight line (basic revision). Spheres, section of sphere by planes, right circular cone and right circular cylinder. (8 hours)

Interpolation and application: Finite differences- forward, backward, central and divided differences, Newton-Gregory interpolation, Lagrange’s interpolation and Newton’s divided difference polynomial. (6 hours)

TEXT/ REFERENCES:


PHYSICS - I

IPH 111 3-0-0-3

Optics: Interference of Light Waves: Conditions for interference, Young’s double-slit experiment, Intensity distribution of the double-slit interference pattern, Phasor addition of waves, Change of phase due to reflection, Interference in thin films, The Michelson Interferometer. (10 hours)
Diffraction Patterns and Polarization: Introduction to diffraction patterns, Diffraction patterns from narrow slits, Resolution of single-slit and circular apertures, The diffraction grating, Diffraction of X-rays by crystals, Polarization of light waves.


TEXT/ REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

ICE 111

PART-A: MECHANICS OF RIGID BODIES:

Introduction: basic principles and concepts (1 hour)

Resultant of coplanar concurrent and non-concurrent force system: Resolution, composition, moment of force, Varignons theorem, couple, application problems. (6 hours)

Equilibrium of Coplanar concurrent and noncurrent force system: Conditions of Equilibrium, Space and Free body diagram, Lami’s theorem- application problems. Support reaction, types of loading, friction- application problems. (6 hours)

Centroid and Moment of Inertia: Simple and composite areas, application problems. (8 hours)

Kinetics: Applications of D’Alembert’s, Work-Energy and Impulse Momentum principles (9 hours)
PART-B: MECHANICS OF DEFORMABLE BODIES:

Simple Stresses and Strains: normal stress and strain, mechanical properties of materials, Hooke’s law, modulus of elasticity, tension test on ductile and brittle materials, factor of safety, allowable stress, Stresses and deformations in tapered bars, stepped bars, Poisson’s ratio, shear stress and shear strain, modulus of rigidity, relation between modulus of elasticity, modulus of rigidity and bulk modulus, application problems. (9 hours)

Statically indeterminate members: Compound bars, thermal stress (6 hours)

Stresses in thin cylinder: hoop, longitudinal and shear stresses. Change in dimensions due to the fluid pressure, joint efficiency and application problems. (3 hours)

TEXT/REFERENCES:

- E. P. Popov, Mechanics of Materials, S.I. Version, PHI.
- Bhavikatti & Rajasekharappa, Engineering Mechanics, New Age International

PROBLEM SOLVING USING COMPUTERS

ICS 111

INTRODUCTION TO COMPUTERS: Block diagram of a computer, computer memories, and operating system basics. (1 hour)

ALGORITHMS AND FLOWCHARTS: Definitions, symbols of flowcharts, examples of flowcharts and algorithms for simple ones, examples of flowcharts and algorithms for complex problems. (3 hours)

BEGINNING WITH C++: Applications of C++, sample program, C++ statements, class example, structure of C++ program, creating the source file, compiling and linking. (1 hour)

TOKENS AND EXPRESSIONS: Tokens, keywords, identifiers and constants, basic data types, user defined data types, derived data types, symbolic constants, type compatibility, declaration of variables, dynamic initialization, reference variables. (3 hours)

OPERATORS AND EXPRESSIONS: Operator precedence and associativity, arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operator, comma operator, type cast operator, type
conversions, implicit conversions, arithmetic expressions, evaluation of expressions, special assignment expressions.

(4 hours)

CONTROL STRUCTURES: Statements and blocks, simple if, if-else, nested if statements, else-if ladder, switch-case statement, looping constructs- entry controlled and exit controlled loops, break and continue statements, exit statement, problem solving using above statements.

(6 hours)

ARRAYS & STRINGS: 1-D arrays- Declaration and Initialization, programs on array manipulation, sorting (selection and bubble sort techniques), searching (linear and binary search techniques), 2-D arrays-basics, simple programs on matrix manipulation, strings-operation on strings, built-in string handling functions, programs on strings.

(6 hours)

STRUCTURED PROGRAMMING – FUNCTIONS: Main function, function prototyping, call by reference, return by reference, inline functions, default arguments, const arguments, function overloading, Functions in Implementation of different problems, Recursive functions.

(5 hours)

STRUCTURES AND POINTERS: Structures - basic operations and programs, advantages of structures over arrays, array of structures, Pointers-pointers to simple variables, pointers to arrays, basic operation on pointers and programs.

(4 hours)

INTRODUCTION TO OOP: Benefits of OOP, Object oriented languages over POP, Basic concepts of OOP, Classes and Objects – access specifier, member function and data, scope resolution operator, this pointer. Friend function, Static members, Objects and functions, Objects and array, Dynamic Memory Allocation and Deallocation.

(8 hours)

CONSTRUCTORS AND DESTRUCTORS: Constructors, Destructors, Inheritance: Introduction to Inheritance, Base Class and Derived Class Pointers, Function Overriding, Base Class Initialization, The Protected Access Specifier, Different Kinds of Inheritance, Order of Invocation of Constructors and Destructors. The Need for Virtual Functions, Virtual Functions. Introduction to Function Template and Class Template.

(7 hours)

PROBLEM SOLVING USING COMPUTERS LABORATORY

Implementing simple programs in C++ using simple operators and expressions, Control structures - Decision making and branching ,Looping ,1D Arrays, 2D Arrays, Strings, Functions, Structure and pointers, Object Oriented Programming-Classes and objects, Constructors, destructors, virtual functions, Inheritance, Problem Solving using MATLAB

TEXT/REFERENCES:

A COURSE ON PSYCHOLOGY FOR ENGINEERS

IHS 111 3-0-0-3

Introduction to Psychology: The Philosophical origin of Psychology, Modern schools of Psychology, Scope of Psychology and important methods (4 hours)

Learning: Classical conditioning, Operant conditioning, learning by observation (4 hours)

Intelligence: Intelligence – theories of Intelligence, Assessing intelligence, Emotional intelligence. (3 hours)

Perception and attribution: Definitions, factors influencing perception, perceptual organization, theories of attribution (3 hours)

Personality: Psychodynamic approach, Trait approach, Behavioural and Humanistic approach, Assessment of personality (4 hours)

Introduction to Industrial/Organizational Psychology: Evolution; Contributions of F W Taylor, F Gilbreth and Elton Mayo; Scope of Industrial/Organizational Psychology, Limitations of Industrial Psychology; Research Methodology (5 hours)

Managerial Psychology: Types of human occupation, Business and Profession, Classification of Industries; Manager and Management, Classification of managers, Functions of managers, Principles of management, Types of planning and plans (5 hours)

Human Relations Psychology: Behavioural management theories-Abraham Maslow, Herzberg and McGregor; Leadership Styles and Leadership Grid. (3 hours)

Consumer Psychology: Types of markets and products; Selling and marketing, Role of marketing, Functions of marketing; Market segmentation, Marketing mix, Product Life Cycle and marketing strategies; Data collection methods (5 hours)

TEXT/ REFERENCES:

COMMUNICATION SKILLS IN ENGLISH

IHS 112 3-0-0-3
Listening: Audio and Video talks and response to each of them. (4 hours)
Speaking: Speech and Presentation techniques /Group Discussion. (10 hours)
Reading: Different styles, kinds of narratives and forms. (8 hours)
Earnest Hemmingway – The Old Man and the Sea (Text for Reading)
Strategies: skimming, scanning and critical analysis
Grammar: Sentence structures: error identification and correction (4 hours)
Writing: (10 hours)
  Paragraph writing
  Essay writing
    o Argumentative
    o Narrative
    o Expository
  Editing
  Summary writing
  Statement of purpose
  Resume’

TEXT/ REFERENCES:

  • Stanley Fish, How to write a sentence: And how to Read one, HarperCollins, New York, 2005
  • Paul Eschholz and Alfred Rosa, Outlooks and Insights: A Reader for Writers, St Martin’s Press, 1995.

ENGINEERING GRAPHICS – I

IME 111 0-0-3-1
Software: AutoCAD
INTRODUCTION: Introduction to engineering graphics, Geometrical constructions, Dimensioning and conventions of lines. (3 hours)
PROJECTION OF POINTS: Introduction to orthographic projection, Meaning of reference planes, Quadrants, Types of quadrants, Conventional representation of first angle projection system. Projection of points in first angle projection system only. (3 hours)
PROJECTION OF STRAIGHT LINES: Line parallel to both reference planes, Perpendicular to reference plane, Inclined to one reference plane, Inclined to both reference planes including locating traces, finding true length and inclinations. (12 hours)

PROJECTION OF PLANE SURFACES: Simple planes (Triangle, Square, Rectangle, Pentagon, Hexagon & Circle), Plane resting on edge and corner conditions, Surface inclined to HP & perpendicular to VP, Surface inclined to VP and perpendicular to HP, Simple cases of planes inclined to both HP & VP (Change of position method only). (9 hours)

PROJECTION OF SOLIDS: Simple solids like prisms & pyramids (Triangle, Square, Rectangle, Pentagon & Hexagon), Cone and cylinder, Solids resting on edge and corner conditions, Axis inclined to HP and parallel to VP, Inclined to VP & parallel to HP, Simple cases of axis inclined to both HP and VP (Change of position method only). (12 hours)

TEXT/ REFERENCES:

B.Sc. (CHEMICAL)

II SEMESTER
MATHEMATICS II

IMA 121  3-1-0-4

Functions with two or more variables, partial differentiation, chain rule, composite and implicit function differentiation, total differentials, error and approximation. Maxima and minima for functions of two or more variables, Lagrange’s method of undetermined multipliers.  (8 hours)

Multiple integrals: double and triple integrals, change of order of integration, Jacobian of polar, cylindrical and spherical coordinate systems, change of variables, Application of multiple integrals to find area and volumes. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process. (8 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency. Inverse of invertible matrices by row operations. Vectors - Vector differentiation, Divergence, Gradient and Curl and their physical interpretation and simple applications. Vector integration, Greens theorem in the plane, Gauss Divergence theorem, Stoke’s theorem and simple applications. Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (10 hours)

Beta and Gamma functions & their properties. (4 hours)

TEXT/REFERENCES:

PHYSICS – II

IPH 121  3-0-3-4

Electric Fields: Coulomb’s law, The electric field, Continuous charge distribution, Charged particles in uniform electric field. (3 hours)

Gauss’s Law: Gauss’s law and derivation, Applications to various charge distributions, Conductors in electrostatic equilibrium. (3 hours)
Electric Potential: Potential difference in uniform electric field, Potential and energy due to point charges, Electric field and potential, Continuous charge distributions, Potential due to charged conductor, Applications of electrostatics. (4 hours)

Capacitance and Dielectrics: Calculating capacitance, Combinations of capacitors, Energy in a charged capacitor, Capacitors with dielectrics, Dipole in electric field, Atomic description of dielectrics. (3 hours)

Current and Resistance: Electric current, Resistance, Electrical conduction, Resistance and temperature, Superconductors, Electrical power. (3 hours)

Direct Current Circuits: Electromotive force, Resistors in series and parallel, Kirchhoff’s rules, RC circuits, Electrical meters. (3 hours)

Magnetic Fields: Magnetic fields and forces, Magnetic force acting on a current-carrying conductor, Torque on a current loop in a uniform magnetic field, Motion of a charged particle in uniform magnetic field, Applications, Hall effect. (3 hours)

Sources of the Magnetic Field: The Biot-Savart law, The magnetic force between two parallel conductors, Ampere’s law, The magnetic field of a solenoid, Magnetic flux, Gauss’s law in magnetism, Displacement current and the general form of Ampere’s law, Magnetism in matter. (4 hours)

Faraday’s Law: Faraday’s law of induction, Motional emf, Lenz’s law, Induced emf and electric fields, Generators and motors, Eddy currents, Maxwell’s equations. (3 hours)

Inductance: Self-inductance, RL circuits, Energy in a magnetic field, mutual inductance, Oscillations in an LC circuit, The RLC circuit. (3 hours)


TEXT/REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

PHYSICS LABORATORY:

To perform any 12 of the following experiments:

1. Field along the axis of a coil
2. Energy band gap of a semiconductor
3. Newton’s rings
4. Blackbody radiation
5. Photoelectric effect
6. Charging and discharging of a capacitor / RC time constant
7. Series and parallel resonance circuits
8. e/m – Thomson’s method
9. Fermi energy of a metal
10. Hall effect
11. Zener diode characteristics
12. Hysteresis loss in magnetic materials
13. Half wave and full wave rectifier circuits, C-filter circuit
14. Resistivity of a semiconductor by four probe method

CHEMISTRY
ICH 121

Electrochemistry: Introduction to electrochemical cell and its types, Liquid junction potential, EMF of the cell and its determination, Standard cell, Origin of electrode potential, Single electrode potential, Nernst equation for electrode potential, Types of electrodes- hydrogen electrode, Calomel electrode and glass electrode, Numericals.


Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Ionic product of water, hydrolysis, hydrolysis of salts of four types, hydrolysis constant, relation between K_h, K_a/K_b and K_w, degree of hydrolysis, Common ion effect, solubility product and its applications. Numericals.


Thermochemistry - Hess’s law and its applications. Limitations of first law.

Chemical Kinetics:
Rate of a reaction, order and molecularity of a reaction, rate law, integrated rate equation and half-life (first and second order reaction), energy of activation, theories of reaction rates- collision theory and transition state theory. Numericals


Covalent bond: Covalent bond formation, valence bond theory, Molecular orbital theory & their application to diatomic molecules, Concept of resonance, Valence shell electron pair repulsion concept (VSEPR), Properties of covalent bond.


Organic reactions and mechanisms: Classification of organic compounds, IUPAC system of Nomenclature, Organic reactions and their Mechanisms- Homolytic and heterolytic

(5 hours)

(4 hours)

(5 hours)

(4 hours)

(10 hours)
fission, carbonium ions, carbanions, carbon free radicals, substitution reactions, addition reactions, elimination reactions, rearrangement reactions, Isomerism - structural and stereoisomerism. (8hours)

TEXT/ REFERENCES:


CHEMISTRY LAB

1. Acid-base titration (Acidimetric/Alkalimeter)
2. Determination of hardness of water
3. Determination of chloride content of water
4. Determination of percentage of copper in brass
5. Determination of percentage of nitrogen ammonia in fertilizer
6. Determination of rate constant of hydrolysis of ethyl acetate
7. Colorimetric determination of copper
8. Conductometric titration of a Mixture of strong & weak acids vs strong base
9. Determination of pKa value of a weak acid using pH meter
10. Redox titration using potentiometer

ENGINEERING GRAPHICS –II

IME 121 0-0-3-1

Software: AutoCAD

INTRODUCTION: Importance of sectioning the object, Development of surfaces of solids, Isometric projection, Orthographic projection and its practical applications. (3 hours)

SECTIONS OF SOLIDS: Introduction, Horizontal vertical and inclined section planes and true shape of sections. Drawing sectional views with true shape of section. Simple cases of solids resting on HP or VP with axis perpendicular to reference planes, inclined to one reference plane. Section plane perpendicular to VP, inclined to HP and inclined to VP. (9 hours)

DEVELOPMENT OF SURFACES: Parallel line development for prisms (Triangle, Rectangle, Square, Pentagon and Hexagon) and cylinders (Including simple cut solids), Radial line development for pyramids (Triangle, Square, Rectangle, Pentagon and Hexagon) and cones (Including simple cut solids). (9 hours)

ISOMETRIC PROJECTIONS AND VIEWS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)
ORTHOPHAGIC CONVERSIONS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/ REFERENCES:


CHEMICAL PROCESS CALCULATIONS

ICHM 121

Introduction to chemical engineering, unit operations, unit processes, importance of chemical engineering. Chemical engineering as profession.

Review of units and dimensions, conversion of units, physical and chemical properties of compound and mixtures; Techniques of problem solving, choosing basis, chemical equation and stoichiometry; single phase systems; ideal and real gases; degrees of freedom.

Phase equilibrium, vapour pressure, Gibbs phase rule; gas liquid system, Raoult’s and Henry’s law; Bubble and dew point calculations; Humidity charts and their uses.

Steady state material balances: Program of analysis of material balance problems; material balance for various unit operations; material balance involving multiple sub-system; material balance with chemical reactions. Material balance involving recycle, bypass and purge calculations.

Energy and energy balances: Balances on non-reactive process; Heat of mixing and solution; balance on reactive processes; calculations of heats of reaction; formation and combustion, adiabatic temperature.

TEXT/ REFERENCES:


CHEMICAL ENGINEERING THERMODYNAMICS – I

ICHM 122

3-1-0-4
Basic concepts and definition: Classical and Statistical thermodynamics, system, boundary, surroundings, internal energy, work, heat, equilibrium, reversible process, intensive and extensive function, ideal gas temperature scale.

First law of thermodynamics for non-flow process, flow process, State and path function, Enthalpy, Heat capacity

PVT behavior of gases: Ideal gas, definition, ideal gas law, equation of state for real gases, graphical representation of P-V-T behavior, V-T diagram, P-V diagram and P-T diagram, Thermodynamic analysis of processes. Generalized correlations for thermodynamic property of gases, reduced equation of state, two parameter and three parameter correlations

Second law of thermodynamics: Spontaneous process, qualitative difference between heat and work, heat reservoir, heat pump, heat engine, Kelvin Plank statement, Clausius statement, irreversibility, entropy, Carnot principle, postulates, thermodynamic temperature scale, third law of thermodynamics.

Thermodynamic relations: Classification of thermodynamic processes, Helmholtz and Gibbs free energy, fundamental property relations, Maxwell’s relations and their applications, Clausius-clapeyron equation, modified equations for U, H and S, relationship between Cp and Cv, ratio of heat capacity, effect of pressure and volume on Cp and Cv, Gibbs Helmholtz equations.


TEXT/ REFERENCES:

- Y.V.C.Rao, Chemical Engineering Thermodynamics, Universities Press, 2004

### III SEMESTER

#### MATHEMATICS III

IMA 231 3-1-0-4

Differential equations - basic concepts and definitions, solution of exact equations, evaluation of integrating factors, solution of first order linear differential equations, Bernoulli's equation, solution by inspection, application of first order differential equations. (6 hours)

Some simple numerical methods for solutions of first order equations: Taylor series method, Euler’s method, modified Euler’s method, Runge-Kutta methods of order two and four. (6 hours)

Introduction to Laplace transforms, transforms of elementary functions, periodic functions, Step functions, Dirac Delta functions, inverse transforms, convolution theorem, and solution of initial value problems by Laplace transforms method. (12 hours)

Complex variables - Analytic functions, Cauchy - Riemann equations, Harmonic functions, Line integrals, Cauchy's integral theorem, Cauchy's integral formulae. Laurent series, Residue calculus. (12 hours)

Partial differential equations - basic concepts, solutions of simple partial differential equations, method of separation of variables and indicated transforms to solve partial differential equations. (4 hours)

**TEXT / REFERENCES:**


**FLUID FLOW OPERATIONS**

**ICHM 231**  
3–0-6–5

Introduction to fluid flow: Different types of fluids and flow. Properties of fluids, Rheological classification, Different non-Newtonian fluids and their constitutive equations. Fluid statics – static pressure, variation of pressure with elevation, pressure measurement, Manometers.

Basic equations of fluid flow: Principle of continuity, one – dimensional Euler’s equation and Bernoulli’s equation and their applications, Impulse momentum equation.

Laminar flow: steady incompressible viscous flow through round pipes, Hagen – Poiseuilli’s theory, Flow between parallel plates, Flow through concentric circular annulus, coutte flow.


Fluid flow around immersed bodies : Boundary layer and friction drag, Drag coefficient, Laminar and turbulent boundary layers on a flat plate, separation of boundary layer, surface, form, profile drag in flat plates, boundary layer control.

Motion of particles through fluids, Stoke’s equation, Flow of fluids through beds of solids, Fluidization principles.

Compressible flow: Thermodynamic considerations, sonic velocity, Mach number, Basic equations of one dimensional compressible flow, Reversible adiabatic flow, Effect of area variation in compressible flow, Flow in convergent divergent passages, Flow in constant area pipes with friction.
Flow measurement: pilot tube, venture and Orifice meters, flow nozzle, variable area meters, compressors and pumps

**TEXT / REFERENCES:**
- McCabe and Smith, Unit operations in Chemical Engineering, McGraw – Hill 7th Edition. 2005
- Coulson and Richardson, Chemical Engineering Volume I, Elsevier India private limited, 5th Edition. 2006

**FLUID FLOW OPERATIONS LAB:**
The experiments are conducted and mini project can be given based on the following topics: Type of flow determination by Reynolds experiment – Flow through Venturi meter, orifice meter, circular pipe, annulus, v-notch, packed bed and fluidized bed to determine the characteristics of flow, pressure drop in fluid, discharge coefficients. Experiment on centrifugal pump to establish its characteristics.

**CHEMICAL ENGINEERING THERMODYNAMICS – II**

**ICHM 232**

Thermodynamic properties of pure substances: fugacity, fugacity coefficient, compressibility factor, activity.
Solution thermodynamics: Ideal and non-ideal gas mixtures and liquid solutions, partial molar properties, physical significance and determination methods, chemical potential.
Gibbs-Duhem equation: general form, various forms of Gibbs-Duhem equation, applications, limitations; Property changes of mixing, excess properties. Criteria of phase equilibrium, Duhem theorem. Vapour liquid equilibrium, VLE equation, low pressure VLE, Phase diagrams for binary solution, T-x-y and P-x-y diagrams. Effect of pressure on VLE, Azeotropes and its types.
Activity coefficient; equations used for the determination, Margules, van Laar, Wilson equations, VLE at high pressures, bubble point, dew point calculations, Thermodynamic consistency tests for VLE data.
Chemical reaction equilibrium; criteria of equilibrium, Reaction stoichiometry, equilibrium constant, Gibbs free energy change, choice of standard state, feasibility of chemical reactions, effect of temperature on equilibrium constant, evaluation of van’t Hoff constant, Effect of parameters like temperature, pressure, composition on the equilibrium conversion.

**TEXT / REFERENCES:**
- Y.V.C.Rao, Chemical Engineering Thermodynamics, Universities Press, 1997
PROCESS PLANT MATERIALS

ICHM 233  3–0–0–3

Structure of solids, Iron Carbon diagram
Introduction of nanomaterials and their application in Chemical Engg.
Selection of process materials: Chemical and physical factors, economic considerations – fabrication, mechanical properties and strength of materials, effect of temperature on mechanical properties, testing and inspection of materials.
Properties and uses of ferrous metals: Cast iron, plain carbon steels, classification of steel, alloy steels, thermal and electrical insulating materials.
Non-ferrous metals and alloys, generalized properties and field of application of non-metals, wood, stoneware, glass and fused silica - carbon - natural and synthetic rubber.
Plastics as material of construction for chemical plant; PVC, PTFE, glass fiber reinforced plastics – glass, rubber and metal lining of process vessels.

TEXT / REFERENCES:

ORGANIC CHEMISTRY - I

ICH 231  4 - 0 - 0 - 4

Preparation, Physical, Chemical properties and Industrial uses of aliphatic hydrocarbons (alkanes, alkenes, and alkynes), allyl halides, alcohols, acids, amines, aldehyde and ketones.
(18 hours)

Carbohydrates: Nomenclature, Classification, Mono-saccharides and their general reactions, Ring Structure of glucose & fructose, Optical activity, Determination of specific rotation using polarimeter, Descending-Ascending of sugars, Interconversion of aldose and ketose, Disaccharides, Sucrose Manufacture from sugar cane, Properties and structure of sucrose, maltose & lactose, Polysaccharide, Starch, Cellulose.
(8 hours)

Amino acids: Classification, Natural amino acids, Zwitter-ion, Isoelectric point, General methods of preparation and properties, Peptides, Poly peptides, Methods of preparation, Terminal residue analysis, Proteins, Classification and general properties, Color tests, Enzymes, Co-enzymes, Specificity of enzymatic actions, Enzymatic reactions, Applications of enzymes.
(8 hours)

(6 hours)
Dyes Chemistry: Colour and constitution, Chromophores, Auxochromes, Bathochromic and hypsochromic effects, Valence bond and molecular orbital approaches to color, UV & visible spectra of dyes, Classification of dyes according to applications and structures, Synthesis of Methyl orange, Cango red, Malachite green, Rosaniline, Alizarin, Fluorescent brightening agents.

(8 hours)

TEXT / REFERENCES:

- M.K. Jain, Modern Organic Chemistry, S.Chand & Co., Delhi, 1986

ORGANIC CHEMISTRY - II

ICH 232

3 - 0 - 0 - 3

High Polymers: Classification of polymers, Degree of polymerization, Types of polymerization, Free radical mechanism of addition polymerization, Polymerization techniques: Bulk, Solution, Suspension and Emulsion polymerizations. Glass transition temperature, Molecular weights of polymers, Number average & weight average numerical problems, Methods of molecular weight determination, Viscosity, Ultracentrifugal methods, Stereoregular polymers, Structure – property relationship, Copolymerization, Graft, Block, random and alternative type, Significance of copolymerization equation and reactivity ratio.

Elastomers: Natural rubber, Processes for improvement of natural rubber, Vulcanization, Plasticizers, SBR, Butyl rubber, Nitrile rubber, Silicone rubber, Starch and Cellulose, Cellulose derivatives, Cuprammonium, Nitro, & Acetylation methods, Regenerated cellulose, Viscose, Ethyl, Methyl phthalate cellulose, Biopolymers.

Oils and Fats: Edible Oils, Saponification, Iodine and Acid values, Methods of their determination, Extraction of oils, Solvent extraction, Refining, Hydrogenation, Manufacture of Vanaspati, Soaps and Detergents, Mechanism of cleansing action, Preparation of soaps, Liquid soaps, Synthetic detergents

Pharmaceutical and Petroleum Chemistry: Structure and chemistry of antibiotics, Penicillin, Streptomycin, Tetracycline, Chloramphenicol, Sulphadugs, Antimalarials, Quinine, Production of penicillin, Petroleum production and classification, Refinery operations, Pyrolysis and cracking, Reforming, Polymerization, Alkylation, Isomerization, Vinyl chloride, Ethylene oxide, Isopropanol, Butadiene, Styrene, Phthalic anhydride

TEXT / REFERENCES:

IV SEMESTER

ENGINEERING ECONOMICS & MANAGEMENT

IHS 241 3-1-0-4

ENGINEERING ECONOMICS: Introduction: Nature and significance, micro & macro differences, law of demand, and supply, elasticities & equilibrium of demand & supply. (1 hour)

Time value of money: Time value of money, interest factors for discrete compounding, nominal & effective interest rates, present and future worth of single, uniform, gradient cash flow. (4 hours)

Economic analysis of alternatives: Bases for comparison of alternatives, present worth amount, capitalized equivalent amount, annual equivalent amount, future worth amount, capital recovery with return, rate of return method, incremental approach for economic analysis of alternatives, replacement analysis. (4 hours)

Break-even and minimum cost analysis: Break even analysis for single product and multi product firms, break even analysis for evaluation of investment alternatives, minimum cost analysis. (2 hours)

Depreciation: Physical & functional depreciation, methods of depreciation - straight line, declining balance, sum-of-the-years digits, sinking fund and service output methods. (2 hours)

Financial management: Nature and objectives, scope and functions. Sources of long term finance - Characteristics of equity capital, preference capital, debenture capital & term loans. (2 hours)

Valuation of securities: Concept of valuation, bond valuation and bond valuation models, bond value theorems, yield to maturity, equity valuation; dividend capitalization approach, ratio approach. (2 hours)

Financial statement analysis: Balance sheet and profit & loss statement, meaning & contents, ratio analysis, financial ratios such as liquidity ratios, leverage ratios, turn over ratios, and profitability ratios, time series analysis, common size analysis, DuPont analysis, drawbacks of financial statement analysis. (5 hours)

MANAGEMENT: Introduction: Definition of management and systems approach, nature & scope. Functions of managers. Corporate social responsibility. (4 hours)
Planning: Types of plans, steps in planning, process of MBO, how to set objectives, strategies, policies & planning premises. Strategic planning process and tools. (6 hours)

Organizing: Nature & purpose of organising, span of management, factors determining the span, basic departmentation, line & staff concepts, functional authority, art of delegation, decentralisation of authority. (6 hours)

Staffing: HR planning, recruitment, development and training. (4 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (6 hours)

Basic control process, Critical control points & standards, Control techniques: Budgets, non-budgetary control devices. Overall & preventive controls: Budget summaries: Profit & loss control, control through ROI, direct, preventive control. (2 hours)

TEXT / REFERENCES:

CHEMICAL REACTION ENGINEERING
ICHM 241


Isothermal reactor design – Design of batch, CSTR’s and PFR’s – Problems on optimization, Multiple reactor systems – Reactors in series or/and parallel combinations – CSTRs series – Performance analysis – Batch, Continuous and Recycle reactors.

Multiple reaction system – Series and parallel reactions in flow reactors - Product distribution – Yield and selectivity – Maximizing the desired product

Non-ideal reactor- types of non-idealities, determination of non-idealities by RTD studies

Introduction to non-isothermal and heterogenous reactions.

TEXT / REFERENCES:
HEAT TRANSFER OPERATIONS

ICHM 242

Modes of heat transfer - Steady state conduction – Development of equations for conduction through plane, curved surfaces - Compound resistances - Variation of thermal conductivity with temperature – Derivations for plane wall and curved surfaces - Insulation – Critical thickness of insulation – Heat transfer with internal heat generation – Introduction to transient conduction


TEXT / REFERENCES:


HEAT TRANSFER OPERATIONS LAB:

The experiments are conducted and mini project can be given based on the following topics:
MASS TRANSFER - I

ICHM 243


TEXT / REFERENCES:

- Principles of mass transfer and separation processes, B.K. Dutta, PHI, India.

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

ICH 241

Electroanalytical Methods: Conductometric Titrations, The basic principles of conductometric titrations, Applications of conductometric titrations-Strong acids with strong bases, weak acids with strong bases, weak acid with weak bases and strong acid with weak bases, Mixture of strong and weak acids with strong base, Precipitation Titrations, Potentiometry-Electrode potential, Direct potentiometry, Indicator electrode, Reference electrode, Glass electrode, Assymetric potential, acid error and alkaline error, Ion selective electrode, Potentiometric
Titrations, Principle, Location of end points, Neutralisation titration, Oxidation reduction Titrations, Precipitation titration.


TEXT / REFERENCES:


BIOCHEMISTRY

IBT 231  3–0–3–4

Carbohydrates: Definition, Classification, general properties in reference to glucose, cyclic structure muta rotation, Haworth projections, epimers and epimerization, monosaccharides of Biological importance, monosaccharides, disaccharides- biomedical importance, important properties of monosaccharides, types of crystals, Interconversion of sugars, oxidation to produce sugar acids, reduction of sugars to form sugar alcohols, action of acids on carbohydrates. Sugar derivative of biomedical importance- deoxy sugars, amino sugars-biomedical importance, amino sugar acids, glycosides. Disaccharides, properties of disaccharides- maltose, lactose,


Blood:Composition, haemoglobin structure and properties, plasma proteins, Normal serum levels, clinical significance Estimations of glucose, urea, creatinine, protein, cholesterol and bilirubin.

Urine Chemistry: Chemical composition of urine under normal and abnormal conditions. Tests for renal function, inulin clearance, urea clearance, Renal plasma flow, composition of urine, abnormal constituents of urine, glycosuria, glucosuria, pentosuria, proteinuria, ketone bodies, bilepigments and bile salts, blood, porphyrins.
Hormones: General introduction, definition, major hormone secreting glands, classification. Functions of hormones [protein hormones, peptide hormones, amines, steroid hormones] examples. (2 hours)

Metabolic Pathways: Introduction to metabolic pathways, Glycolysis and its regulation, TCA cycle and its regulation, beta-oxidation, urea cycle, Electron transport system. (4 hours)

Bioenergetics: Biological energy transformation, concept of free energy, exergonic and endergonic reactions, coupled reactions with examples, High energy compounds [phosphoenol pyruvate, phosphocreatinine, role of high energy compounds] ATP structure and functions, Oxidative phosphorylation, Chemiosmotic hypothesis, The redox reactions [redox potential, redox couples]. (3 hours)

TEXT / REFERENCES:

BIOCHEMISTRY LABORATORY
1. Estimation of Sugars (1 Practical)
2. Estimation of Glucose by Different Methods (2 Practical’s)
3. Extraction and Estimation of Starch (1 Practical)
4. Extraction of Protein and Estimation Different Methods (1 Practical)
5. Estimation of Cholesterol and Vitamin – C (2 Practical’s)
6. Urine Analysis - Normal, Abnormal, Unknown and Estimation of Urine Creatine (3 Practical)

V SEMESTER PROJECT WORK
ICHM 351

0-0-36-12

Students need to form batches with maximum four in numbers and required to identify the problem in their area of interest within their discipline of study under the supervision of a faculty (Guide) for 12 to 14 weeks. At the end, the findings need to be presented in the form of a project report for final evaluation.
Indian industry – A brief review - Detailed description of the processes along with neat flow diagrams, engineering problems that are encountered frequently during the process and major uses and application are to be discussed for the following.

Chloroalkali industry: Common salt – Caustic soda – Chlorine – Hydrochloric acid – Bleaching powder – Soda ash
Sulfur and sulfuric acid: Extraction of sulfur – Production of sulfuric acid from sulfur and other sources – Recent advances
Fertiliser industry: Ammonia – Nitric acid – Ammonium nitrate – Ammonium sulfate – Ammonium chloride – Urea
Phosphate industry: Elemental Phosphorous – Phosphoric acid – Superphosphates – NPK fertilizers
Pulp and paper: Chemical and mechanical pulp – Pulping methods – Chemical recovery of black liquor – Paper and paper board
Sugar and starch: Sugar – Starch and modified starches – Glucose – Fermentation – Media for growth - Industrial alcohol – Absolute alcohol – Acetone and Butanol
Polymerisation: Classification of polymers – Modes of polymerization – Polyvinyl chloride – Polyethylene – Viscose rayon , Nylon 6 and Nylon 66 – Natural and synthetic rubber

TEXT / REFERENCES:


MASS TRANSFER - II


Liquid-Liquid Extraction: liquid-Liquid-Equilibria- Ternary systems – triangular and rectangular coordinates-choice of solvent-single stage and multi stage cross current, equipment’s such as mixer settler, packed and tray towers.
Leaching: Concept of Leaching, effect of temperature and size of feed on leaching, Batch leaching processes.


Recent advances in mass transfer operations: Introduction to membrane process- advantages-disadvantages- types membranes – preparation of membrane-pore measuring techniques

TEXT / REFERENCES:
- McCabe and Smith, Unit Operations of Chemical Engineering, (5e), McGraw-Hill 1993
- Coulson-Richardson, Chemical Engineering –Vol-II, Paragmon and ELBS, 1970
- Kausik Nath, Membrane separation process

MASS TRANSFER LABORATORY:
The experiments are conducted based on the following topics:

ELECTIVE – I
ICHM 363 3-0-0-3

PETROCHEMICALS:
First generation petrochemicals – Alkanes – Alkenes and alkynes – BTX aromatics – Diene base petrochemicals

TEXT / REFERENCES:
INDUSTRIAL WASTEWATER ENGINEERING:


REFERENCES:

- Templeton M R, Butler D, Introduction to Wastewater Treatment (e-book)

ELECTIVE - II  
ICHM 364 3-0-0-3

PETROLEUM REFINERY ENGINEERING:

Origin, Formation, Migration & Accumulation of petroleum, Exploration, Drilling, Well completion, Recovery (primary, secondary & tertiary), Separation and Transportation; Indian refining scenario, OPEC and WPC; Crude oil composition, Characterization and classification; Atmospheric and vacuum distillation, Design of crude oil distillation columns; Thermal Cracking, Visbreaking, Coking; Catalytic cracking and hydro cracking: principles, feedstocks, technologies, catalyst, operational conditions, products etc.; Catalytic reforming: principles, feedstocks, technologies, catalysts, operational conditions, products etc.; Isomerization, Alkylation and Polymerization; Refinery Products, Tests and specifications, Treatment of petroleum products, Hydro desulfurization, Product blending; Lube oil processing: Deasphalting, solvent extraction and de-waxing; Energy conservation in petroleum refineries; Environmental issues and New Trends in petroleum refinery operations

REFERENCES:
POLLUTION CONTROL ENGINEERING:

Man and environment – Nutrient and hydrologic cycles – Types of pollution – Legislation to environmental pollution – Aspects of pollution control
Evaluation and characterization of wastewater – Treatment methods – Advanced wastewater treatment – Sludge treatment and disposal – Solid waste management
Noise pollution and control
Ambient and stack gas sampling – analysis of air pollutants – Principles of air pollution – Plume behavior – Meteorological factors affecting air pollution – Equipments for control and abatement of air pollution
Pollution control of effluent in chemical industries such as Fertilizer, Petroleum refinery, Pulp and paper and Tannery industries

TEXT / REFERENCES:

- C.S. Rao, Environmental Pollution Control Engineering, (2e), New Age International Publishers, 2006
- V Cavaseno, Industrial Air Pollution Engineering, (1e), McGraw Hill, NY, 1980

ELECTIVE - III

ICHM 365

SOLID WASTE ENGINEERING AND MANAGEMENT:

Sources, quantities generated, and physiochemical properties of municipal solid waste and hazardous waste, Solid Waste Management Pyramid – Key Technologies for SWM (collection, handling, transformation, landfills, incinerators, composting); Relevant environmental regulations for waste disposal, site investigations; Site Selection (NIMBY), Regulatory permitting process; Incineration, composting, Types of Landfills, basic geotechnical considerations, earthen liners for waste disposal, Clay mineralogy, factors controlling hydraulic conductivity, methods to measure k in the lab and field, compatibility of liner materials to chemicals in leachate, Operational aspects of MSW landfills (daily cover, leachate disposal, GW monitoring), Landfill Gas Collection System and Leachate Recirculation System Design, Landfill Final Cap Design and Water Balance Modeling

TEXT / REFERENCES:
- LaGrega, Mi, Bucking ham P, Evans, J, Hazardous Waste Management, (2e), McGraw Hill, 2001

OIL AND GAS RESERVOIR ENGINEERING:

Basic concepts of reservoir engineering: Calculation of hydrocarbon volume, Fluid pressure regimes, Recovery factor, Hydrocarbon phase behavior.
PVT analysis for oil, gas and water: Definition of parameters, Fluid sampling, Laboratory testing and conversion to field conditions.
Material balance applied to oil reservoirs: General form of equation, Reservoir drive mechanisms, Solution gas drive, Gas cap drive, Natural water drive.
Flow through porous media: Darcy’s law, Flow regimes, Real gas potential, Flow geometry and pressure distribution, Radial flow equation, Multiphase flow: effective and relative permeability, solution of radial flow equation; transient flow analysis, stabilized deliverability, calculation of water influx.
Oil Well Testing: The constant terminal rate solution for transient and steady state flow, Superposition theories, Pressure build-up theory and analysis, Well-completion.
Gas Well Testing: Radial flow of a real gas, Solution techniques of radial flow equation, Theory of gas well testing, Pressure build-up and analysis techniques
Natural Water Influx and Immiscible Displacement: Water influx theory and prediction of water influx, Oil recovery calculations, Displacement under different conditions.
Reservoir Simulation: Classical reservoir engineering and reservoir simulation, Effects of variable properties, Capillary pressure and flow.

TEXT / REFERENCES:

ELECTIVE - IV

ICHM 366

AIR POLLUTION CONTROL AND EQUIPMENT DESIGN:

Meteorological aspects of air pollution dispersion; Air pollution sampling and measurements; Air pollution control methods and design of Equipments: Settling chambers, laminar and turbulent flow – Filtration, Collection of particles by cylindrical fibers and granular beds – Electrostatic precipitation – Cyclones – Wet collectors; Efficiency and dimensions of particle control devices; Gas absorption in tray and packed towers, Stage efficiency, Equilibrium number of stages/packed height; Absorption with/without chemical reaction. Advanced techniques for Removal of SO2 and CO2; Removal of HCs/VOCs; NOx removal from effluent streams.
TEXT / REFERENCES:


PROJECT ENGINEERING:

Preliminary data on projects; Process engineering, Block flow diagram, Process flow diagram, Piping and instrumentation diagram, Pilot plants, General considerations for plant location and layout, piping design, plant utilities, insulation, instrumentation, safety in chemical plant, Project engineering management, Project scheduling and its importance, PERT and CPM techniques, Gantt chart, Optimum project design, optimum production rates, selected examples such as heat exchangers, pumps, vessels, evaporators, and driers.

TEXT / REFERENCES:

- J.Modes, Philips, Project Engineering with CPM & PERT, Renhold Publishing Co.
- Coulson and Richardson's Chemical Engineering Series Chemical Engineering Volume 6, Chemical Engineering Design, (3e), 2003

SEMINAR

ICHM 367 0-0-3-1

Students need to present a seminar on a topic of recent developments in their subject filed.
B.Sc. (CIVIL)  

II SEMESTER  

MATHEMATICS II  

IMA 121  

Functions with two or more variables, partial differentiation, chain rule, composite and implicit function differentiation, total differentials, error and approximation. Maxima and minima for functions of two or more variables, Lagrange’s method of undetermined multipliers. (8 hours)

Multiple integrals: double and triple integrals, change of order of integration, Jacobian of polar, cylindrical and spherical coordinate systems, change of variables, Application of multiple integrals to find area and volumes. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process. (8 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency, Inverse of invertible matrices by row operations. Vectors - Vector differentiation, Divergence, Gradient and Curl and their physical interpretation and simple applications. Vector integration, Greens theorem in the plane, Gauss Divergence theorem, Stoke’s theorem and simple applications. (10 hours)

Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (2 hours)

Beta and Gamma functions & their properties. (4 hours)

TEXT/REFERENCES:


PHYSICS – II  

IPH 121  

Electric Fields: Coulomb’s law, The electric field, Continuous charge distribution, Charged particles in uniform electric field. (3 hours)

Gauss’s Law: Gauss’s law and derivation, Applications to various charge distributions, Conductors in electrostatic equilibrium. (3 hours)
Electric Potential: Potential difference in uniform electric field, Potential and energy due to point charges, Electric field and potential, Continuous charge distributions, Potential due to charged conductor, Applications of electrostatics. (4 hours)

Capacitance and Dielectrics: Calculating capacitance, Combinations of capacitors, Energy in a charged capacitor, Capacitors with dielectrics, Dipole in electric field, Atomic description of dielectrics. (3 hours)

Current and Resistance: Electric current, Resistance, Electrical conduction, Resistance and temperature, Superconductors, Electrical power. (3 hours)

Direct Current Circuits: Electromotive force, Resistors in series and parallel, Kirchhoff’s rules, RC circuits, Electrical meters. (3 hours)

Magnetic Fields: Magnetic fields and forces, Magnetic force acting on a current-carrying conductor, Torque on a current loop in a uniform magnetic field, Motion of a charged particle in uniform magnetic field, Applications, Hall effect. (3 hours)

Sources of the Magnetic Field: The Biot-Savart law, The magnetic force between two parallel conductors, Ampere’s law, The magnetic field of a solenoid, Magnetic flux, Gauss’s law in magnetism, Displacement current and the general form of Ampere’s law, Magnetism in matter. (4 hours)

Faraday’s Law: Faraday’s law of induction, Motional emf, Lenz’s law, Induced emf and electric fields, Generators and motors, Eddy currents, Maxwell’s equations. (3 hours)

Inductance: Self-inductance, RL circuits, Energy in a magnetic field, mutual inductance, Oscillations in an LC circuit, The RLC circuit. (3 hours)


TEXT/REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

PHYSICS LABORATORY:

To perform any 12 of the following experiments:

15. Field along the axis of a coil
16. Energy band gap of a semiconductor
17. Newton’s rings
18. Blackbody radiation
19. Photoelectric effect
20. Charging and discharging of a capacitor / RC time constant
21. Series and parallel resonance circuits
22. e/m – Thomson’s method
23. Fermi energy of a metal
24. Hall effect
25. Zener diode characteristics
26. Hysteresis loss in magnetic materials
27. Half wave and full wave rectifier circuits, C-filter circuit
28. Resistivity of a semiconductor by four probe method

CHEMISTRY

ICH 121

Electrochemistry: Introduction to electrochemical cell and its types, Liquid junction potential, EMF of the cell and its determination, Standard cell, Origin of electrode potential, Single electrode potential, Nernst equation for electrode potential, Types of electrodes- hydrogen electrode, Calomel electrode and glass electrode, Numericals. 


Chemical Kinetics:
Rate of a reaction, order and molecularity of a reaction, rate law, integrated rate equation and half-life (first and second order reaction), energy of activation, theories of reaction rates- collision theory and transition state theory. Numericals


Organic reactions and mechanisms: Classification of organic compounds, IUPAC system of Nomenclature, Organic reactions and their Mechanisms- Homolytic and heterolytic
fission, carbonium ions, carbanions, carbon free radicals, substitution reactions, addition reactions, elimination reactions, rearrangement reactions, Isomerism - structural and stereoisomerism. (8 hours)

TEXT/REFERENCES:


CHEMISTRY LAB

11. Acid-base titration (Acidimetric/Alkalimeter)
12. Determination of hardness of water
13. Determination of chloride content of water
14. Determination of percentage of copper in brass
15. Determination of percentage of nitrogen ammonia in fertilizer
16. Determination of rate constant of hydrolysis of ethyl acetate
17. Colorimetric determination of copper
18. Conductometric titration of a Mixture of strong & weak acids vs strong base
19. Determination of pK_a value of a weak acid using pH meter
20. Redox titration using potentiometer

ENGINEERING GRAPHICS –II

IME 121 0-0-3-1

Software: AutoCAD

INTRODUCTION: Importance of sectioning the object, Development of surfaces of solids, Isometric projection, Orthographic projection and its practical applications. (3 hours)

SECTIONS OF SOLIDS: Introduction, Horizontal vertical and inclined section planes and true shape of sections. Drawing sectional views with true shape of section. Simple cases of solids resting on HP or VP with axis perpendicular to reference planes, inclined to one reference plane. Section plane perpendicular to VP, inclined to HP and inclined to VP. (9 hours)

DEVELOPMENT OF SURFACES: Parallel line development for prisms (Triangle, Rectangle, Square, Pentagon and Hexagon) and cylinders (Including simple cut solids), Radial line development for pyramids (Triangle, Square, Rectangle, Pentagon and Hexagon) and cones (Including simple cut solids). (9 hours)

ISOMETRIC PROJECTIONS AND VIEWS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)
ORTHOGRAPHIC CONVERSIONS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/REFERENCES:


BUILDING SCIENCE & TECHNOLOGY

ICE 121 3-1-0-4

Cement: Types, composition, properties and uses, physical tests on cement as Per I.S. (4 hours)

Concrete Technology: Concrete: Definition, ingredients: coarse aggregate, fine aggregate, water, properties, tests as per IS, Water-cement ratio. Fresh Concrete: Mix design proportion-batching-workability mixing, placing, compacting, various methods of curing, Test on Fresh concrete as per IS. Shrinkage of Concrete. Hardened Concrete: Deformation Characteristics and Mechanical properties. (13 hours)

Introduction to Alternative Concretes: High Strength/Performance Concrete, Roller Compacted Concrete, Self-Compacting Concrete, Reactive Powder Concrete, Polymer Concrete, Slurry infiltrated fibrous concrete(SIFCON), Slurry Infiltrated Mat Concrete (SIMCON) (2 hours)

Bricks: chemical composition, classification, and applications. Tests on bricks Refractory and modular bricks. (2 hours)

Timber: properties, defects, seasoning and preservation, plywood-Types and uses. (2 hours)

Roofs: Sloped roofs - Lean-to, Coupled and Collared roofs. (2 hours)

Tiles: Roofing, Flooring and decorative Tiles – Mechanical Properties and uses of Tiles, Lime – Types, properties and uses (2 hours)

Modern Building Materials: Plastic, FRP, rubber, glass, ferro-cement, glass, ceramics, paints, distemper, varnishes-Definitions and applications. (4 hours)

Masonry elements: Mortar, Lime mortar, Cement mortar, bonds in brickwork, Reinforced brickwork. (3 hours)

Stone masonry: coursed, rubble and ashlar stone masonry, Joints in masonry, Hollow block construction. Rat trap masonry, Load bearing and partition walls. Damp proof construction for walls and floors. Masonry arches. (4 hours)
Plastering, Painting and Flooring: Wall plastering: types, properties. White washing, Colour washing and Distempering of walls. Plastic emulsion, enamel and powder coat painting of walls. Painting of wood and metal works. Granolithic, Concrete, Ceramic, Marble, Terrazzo and Synthetic material flooring: Definitions  (5 hours)

Tar, Bitumen and Asphalt: Properties and uses.  (2 hours)

Shoring, Underpinning, and Scaffolding.  (3 hours)

TEXT/ REFERENCES:

• SP 20-1991 Handbook on Masonry design and construction
• SP10-1975 Nomograms for thickness of masonry walls (First reprint September 1991)
• “National Building Code”, (1988), BIS, New Delhi
• Sushil Kumar, (1976) "Building Construction", Standard Publication

MECHANICS OF STRUCTURES

ICE 122  3-1-0-4

Introduction: Overview and Scope of the subject  (1 hour)

Analysis of Determinate Trusses: Plane trusses- method of joints and method of sections  (5 hours)

Bending moment and shear force diagram: for statically determinate beams  (6 hours)

Bending and shear stresses: Determination of bending and shear stresses in statically determinate beams of various cross sections  (5 hours)

Torsion of circular shaft: Simple torsion theory, solid and hollow circular shafts, power transmitted by shafts  (4 hours)

Stability of columns: Slenderness ratio, failure by buckling, Euler’s formula, concept of equivalent length for different support conditions, limitation of Euler’s formula, Rankine-Girdon Formula  (4 hours)

Stress on inclined planes: principal stresses and their planes.  (4 hours)
Analysis of Arches and suspension bridge: Analysis of three hinged parabolic and segmental arches. Determination of horizontal reaction, normal thrust, radial shear and bending moment. Analysis of suspension bridge with three hinged stiffening girder. (6 hours)

Strain Energy: Strain energy due to axial force, shearing force, bending moment and twisting moment. Law of conservation of energy, virtual work on rigid and elastic bodies, Betti's theorem, Maxwell's law of reciprocal deflections, Castigliano’s theorems. (3 hours)

Deflection: Determination of deflection in beams and simple frames by strain energy methods—Unit load method and Castigliano’s method. Determination of deflection in statically determinate beams using Mecaulay’s method (10 hours)

**TEXT / REFERENCES:**
- Ramamrutham & Narayanan, Strength of Materials, Dhanpat Rai

**III SEMESTER**

**MATHEMATICS III**

IMA 231 3-1-0-4

Differential equations - basic concepts and definitions, solution of exact equations, evaluation of integrating factors, solution of first order linear differential equations, Bernoulli's equation, solution by inspection, application of first order differential equations. (6 hours)

Some simple numerical methods for solutions of first order equations: Taylor series method, Euler's method, modified Euler’s method, Runge-Kutta methods of order two and four. (6 hours)


Introduction to Laplace transforms, transforms of elementary functions, periodic functions, Step functions, Dirac Delta functions, inverse transforms, convolution theorem, and solution of initial value problems by Laplace transforms method. (12 hours)

Complex variables - Analytic functions, Cauchy - Riemann equations, Harmonic functions, Line integrals, Cauchy's integral theorem, Cauchy's integral formulae, Laurent series, Residue calculus. (12 hours)

Partial differential equations - basic concepts, solutions of simple partial differential equations, method of separation of variables and indicated transforms to solve partial differential equations. (4 hours)

**TEXT / REFERENCES:**
BASIC REINFORCED CONCRETE DESIGN

ICE 231

Elements of RCC: Role of reinforcement, behavior of RCC section. Straight line Theory-Assumptions, determination of Neutral axis, determination of stress and strain due to bending moment – Singly reinforced and doubly reinforced sections. (8 hours)

Determination of short term and long term deflections of R.C. beams, Determination of Crack width. (6 hours)

Limit state method: principle of limit state method of design, characteristic loads, characteristic strength and partial safety factors. Stress strain characteristics for concrete and steel. (2 hours)

Introduction to stress block parameters for collapse, limit state of serviceability. (2 hours)

Limit state method of design of beams- Design of rectangular beams (singly and doubly reinforced), flanged beams (6 hours)

Limit state design and detailing of RCC member - for development length, shear and torsion (6 hours)

Limit State Design of one way and two way slabs for various boundary conditions. (6 hours)


Design of footing – loads on foundation – Design basis (limit state method). (4 hours)

Introduction to pre-cast, pre-stressed concrete

TEXT / REFERENCES:

- Sinha N.C. and Roy S.K “ Fundamental of Reinforced Concrete” S. Chand and company.
- Jain A.K. “ Reinforced Concrete- limit state design”.
- Unnikrishna Pillai,Devdas Menon(1998),”Reinforced Concrete Design” Tata McGraw Hill
- Publishing Company Limited, New Delhi
FLUID MECHANICS

ICE 232

Introduction: Scope and importance of the subject. Definition of fluid - Distinction between a solid and a fluid - Distinction between a liquid and a gas - fluid continuum

Fluid Properties and Classification of Fluids: Specific weight, mass density, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity and their units, dimensions and significance. Classification of fluids - Ideal and Real fluids, Newtonian and Non - Newtonian fluids, Compressible and Incompressible fluids.

Fluid Pressure and its Measurement: Pressure at a point in a static fluid - Pascal law - Atmospheric, absolute, gauge and vacuum pressures. Pressure measurement – simple, differential & compound manometers; Mechanical pressure gauges (Bourdon Pressure gauge only)

Hydrostatics: Forces on plane surfaces - Horizontal, vertical and inclined surfaces. Forces on curved surfaces, center of pressure on plane and curved surfaces, Drawing pressure distribution diagrams & its Applications.

Kinematics of Fluid Motion: Introduction, methods of describing fluid motion - Lagrangian and Eulerian approach - classification of flow - steady flow and unsteady flow, uniform flow and Non - uniform flow, laminar and turbulent flow, compressible and incompressible flow, three, two and one dimensional flow, Rotational flow and Irrotational flow - stream line, pathline, streak line and stream tube, Acceleration in one dimensional flow - continuity equation in differential form in Cartesian co-ordinates - continuity Equation for one dimensional flow (Integral form).

Dynamics of Fluid Motion: Euler's Equation of motion; Bernoulli's Equation, limitations, modification, applications of Bernoulli’s Equation, Venturimeter, Orifice meter, Pitot tube.


Laminar Flow Through Pipes: Reynold’s Experiment, steady laminar flow through a circular pipe, Relation between pipe friction factor and Reynold's Number.

Turbulent Flow Through Pipes: Head loss due to friction - Darcy Weisbach Equation; Minor losses in pipe lines; pipes in series and pipes in parallel. Concept of equivalent pipe, equivalent length - pipe siphons - Hydraulic and Energy gradients. Water hammer in pipes- pressure rise in a pipe due to gradual and sudden closure of valves.

Flow Measurement: Flow under constant head - Orifices and Mouth Pieces. Classification of orifice and mouth pieces, Hydraulic coefficients and their determination - Flow through notches and weirs - Rectangular, Triangular, Trapezoidal and Cippoletti notches; Broad
crested weir, Open spillway and Siphon spillway; Flow under variable head – Time of emptying and filling of tanks through orifices. (5 hours)

Flow in open Channels: Introduction to free surface flows - Geometric elements; Types of open channel flows. Chezy's and Manning’s formulas, hydraulically efficient channel cross section – Rectangular and Trapezoidal channels; Specific energy, specific energy curve, critical depth, alternate depth, critical flow in rectangular channels, Froude's Number, its significance; Hydraulic jump in rectangular channels - Sequent depth, Loss of energy. (8 hours)

TEXT / REFERENCES:


GEOTECHNICAL ENGINEERING
ICE 233 3 - 1 - 0- 4

Introduction: Origin & formation of Soil: Types, Typical Indian Soil, Fundamental of Soil Structure, Clay Mineralogy. (5 hours)

Physical & Index properties of soil: Soil as a three phase system, Physical properties of Soil and Laboratory Determination - Specific gravity, Void ratio, Porosity, Degree of saturation, Bulk density, Dry density, Saturated density, Relative density, Moisture content, Inter - relationships between them Atterberg’s limits, Sieve Analysis, Hydrometer analysis. (8 hours)

Classification and Compaction of soil: Field identification of soil, IS Classification of soil, Soil compaction – Theory, laboratory determination of Maximum Dry Density and Optimum Moisture Content, Factors influencing compaction behavior of soils. Equipment’s for compaction control in the field, field compaction methods. (6 hours)
Flow through soil: Darcy’s Law, Coefficient of permeability, laboratory determination of coefficient of permeability, Permeability for Stratified Deposits, Soil water – static pressure in water – Effective stress concepts in soils – capillary stress, Quicksand condition, Seepage – introduction to flow nets. (9 hours)

Stress distribution: Boussinesq’s theory, Stress due to point loads & uniformly loaded circular area & rectangular area, pressure bulbs, Use of Newmark’s charts. (4 hours)

Compressibility & Consolidation of Soil: Components of settlement — immediate and consolidation settlement – Terzaghi’s one dimensional consolidation theory (no derivation) Oedometer test, √t and log t methods– e-log p relationship – Normally Consolidated, Over and Under consolidated soils. (8 hours)

Shear Strength of Soil: Concept of shear strength of soils, Mohr-Coulomb theory and failure criteria, Laboratory determination of shear strength parameters - Direct shear, Triaxial,
Unconfined compression and Vane shear tests, Drained, Undrained and consolidated undrained tests and their applications. (8 hours)

TEXT / REFERENCES:


SURVEYING

ICE 234 3 - 1 - 0- 4

Introduction: Introduction of surveying, objectives, classification, principles of surveying. (2 hours).

Leveling: Definitions of terms, levelling instruments. Temporary and permanent adjustments of levels. Terms: Station, height of instrument, back sight, intermediate sight, fore sight, change point.

Methods of levelling - Differential, profile, cross sectioning reciprocal and trigonometric levelling.

Sensitivity of bubble tube, curvature and refraction effects. Methods of booking, errors in levelling. (10 hours)

Theodolite: Function of various parts. Temporary and permanent adjustments.

Measurement of horizontal and vertical angles, setting out centre line of roads, buildings (4 hours)

Tacheometry: Principles, methods - analytic tacheometer - distance and elevation formulae for horizontal and inclined site with staff vertical and normal - Beaman's stadia arc - range finder. (8 hours)

Contours - Contour interval, characteristics, contour maps and their use. Methods of contouring, contour gradient. Area and volume measurements from contour maps. (3 hours)

Curves: Introduction - simple curve - Basic definition - compound curve - reverse curve - transition curve – Bernoulli’s lemniscate curve - vertical curve - design of vertical curve. (11 hours)

Construction Surveying: Introduction - equipment’s for setting out - pipe line - building and structures - staking out a highway. (2 hours)
Photogrammetric Surveying: Terrestrial - principles - photo theodolite, horizontal and vertical distances of points from photographic measurement. (2 hours)

Under Ground Surveys: Introduction - application of under-ground surveys - auxiliary theodolite-aligning the theodolite -problems in tunnel survey (3 hours)

Electronic Distance measurement: Introduction – Basic concept – Basic principles of EDM – Total Station Instruments – Computing distance from the Phase differences – Brief discription of EDM instruments. (3 hours)

TEXT / REFERENCES:

SURVEYING PRACTICE

ICE 235 0 - 0 - 3- 1


Contouring: Direct and indirect method of contouring, radial and block leveling Curve surveying: Setting out simple curves by the method of deflection angles. Setting out compound curves by the method of deflection angles.

Setting out reverse curves when the straights meet at an acute angle and when the straight are parallel.

Total stations –Demo

TEXT / REFERENCES:
- Surveying and field work – Vol.1 & 2 by B.C. Punmia.
- Plane and geodetic surveying - Vol 1 by David Clark.
- Surveying and leveling - Vol 1 by T.P. Kanetkar and Kulkarni.
- Higher Surveying by Norman Thomas.
- Surveying by Higgins.

MATERIAL TESTING LABORATORY

ICE 236 0 – 0 – 6 – 2

Tension test on mild steel, compression test on cast iron, timber and shear test on mild steel and Rockwell hardness test, Brignell’s hardness test and bending test on wood, Impact tests.
Determination of specific gravity of fine and coarse aggregates, grading of coarse and aggregates, Bulking of sand, aggregate impact value (Los angles test).
Concrete- workability, Compressive strength

TEXT / REFERENCES:

- I.S. specification of cement, fine and coarse aggregates and concrete.
- Laboratory manual of concrete testing (Parts I & II) by V.V. Sastry & M.L. Gambhir.
- Properties of concrete by Neville.

IV SEMESTER

ENGINEERING ECONOMICS & MANAGEMENT

IHS 241 3- 1 -0 -4

ENGINEERING ECONOMICS: Introduction: Nature and significance, micro & macro differences, law of demand, and supply, elasticities & equilibrium of demand & supply. (1 hour)

Time value of money: Time value of money, interest factors for discrete compounding, nominal & effective interest rates, present and future worth of single, uniform, gradient cash flow. (4 hours)

Economic analysis of alternatives: Bases for comparison of alternatives, present worth amount, capitalized equivalent amount, annual equivalent amount, future worth amount, capital recovery with return, rate of return method, incremental approach for economic analysis of alternatives, replacement analysis. (4 hours)

Break-even and minimum cost analysis: Break even analysis for single product and multi product firms, break even analysis for evaluation of investment alternatives, minimum cost analysis. (2 hours)

Depreciation: Physical & functional depreciation, methods of depreciation - straight line, declining balance, sum-of-the-years digits, sinking fund and service output methods. (2 hours)

Financial management: Nature and objectives, scope and functions. Sources of long term finance - Characteristics of equity capital, preference capital, debenture capital & term loans. (2 hours)
Valuation of securities: Concept of valuation, bond valuation and bond valuation models, bond value theorems, yield to maturity, equity valuation; dividend capitalization approach, ratio approach. (4 hours)

Financial statement analysis: Balance sheet and profit & loss statement, meaning & contents, ratio analysis, financial ratios such as liquidity ratios, leverage ratios, turn over ratios, and profitability ratios, time series analysis, common size analysis, DuPont analysis, drawbacks of financial statement analysis. (5 hours)

MANAGEMENT: Introduction: Definition of management and systems approach, nature & scope. Functions of managers. Corporate social responsibility. (4 hours)

Planning: Types of plans, steps in planning, process of MBO, how to set objectives, strategies, policies & planning premises. Strategic planning process and tools. (6 hours)

Organizing: Nature & purpose of organising, span of management, factors determining the span, basic departmentation, line & staff concepts, functional authority, art of delegation, decentralisation of authority. (6 hours)

Staffing: HR planning, recruitment, development and training. (4 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (6 hours)

Basic control process, Critical control points & standards, Control techniques: Budgets, non-budgetary control devices. Overall & preventive controls: Budget summaries: Profit & loss control, control through ROI, direct, preventive control. (2 hours)

TEXT / REFERENCES:

HIGHWAY ENGINEERING

ICE 241

3- 1 -0 –4

Introduction: - Highway engineering, Scope of highway engineering, Highway classification, Factors controlling highway alignment, Engineering survey for highway location. (6 hours)

Traffic Engineering: - Traffic engineering, vehicular and road user characteristics, Traffic Studies-Speed, Density and Volume, Relation between speed, travel time and traffic volume, Traffic density and passenger car units, Traffic flow characteristics. (8 hours)

Geometric Design: - Elements of highway, factor and effecting friction, Camber, types of camber, width of formation, Sight distance-stopping and Overtaking, Horizontal curve, Extra
widening, Super elevation, Transition curve, Vertical Curves-Summit and Valley Curves.

Pavements Design: - Types of pavements, Factors which influences design and selection of different types of pavements, Brief study on pavement materials, Design of Flexible and Rigid pavements- IRC method. (14 hours)

Highway Economics and Finance: -Methods of Economic Analysis- Motor vehicle operation cost, Highway finance. (10 hours)

Highway Drainage System: -Types of highway drainage and its design. (6 hours)

TEXT / REFERENCES:


BUILDING DESIGN AND DRAWING

ICE 242

0-0-3-1

Introduction to Auto cad: Introduction to Auto CAD for drafting Civil Engineering Drawings (2 hours)

Hand drawing of following Building Components/ Building to proportionate scale and drafted using Auto-Cad

Foundations: Plan, elevation and sectional views giving all details for different types of foundations – Masonry foundations, RCC Footings – Isolated, combined and raft footings.

Doors and Windows: Plan, elevation and sectional views giving all details for

a) Wooden and Aluminium doors, with
   i) Fully panelled
   ii) Fully glazed, (1 hour)

b) PVC doors and Steel doors

c) Collapsible Door, (2 hours)

d) Wooden windows with
   i) Partially glazed
   ii) Fully panelled.

e) Aluminium windows with
   i) Fully glazed Fixed and open able shutters
   ii) Fully glazed Sliding (2 leaves and 3 leaves) (2 hours)

Designing and Drawing of Residential Buildings: Plan, Elevation and Sectional views of Single bedroom house with Mangalore tiled roof, Double bedroom house with RCC roof. (2 hours)

Designing and Drawing of Public Buildings: Plan, Elevation and Sectional views of School Building, Bank, and Health Centre for the given Line Diagram. (4 hours)

Plan and elevation of single bed room RCC building with flat roof. (3 hours)

TEXT / REFERENCES:

ICE 243

Introduction: Need for protected water supply, essentials of water supply, project documents preparation. (2 hours)

Quantity of water - Population forecasting - different methods, rate of demand - factors affecting and its variation. (5 hours)

Sources of water: different sources of water, intakes/ water borne diseases and their control, conveyance of water (Pump capacity, Economical diameter). (4 hours)

Quality of water - Physical, chemical and biological characteristics, analysis of water, drinking water standards. (5 hours)

Treatment of water - Aeration of water - types of aerators, theory of sedimentation, sedimentation with coagulation, coagulants, feeding devices, mixing devices, flocculation - design considerations. (10 hours)

Filtration - types of filters - design considerations.
Disinfection – theory, methods of disinfections, chlorination.
Other treatment methods - softening of water, Removal of iron and manganese, defluoridation, desalination. (12 hours)

Distribution of water - distribution methods, systems of supply, service reservoirs and their capacity, layouts of distribution. (5 hours)

Pipe appurtenances: service connection, location of water supply pipes in buildings. wastage of water - Leakage detection & prevention, corrosion, and its prevention. (5 hours)

TEXT / REFERENCES:


Limit state method of design: Allowable stress design, Limit state method of design, partial safety factors, and load combinations. 

Structural fasteners: Bolted connections-type of bolts and bolted joints, specifications for bolts, strength of a joint, efficiency of joints, design of lap joints, butt joints and bracket connections. Welded connections – type of welds and welded joints, standard notations for fillet and Butt welds, strength of welds, design of lap joints, butt joints and bracket connections. 

Design of Tension members: Types of sections used for tension members, effective length of compression members, classification of cross section, buckling class of cross sections, local and overall buckling, design of axially loaded tension member - plate, single angles, double angles and other sections with welded and bolted connections. 

Compression member: Types of sections used for compression members, design of axially loaded compression member –standard sections, built up sections, laced and battened columns. Design of column splices, column bases – simple slab base and gusseted base for axially loaded column. 

Design of flexural members: standard and built up sections. Design of beams –laterally supported and laterally unsupported compression flange. Web crippling, web buckling and deflection. 

Welded Plate Girders : Elements of plate girder, proportioning of web, proportioning of flanges, self weight of plate girders, stiffeners - Detailed Design. 

Design concepts for roof trusses 

TEXT / REFERENCES:

ANALYSIS OF INDETERMINATE STRUCTURES

ICE 245

Analysis of two hinged parabolic arches. Determination of horizontal reaction, normal thrust, radial shear and bending moment. Lateral yielding, rib shortening, and effect of temperature change. (4 hours)

Analysis of Simple Statically Indeterminate Beams: Analysis of propped cantilever, fixed and continuous beams by strain energy and consistent deformation methods. Analysis of continuous beams by three-moment theorem. (12 hours)

Analysis of statically indeterminate beams, bents and frames: using slope deflection, and moment distribution methods. (12 hours)

Kani’s method of Analysis: Analysis for continuous beams with and without support sinking. Analysis of symmetrical and non symmetrical frames with hinged and fixed boundary conditions. (6 hours)

Introduction to influence line diagrams for beams and analysis of beams by Muller’s and Brauslo Principles. (8 hours)

Plastic Analysis : Ductility, Behaviour in the plastic range, concept of plastic hinge, plastic moments, shape factor for different shapes of cross - section, redistribution of moment, collapse mechanism. Upper and lower bound theorems. Determination of collapse loads using static and kinematic methods for beams and frames structures. (6 hours)

TEXT / REFERENCES:

- Hibbeler, RC, Structural analysis, Pearson Education
- Daniel L Schodak, Structures, Pearson Education
- Ramamrutham, Theory of Structures,

FLUID MECHANICS LABORATORY

ICE 246

Calibration of Triangular Notch, Rectangular Notch, Cippoletti Notch, Venturimeter, Orifices, Mouth pieces, Orifice meter, Broad crested weir, Curved weir, Ogee weir, Plug Sluice, Determination of Friction factor of pipes, Experiment on Venturi flume, Standing wave flume, Demonstration of Parshall Flume.

TEXT / REFERENCES:

Students need to form batches with maximum four in numbers and required to identify the problem in their area of interest within their discipline of study under the supervision of a faculty (Guide) for 12 to 14 weeks. At the end, the findings need to be presented in the form of a project report for final evaluation.

VI SEMESTER
ADVANCED CONCRETE TECHNOLOGY

Microstructure and Properties of Hardened Concrete: Importance of Bogue’s compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete, Rheology of concrete in terms of Bingham’s parameter. (9 hours)

Chemical admixtures: Mechanism of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, new generation superplasticiser. Mineral admixture-Fly ash, Silica fume, GCBS, and their effect on concrete property in fresh state and hardened state. (7 hours)
MIX Design: Factors affecting mix design, design of concrete mix by BIS method using IS 10262 (7 hours)
Special Types of Concrete: Fibre reinforced concrete - Fibres types and properties, Behaviour of FRC in compression, tension including pre-cracking stage and post-cracking stages, behaviour in flexure and shear. (6 hours)
Light weight concrete – materials, properties and types. Typical light weight concrete mix. (2 hours)
High volume fly ash concrete concept, properties, application. (2 hours)
Self-compacting concrete concept, materials, tests, properties, application. (2 hours)
High density concrete and high performance concrete-materials, properties and applications. (2 hours)
RMC concrete - manufacture, transporting, placing, precautions, Methods of concreting- Pumping, under water concreting, shotcrete, (4 hours)
Non-destructive Methods: Rebound hammer, pulse velocity methods. (3 hours)

TEXT / REFERENCES:
- Gambhir, M.L. , Concrete Technology, Tata McGraw Hill, New Delhi
ESTIMATING AND COSTING

ICE 362

Estimation: Definition, Types of estimate, Units of measurement, Method of estimation, project, contingencies, work charged establishment, plinth area, carpet area, Quantity calculation of different items for Residential buildings, R.C.C. works, roads, irrigation works etc.. Earth Work Calculation: Measurement of earth-work by cross-sections, spot levels, contours, mass diagram and its characteristics. (20 hours)

Specification: Definition, types, principles, Detailed specification for different components of buildings. (4 hours)

Rate Analysis: Purpose, factors affecting, overhead charges, Turn out of work, Rate analysis for different items of building. (6 hours)


TEXT / REFERENCES:

- PWD Karnataka Schedule of Rates.

ELECTIVE - I

ICE 363

PRESTRESSED CONCRETE DESIGN:

Basic Concepts of Prestressing: Need for high strength concrete and high tensile steel - Stress strain characteristics and properties. Advantages and applications of prestressed concrete.
Basic principles of prestressing: Load balancing concept, stress concept, centre of thrust. Pre-tensioning and Post-tensioning systems, tensioning methods and end anchorages. (4 hours)

Losses of prestress: Various losses in pretensioned and post tensioned systems, determination of jacking force. (4 hours)

Analysis of sections for flexure: Stresses in concrete due to pre-stress and loads, stresses in steel due to loads. (4 hours)

Camber and deflections: Prediction of short term and long term deflections of un cracked members; I.S. code provisions; Cable layouts. (4 hours)

Limit state of collapse and serviceability – Criteria for limit state, I.S. Code recommendations-Ultimate flexural and shear resistance of sections; shear reinforcement. Limit state of serviceability - Control of deflection and cracking. Classification of PSC structures. (8 hours)

Transmission of pre-stress in pre-tensioned members: transmission length, bond stress. Anchorage stresses in post tensioned members, bearing stress and bearing tensile force - stresses in end blocks - Methods, I.S. code provisions for the design of end block reinforcements. (6 hours)

Design of pre-tensioned and post-tensioned: symmetrical and unsymmetrical sections. Permissible stresses, design of pre-stressing force and eccentricity, limiting zone of pre-stressing force and eccentricity, cable profile. (6 hours)

**TEXT / REFERENCES:**

- Mallick S. K. and Gupta A. P., “Pre-stressed Concrete”, Oxford and IBH, New Delhi

**ADVANCED REINFORCED CONCRETE DESIGN:**

Flat slabs: Introduction, Design using direct design method (with and without drops). (7 hours)

Retaining walls: Types of retaining walls, Design of Cantilever type and Counter fort type retaining wall. (7 hours)

Design of grid floors and portal frame: Single storey and single bay. Introduction to approximate method of design of multi - storey frames. (8 hours)

Water Tanks: Introduction, Design of water tanks as per IS 3370 code, Rectangular and circular tanks resting on ground, Overhead tanks - Intze type with supporting structures. (8 hours)

Silos and Bunkers: Introduction, Design of Silos and Bunkers. (6 hours)

Shells and Folded plates: Introduction, behavior of shells and folded plate roof forms. (2 hours)
TEXT / REFERENCES:


ELECTIVE - II

ICE 364 3-0-0-3

WASTE WATER MANAGEMENT:

Introduction, Unit Operations, Unit Processes, Stabilization Ponds – Aerobic, Facultative & Anaerobic Lagoons, Septic tanks and their Design Aspects, Sludge Treatment, Sludge Digestion- Aerobic and Anaerobic, Energy recovery from digesters, Operation and Maintenance of treatment units, Disposal of wastes from various units.

TEXT / REFERENCES:


AIR POLLUTION AND CONTROL:

Air pollution, Meteorology variables, primary and secondary pollutants, Effects of air pollution on - human health, animals, plants and materials, Industrial plant location and planning, Ambient and stack sampling, Air pollution control devices, Global effects of air pollution - Acid rain, Greenhouse effect, Ozone layer depletion, Air quality and emission standards, Air pollution index, Air pollution act.

TEXT / REFERENCES:
RAILWAY ENGINEERING AND AIRPORT PLANNING:

RAILWAY ENGINEERING: Introduction: Role of railways in transportation, Indian Railways, Selection of Routes, Gauges and types, Typical cross sections-single and double line B G track in cutting, embankment and electrified tracks.

Tractive resistance: Resistant due to friction, wave action, curves, gradients, speed of the train; Hauling capacity and Tractive efforts.

Permanent way: Components parts rail and rail fastenings, ballast, sleepers, Railway creep, Anti-creep devices, coining of wheel, wear of rail.

Alignment Details: Grades and curves, effect of normal and ruling gradients, pusher and balance grades, super elevation, equilibrium cant, cant deficiency and grade compensation

Points and crossing: Necessity of turnouts, Switches and track junction, Design of turnout

Track Junctions: Introduction, Types of Track Junctions, Design calculation of simple junctions.

Missalenoious Topics: Railway Station and Yards - Types of railway stations, classification of yards, Triangle, Turn Table, Scotch Block, Fouling marks, Buffer Stops. Signals - Classification, function, Control on movement of train by different methods. Interlocking - Types and function.

AIRPORT ENGINEERING:

Introduction: History and development of aviation, Aviation organizations and their functions, Aircraft characteristics and its influence on airport planning, Factors to be considered in Airport Planning, Site selection survey, Obstructions, Airport configuration.

Geometric Design: Runway orientation, Basic runway lengths, Geometric design of Runway Taxiways and Exit Taxiways.

Airport Capacity and Designing of Terminal Area: Runway and Terminal capacity and its improvement, Delay related capacity, Gate position and gate capacity, Planning and Designing of Terminal area, Aircraft parking system.

Visual aids and Air traffic control system: Flight rules, Navigational and landing aids, ILS

TEXT / REFERENCES:

- Saxena S C and Arora S P “A Text Book Of Railway Engineering”.
- Khanna S K., Arora M G and Jain S S “Airport Planning and Design”.
PAVEMENT MATERIALS AND DESIGN:

Introduction: Types of pavements, Design wheel load – Maximum wheel load, Equivalent single wheel load, Soil classification, Strength determination of soil, Strength properties of mineral aggregates.

Design of Flexible pavement: Stress in Flexible pavements, Design factors, Design methods – IRC and AASHTO.


Design of Rigid pavement: Westergaard's design factors, Critical load position and stress computation, Temperature stresses, Warping stresses, Bradburry equation for stress calculation, frictional stress, combination of stress, Design of slab thickness, position and types of joints, design of joints – design of tie bars and spacing of dowel bars.


Design of Runway Pavement: Requirements, Types of pavements, Design of Flexible pavement, Design of Rigid pavement.


TEXT / REFERENCES:


ELECTIVE – IV

ICE 366

GROUND IMPROVEMENT TECHNIQUE:

Introduction: Ground Improvement: Definition, Objectives of soil improvement, Classification of ground improvement techniques, Factors to be considered in the selection of the best soil improvement technique. Principle of modification for various types of soils.

Mechanical Modification: Type of mechanical modification, Aim of modification, Methods of compaction-shallow and deep compaction, Properties of compacted soil, Compaction control.
tests, Field compaction – static, dynamic, impact and vibratory type. Vibro compaction and vibro replacement-stone columns. Effect of compaction on engineering behaviour of soil, Specification of compaction. (7 hours)

Hydraulic Modification: Definition, aim, principle, techniques. gravity drain, lowering of water table, multistage well point, vacuum dewatering, Electro kinetic dewatering. Preloading-Methods Vertical drains-Sand drains and prefabricated drains. (7 hours)

Chemical Modification : Definition, Techniques – sandwich technique, Modification by admixtures- granular admixtures, cement, lime, flyash, industrial wastes etc., Stabilization of soil with lime columns and cement columns. Stabilization using other chemicals - chlorides, hydroxides, lignin, hydrofluoric acid, Bitumen, tar or asphalt. Modification at depth by grouting-techniques, grouting plant, applications of grouting, materials used for grouting. (8 hours)

Miscellaneous methods: Thermal Modification, Soil reinforcement. Anchors, Rock bolts and soil nailing. Ground improvement by confinement – Crib walls, Gabions and Mattresses. Geosynthetics - Types, Civil Engineering applications of geo-synthetics. (11 hours)

TEXT / REFERENCES:


APPLIED SOIL ENGINEERING:

Soil Exploration: Objectives of exploration, planning of exploration program, soil samples and soil samplers, field penetration tests: SPT, SCPT, DCPT. Introduction to geophysical methods, Ground water investigations, Bore log and report writing. (8 hours)

Earth pressure: Earth pressure at rest, active and passive conditions, Rankine’s theory (no derivation) for active and passive condition for cohesion less and cohesive soil. (7 hours)


Bearing capacity of shallow foundations –Types of shallow foundation, Modes of shear failure, factors affecting bearing capacity, allowable bearing pressure, determination of bearing capacity-as per IS code, Permissible, total and differential settlement, Estimation of bearing capacity from plate load and penetration tests. (7 hours)

Pile foundations: Introduction, types of piles according to their composition, their method of installation and their load carrying characteristics, piles subjected to vertical loads- pile load carrying capacity from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test. Pile group: carrying capacity, efficiency and settlement. Negative skin friction. Under-reamed piles and Bored compaction piles. (7 hours)
TEXT / REFERENCES:


SEMINAR

ICE 367 0-0-3-1

Students need to present a seminar on a topic of recent developments in their subject filed.

ENVIRONMENTAL ENGINEERING LABORATORY

ICE 368 0-0-3-1

Determination of solids, Turbidity determination and Jar test, Determination of Alkalinity, Acidity and Ph, Calcium, Magnesium and total Hardness, Chlorides, dissolved oxygen and BOD determination, Residual chlorine and chlorine demand, Determination of Iron and Fluorides, Determination of C.O.D., Ammoniacal Nitrogen and Nitrates, Demonstration of High volume sampler and sound level meter, determination of oil, grease and Sulphates.

TEXT / REFERENCES:

Introduction to STAAD software package. Analysis of continuous beams using STAAD, Analysis of plane trusses, plane frames, and space frames using STAAD, Design of frames using STAAD package, Introduction and application of ETABS

TEXT / REFERENCES:

- STAAD Pro software tutorial.
- ETABS software tutorial.
B.Sc. (COMPUTER SCIENCE & ENGINEERING)

II SEMESTER

MATHEMATICS II

IMA 121 3-1-0-4

Functions with two or more variables, partial differentiation, chain rule, composite and implicit function differentiation, total differentials, error and approximation. Maxima and minima for functions of two or more variables, Lagrange’s method of undetermined multipliers. (8 hours)

Multiple integrals: double and triple integrals, change of order of integration, Jacobian of polar, cylindrical and spherical coordinate systems, change of variables, Application of multiple integrals to find area and volumes. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process. (8 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency. Inverse of invertible matrices by row operations. (6 hours)

Vectors - Vector differentiation, Divergence, Gradient and Curl and their physical interpretation and simple applications. Vector integration, Greens theorem in the plane, Gauss Divergence theorem, Stoke’s theorem and simple applications. (10 hours)

Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (2 hours)

Beta and Gamma functions & their properties. (4 hours)

TEXT/REFERENCES:


PHYSICS – II

IPH 121 3-0-3-4

Electric Fields: Coulomb’s law, The electric field, Continuous charge distribution, Charged particles in uniform electric field. (3 hours)

Gauss’s Law: Gauss’s law and derivation, Applications to various charge distributions, Conductors in electrostatic equilibrium. (3 hours)
Electric Potential: Potential difference in uniform electric field, Potential and energy due to point charges, Electric field and potential, Continuous charge distributions, Potential due to charged conductor, Applications of electrostatics. (4 hours)

Capacitance and Dielectrics: Calculating capacitance, Combinations of capacitors, Energy in a charged capacitor, Capacitors with dielectrics, Dipole in electric field, Atomic description of dielectrics. (3 hours)

Current and Resistance: Electric current, Resistance, Electrical conduction, Resistance and temperature, Superconductors, Electrical power. (3 hours)

Direct Current Circuits: Electromotive force, Resistors in series and parallel, Kirchhoff’s rules, RC circuits, Electrical meters. (3 hours)

Magnetic Fields: Magnetic fields and forces, Magnetic force acting on a current-carrying conductor, Torque on a current loop in a uniform magnetic field, Motion of a charged particle in uniform magnetic field, Applications, Hall effect. (3 hours)

Sources of the Magnetic Field: The Biot-Savart law, The magnetic force between two parallel conductors, Ampere’s law, The magnetic field of a solenoid, Magnetic flux, Gauss’s law in magnetism, Displacement current and the general form of Ampere’s law, Magnetism in matter. (4 hours)

Faraday’s Law: Faraday’s law of induction, Motional emf, Lenz’s law, Induced emf and electric fields, Generators and motors, Eddy currents, Maxwell’s equations. (3 hours)

Inductance: Self-inductance, RL circuits, Energy in a magnetic field, mutual inductance, Oscillations in an LC circuit, The RLC circuit. (3 hours)


TEXT/REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

PHYSICS LABORATORY:

To perform any 12 of the following experiments:

29. Field along the axis of a coil
30. Energy band gap of a semiconductor
31. Newton’s rings
32. Blackbody radiation
33. Photoelectric effect
34. Charging and discharging of a capacitor / RC time constant
35. Series and parallel resonance circuits  
36. e/m – Thomson’s method  
37. Fermi energy of a metal  
38. Hall effect  
39. Zener diode characteristics  
40. Hysteresis loss in magnetic materials  
41. Half wave and full wave rectifier circuits, C-filter circuit  
42. Resistivity of a semiconductor by four probe method

CHEMISTRY

ICH 121

Electrochemistry: Introduction to electrochemical cell and its types, Liquid junction potential, EMF of the cell and its determination, Standard cell, Origin of electrode potential, Single electrode potential, Nerst equation for electrode potential, Types of electrodes- hydrogen electrode, Calomel electrode and glass electrode, Numericals. (5 hours)


Chemical Kinetics: 
Rate of a reaction, order and molecularity of a reaction, rate law, integrated rate equation and half-life (first and second order reaction), energy of activation, theories of reaction rates-collision theory and transition state theory. Numericals (4 hours)


Organic reactions and mechanisms: Classification of organic compounds, IUPAC system of Nomenclature, Organic reactions and their Mechanisms- Homolytic and heterolytic
fission, carbonium ions, carbanions, carbon free radicals, substitution reactions, addition reactions, elimination reactions, rearrangement reactions, Isomerism - structural and stereoisomerism.

TEXT/ REFERENCES:


CHEMISTRY LAB

21. Acid-base titration (Acidimetric/Alkalimeter)
22. Determination of hardness of water
23. Determination of chloride content of water
24. Determination of percentage of copper in brass
25. Determination of percentage of nitrogen ammonia in fertilizer
26. Determination of rate constant of hydrolysis of ethyl acetate
27. Colorimetric determination of copper
28. Conductometric titration of a Mixture of strong & weak acids vs strong base
29. Determination of pKa value of a weak acid using pH meter
30. Redox titration using potentiometer

JAVA PROGRAMMING

ICS 121 3-1-3-5


LANGUAGE BASICS: Java’s Primitive Types, Literals, Variables, Scope and Lifetime of Variables, Operators and Operator Precedence, Expressions, Input, Control Structures, Arrays and Strings.

INTRODUCTION TO CLASSES, OBJECTS AND METHODS: Class Fundamentals, Creating Objects, Reference Variables and Assignment, Methods, Returning from a method, Returning a Value, Using Parameters, Constructors, Parameterized Constructors, The new operator, Garbage Collection and Finalizers, this keyword, Controlling Access to Class Members, Pass Objects to Methods, Arguments Passing, Returning Objects, Method Overloading, Overloading Constructors, Understanding static, Nested and Inner Classes, Variable Length Arguments.

INHERITANCE: Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, User Super to Call Superclass Constructors and Access Superclass Members, Creating Multilevel Hierarchy, Order of execution of Constructors, Superclass References and
Subclass Objects, Method Overriding and Polymorphism, Using Abstract Classes, Using Final, The Object Class.  
(6 hours)

INTERFACES: Interface Fundamentals, Creating and Interface, Implementing an Interface, Using Interface References, Implementing Multiple Interfaces, Constants in Interfaces, Extending Interfaces, Nested Interfaces.  
(4 hours)

PACKAGES: Package Fundamentals Packages and Member Access, Importing Packages, Static Import  
(3 hours)

(4 hours)

MULTITHREADED PROGRAMMING: Multithreading Fundamentals, The Thread Class and Runnable Interface, Creating a Thread and Multiple Threads, Determining when a Thread Ends, Thread Priorities, Synchronization, Using Synchronized Methods, The synchronized statement, Thread Communication, Suspending, Resuming and Stopping Threads.  
(6 hours)

USING INPUT OUTPUT: Char and Byte stream classes, Predefined streams, Console i/o using streams, Reading and Writing Files using Bytestreams and Charstreams. File, Filename Filter, Random Access File class.  
(4 hours)

SWINGS AND EVENT HANDLING: The origins and design philosophy of swings, components and containers, Layout Managers, Event handling, using pushbutton, JTextField, Anonymous inner classes to handle events.  
(7 hours)

JAVA PROGRAMMING LABORATORY
Implementing programs in Java using Control statements and arrays, Classes and methods, Inheritance and Packages, Interfaces, Exception Handling, Threads, Input/Output, Applets and Event Handling, Generics, String handling, Swings

TEXT/ REFERENCES:

COMPUTER ORGANIZATION AND ARCHITECTURE
ICS 122  3-1-0-4

BASIC STRUCTURE OF COMPUTERS: Computer types, Functional units, Basic operational concepts, Number Representation and Arithmetic Operations, Character Representation, Performance, Problems  
(3 hours)

INSTRUCTION SET ARCHITECTURE: Memory locations and addresses, Memory operations, Instructions and Instruction Sequencing, Addressing modes, CISC Instruction Sets, RISC and CISC Styles, Example Programs.  
(3 hours)
ARITHMETIC AND LOGIC UNIT: Number Systems-Positional number systems-Decimal, Binary, Hexadecimal, Conversions, The ALU-Integer and Floating point arithmetic. (9 hours)

PROCESSING UNIT:CPU structure and Function: processor organization, register organization, Instruction cycle, Control Unit Operation: Micro operations, Control of the processor(exclude Intel 8085), hardwired Implementation, micro-programmed control-Basic concepts, micro instructions, micro programmed control unit, wilkes control, microinstruction sequencing – Design considerations, sequencing techniques, Address generation, Microinstruction execution – a taxonomy of micro instructions, microinstruction encoding. 

MEMORY SYSTEMS: Basic concepts, RAM memories, Read only memories, Memory Hierarchy, Cache memories-mapping functions, Placement strategies, Replacement algorithms, Performance considerations, Virtual memories, Secondary storage. (7 hours)


INTRODUCTION TO PARALLEL ARCHITECTURE: Pipelining- Basic Concept, Pipeline Organization, Pipelining Issues, Data Dependencies, Operand Forwarding, Handling Data Dependencies in Software, Memory Delays, Branch Delays, Unconditional Branches, Conditional Branches, The Branch Delay Slot, Branch Prediction, Hardware Multithreading, Vector (SIMD) Processing, Graphics Processing Units (GPUs), Shared-Memory Multiprocessors, Interconnection Networks, Cache Coherence, Write-Through Protocol, Write-Back protocol, Snoopy Caches, Directory-Based Cache Coherence . (8 hours)

TEXT/REFERENCES:


III SEMESTER

MATHEMATICS III

IMA 231 3-1-0-4

Differential equations - basic concepts and definitions, solution of exact equations, evaluation of integrating factors, solution of first order linear differential equations, Bernoulli’s equation, solution by inspection, application of first order differential equations. (6 hours)

Some simple numerical methods for solutions of first order equations: Taylor series method, Euler’s method, modified Euler’s method, Runge-Kutta methods of order two and four. (6 hours)

Higher order linear differential equations with constant coefficients, homogeneous and nonhomogeneous differential equations, solution by the method of undermined coefficients,
method of variation of parameters and inverse differential operator method. Application of second order differential equations - vibration of spring. (8 hours)

Introduction to Laplace transforms, transforms of elementary functions, periodic functions, Step functions, Dirac Delta functions, inverse transforms, convolution theorem, and solution of initial value problems by Laplace transforms method. (12 hours)

Complex variables - Analytic functions, Cauchy - Riemann equations, Harmonic functions, Line integrals, Cauchy's integral theorem, Cauchy's integral formulae. Laurent series, Residue calculus. (12 hours)

Partial differential equations - basic concepts, solutions of simple partial differential equations, method of separation of variables and indicated transforms to solve partial differential equations. (4 hours)

**TEXT / REFERENCES:**


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**DATA STRUCTURES**

ICS 231  

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithm Analysis: Space Complexity, Time Complexity, Big-oh notation</td>
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<tr>
<td>Recursion: Definition &amp; Examples, Complexity analysis of Recursive algorithms</td>
<td>3</td>
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<tr>
<td>Stacks: Definitions &amp; implementation, Representation, Operations on Stacks, Applications of Stacks</td>
<td>6</td>
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<tr>
<td>Queues: Definition, Representation, Operations on Queues, Priority Queues</td>
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<td>Linked lists: Singly Linked lists, Doubly Linked lists</td>
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<tr>
<td>Searching: Linear Search, Binary Search, Comparative Performance of Searching Algorithms</td>
<td>3</td>
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<tr>
<td>Hashing: Abstract Data Type, Static Hashing - Hash Tables, Hashing Functions, Overflow Handling</td>
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<tr>
<td>Sorting: Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Time Complexity Analysis of the above Sorting Methods.</td>
<td>6</td>
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<tr>
<td>Graphs: Types of Graphs, Representation - Adjacency Matrix, Adjacency Lists, Traversals-Depth-First Search and Breadth-First Search</td>
<td>6</td>
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</table>
DATA STRUCTURES LABORATORY

Recursive programs, Implementation of Stacks and queues using arrays, Linked lists, Implementation of stack and queue using linked list, Binary trees – traversal, insertion, deletion, Binary Search trees, Linear Search, Binary Search, Sorting Programs.

TEXT / REFERENCES:


SWITCHING CIRCUITS AND LOGIC DESIGN

ICS 232

3– 1– 3 – 5

INTRODUCTION TO LOGIC CIRCUITS: Variables and functions, Inversion, Truth Tables: AND OR, NOT, NAND, NOR, XOR gates, Logic Gates and Networks, Boolean algebra, Synthesis using AND, OR and NOT gates, NAND and NOR logic Networks, Introduction to Verilog HDL (8 hours)

OPTIMIZED IMPLEMENTATION OF LOGIC FUNCTIONS: Karnaugh Map, Strategy for minimization, Minimization of POS forms, Incompletely Specified Functions, Multiple Output Circuits, Multilevel Synthesis, Multilevel NAND and NOR Circuits, Quine-McCluskey method simplification (9 hours)

ARITHMETIC CIRCUITS: Positional Number Representation, Addition of unsigned numbers, Signed numbers, Arithmetic Circuits: Half Adder, Full Adder, Ripple Carry Adder, Adder/Subtractor, Fast adders-Carry Look Ahead adder, BCD Adder, Design of Arithmetic Circuits Using Verilog (7 hours)

COMBINATIONAL CIRCUIT BUILDING BLOCKS: Multiplexer, Decoder, Encoder, Code converter, Arithmetic comparison circuits, Verilog for Combinational Circuits. (7 hours)

SYNCHRONOUS SEQUENTIAL CIRCUITS: Flip-Flops, Analysis and Design of Synchronous Sequential Circuits, Ripple Counters, Registers, Shift Registers, Ring and Johnson Counters, Using Verilog Constructs for Storage Elements. (12 hours)

SWITCHING CIRCUITS: Transistor Switches, NMOS, CMOS Logic Gates, Programmable Logic Devices, Noise Margin, Power dissipation, Transmission Gates, Fan-in, Fan-out, Tristate drivers (5 hours)

SWITCHING CIRCUITS & LOGIC DESIGN LABORATORY

Introduction to Logic gates, Implementation of Boolean functions using gates, Code converter circuits, Magnitude comparators, Arithmetic circuits, Multiplexers Demultiplexers/Decoders, Encoders, Flip Flops and ripple counters, Synchronous counters, Combinational and sequential
circuits. Implementation of ALU/Control Signals of RISC processors. Implementation of the above using Verilog HDL

**TEXT / REFERENCES:**


**SOFTWARE DESIGN USING OBJECT ORIENTED PARADIGM**

**ICS 233**


CASE STUDY : Case study – the Next Gen POS system, Inception -Use case Modeling - Relating Use cases – include, extend and generalization - Elaboration - Domain Models - Finding conceptual classes and description classes – Associations –Attributes – Domain model refinement – Finding conceptual class Hierarchies - Aggregation and Composition. (8 hours)

APPLYING DESIGN PATTERNS: System sequence diagrams - Relationship between sequence diagrams and use cases- Logical architecture and UML package diagram – Logical architecture refinement - UML class diagrams – UML interaction diagrams – Applying GoF design patterns. (8 hours)

DESIGN PATTERNS:


**SOFTWARE DESIGN USING OBJECT ORIENTED PARADIGM LABORATORY**

Requirement elicitation for a given problem, Create use case diagram, activity diagram, sequence diagram, collaboration diagram, Domain class and detailed class diagram of the given system, Create a state chart diagram for each of the classes identified, Miniproject
ANALOG ELECTRONIC CIRCUITS

IEC 231

3–1–0–4

Bipolar transistor: Structure of Bipolar Transistor, Operation of Bipolar Transistor in Active Mode: Collector Current, Base and Emitter Currents, Bipolar Transistor Models and Characteristics: Large-Signal Model, Small-Signal Model, Early Effect, operation of Bipolar Transistor in Saturation Mode


MOS Transistor: Structure and operation of MOSFET, I-V Characteristics, Channel-Length Modulation, Trans conductance, MOS Device Models: Large-Signal and Small-Signal Model, PMOS Transistor, Comparison of Bipolar and MOS.

MOS Amplifier: Amplifier Topologies, Biasing, Realization of Current Sources, Common-Source Stage: CS Core, CS Stage with Current-Source Load, CS Stage with Diode Connected Load, CS Stage with Degeneration, CS Core with Biasing, Common-Gate Stage: CG Stage with Biasing, Source Follower: Source Follower Core, Source Follower with Biasing.


Oscillators: General Considerations, Heartley and Colpitts Oscillator, Phase Shift Oscillator, Ring Oscillator.
Power Amplifier: General Considerations, Different Classes of Power amplifiers, Class A amplifier, Class B amplifier and Class AB amplifier, Power efficiency of all Classes. (4 hours)

TEXT / REFERENCES:

IV SEMESTER
ENGINEERING ECONOMICS & MANAGEMENT

IHS 241 3-1-0-4


(1 hour)

Time value of money: Time value of money, interest factors for discrete compounding, nominal & effective interest rates, present and future worth of single, uniform, gradient cash flow.

(4 hours)

Economic analysis of alternatives: Bases for comparison of alternatives, present worth amount, capitalized equivalent amount, annual equivalent amount, future worth amount, capital recovery with return, rate of return method, incremental approach for economic analysis of alternatives, replacement analysis.

(4 hours)

Break-even and minimum cost analysis: Break even analysis for single product and multi product firms, break even analysis for evaluation of investment alternatives, minimum cost analysis.

(4 hours)

Depreciation: Physical & functional depreciation, methods of depreciation - straight line, declining balance, sum-of-the-years digits, sinking fund and service output methods.

(2 hours)


(2 hours)

Valuation of securities: Concept of valuation, bond valuation and bond valuation models, bond value theorems, yield to maturity, equity valuation; dividend capitalization approach, ratio approach.

(4 hours)

Financial statement analysis: Balance sheet and profit & loss statement, meaning & contents, ratio analysis, financial ratios such as liquidity ratios, leverage ratios, turn over ratios, and profitability ratios, time series analysis, common size analysis, DuPont analysis, drawbacks of financial statement analysis.

(5 hours)

Planning: Types of plans, steps in planning, process of MBO, how to set objectives, strategies, policies & planning premises. Strategic planning process and tools.

Organizing: Nature & purpose of organising, span of management, factors determining the span, basic departmentation, line & staff concepts, functional authority, art of delegation, decentralisation of authority.

Staffing: HR planning, recruitment, development and training.

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid.

Basic control process, Critical control points & standards, Control techniques: Budgets, non-budgetary control devices. Overall & preventive controls: Budget summaries: Profit & loss control, control through ROI, direct, preventive control.

TEXT / REFERENCES:

MICROPROCESSORS

ICS 241

8086 FAMILY ASSEMBLY LANGUAGE PROGRAMMING: 8086 internal architecture, Introduction to programming the 8086, Addressing modes, assembler and Assembler directives, Simple sequence programs, Jumps, Flags, and conditional jumps, Loop instructions, Instruction timing and delay loops.

8086 INTERRUPTS AND INTERRUPT APPLICATIONS: 8086 Interrupts and Interrupt Responses, 8259 Priority Interrupt Controller, 8255- Programmable Parallel ports and Handshake Input/Output.

8086 SYSTEM CONNECTIONS TIMING: Min and Max mode operation, Reset and Wait state, Min and max mode input, output timing diagrams.

Signals, Special 80386 Registers, 80386 Memory Management, Protected Mode, Virtual Mode, The Memory Paging Mechanism, Introduction to The 80486 Microprocessor, Basic 80486 Architecture, 80486 Memory System. (8 hours)


MICROPROCESSOR LABORATORY

Basics of Assembly Programming, Simple Programs using Addition, Subtraction and Branching Instructions, Operations on BCD and ASCII data (Packing, Unpacking, Conversion between BCD and ASCII), Multiplication and Division, List Operations (Arrays), String Operations, DOS and BIOS interrupts – String Operations, DOS interrupts – Integer Operations and file operations, Logic Controller Interfacing, DAC Interfacing, Keyboard Interfacing, Seven Segment Display Interfacing, Stepper Motor, ADC Interfacing, Elevator Interfacing

TEXT / REFERENCES:


DATABASE MANAGEMENT SYSTEMS

ICS 242 2- 1 -3 –4

Introduction: Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators. (3 hours)

Relational Model: Structure of Relational Databases, Database Schemas, Keys, Relational Query Languages, Relational Operations. (4 hours)

SQL: SQL Data Definition, SQL Data Types and Schemas, Integrity Constraints, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Nested Subqueries, Additional Basic Operations Null Values, Modification of the Database. Join Expressions, Views, Transactions, Introduction to PL/SQL. (8 hours)


Indexing and Hashing: File Organization, Organization of Records in Files, Basic concepts, Ordered Indices, B+ Tree Index Files, B+ Tree Extensions, Multiple-Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing. (6 hours)


**DATABASE MANAGEMENT SYSTEMS LABORATORY**

Implementation of ER diagrams using DIA tool, Designing the different databases and working with queries using SQL. Working with Advanced SQL like, Exceptions Cursors, Procedures, Functions and Packages, Mini-Project work using Java as front end and Oracle/PostgreSQL as back end.

**TEXT / REFERENCES:**

**OPERATING SYSTEMS**

ICS 243 2-1-0-3


System structure: Operating System Services, User Operating System Interfaces, System Calls, Types of System Calls, System Programs, Operating System Structure. (2 hours)

Process concept: Overview, Process Scheduling, Operations on Processes, Interprocess Communication. (2 hours)

Multithreaded programming: Overview, Multithreaded Models, Thread Libraries, Threading Issues. (3 hours)
Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Linux scheduling. (4 hours)

Synchronization: Background, Critical Section Problem, Peterson’s Solution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization. (4 hours)

Deadlocks: System Model, Deadlock, Characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock Avoidance. (4 hours)

Memory management strategies: Logical Versus Physical Address Space, Swapping, Contiguous Memory Allocation, Paging, Page Table Structure, Segmentation. (4 hours)

Virtual memory management: Background, Demand Paging, Copy-On-Write, Page Replacement, Allocation of Frames, Thrashing. (5 hours)

File system: File Concept, Access Methods, Directory Structure, File Sharing. (2 hours)


Linux system: Linux system design Principles, Kernel Modules. (2 hours)

TEXT / REFERENCES:


DESIGN & ANALYSIS OF ALGORITHMS

ICS 244 2-1-0-3

Introduction: Introduction, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental Data Structures. (3 hours)

Fundamentals of the analysis of algorithm efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Nonrecursive and Recursive Algorithms, Example. (4 hours)

Brute force: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search Method, Depth First Search, Breadth First Search. (5 hours)

Decrease and conquer: Insertion Sort, Topological Sorting, Algorithms for generating Combinatorial Objects. (3 hours)

Divide and conquer: Mergesort, Quicksort, Binary Search, Multiplication of large integers and Strassen’s Matrix Multiplication. (4 hours)

Transform and conquer: Presorting, Balanced Search Trees, Heaps and Heapsort, Problem Reduction (4 hours)

Space and time tradeoffs: Sorting by Counting, Input Enhancement in String Matching, Hashing. (4 hours)

Dynamic programming: Basic Examples, The Knapsack Problem and Memory Functions, Warshall’s and Floyd’s Algorithms (5 hours)

Greedy technique: Prim’s Algorithm, Kruskal’s Algorithm, Dijkstra’s Algorithm, Huffman Trees. (4 hours)

TEXT / REFERENCES:
SIGNALS AND SIGNAL PROCESSING

IEE 241

Introduction to Signals and Systems: Definitions of signals and systems, classification of signals, basic operations on signals, elementary signals and functions, systems viewed as interconnections of operations, properties of systems. (8 hours)

Time domain representations for linear time-invariant (LTI) systems: Introduction, convolution: Impulse response representation for LTI systems, properties of the impulse response representation for LTI systems. Block diagram representations. (8 hours)


Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier transform representations for periodic signals, Sampling Theorem, Reconstruction of continuous-time signals from samples. (4 hours)

Z-Transform: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform (Using Partial fraction method), Transform analysis of LTI systems. (8 hours)

Frequency Response of Analog Filters: Frequency response of an LTI system, Butterworth filters, Chebyshev filters (Qualitative discussion). (2 hours)

Digital Filters: Relation between DTFT and Z-transform, Discrete Fourier Transform (DFT), N-point DFT computation. Introduction to digital filters: Finite impulse response (FIR) and infinite impulse response (IIR) filters, Ideal frequency responses of frequency selective filters. (6 hours)

TEXT / REFERENCES:


V SEMESTER
PROJECT WORK
ICS 351
0-0-36-12

Students need to form batches with maximum four in numbers and required to identify the problem in their area of interest within their discipline of study under the supervision of a faculty (Guide) for 12 to 14 weeks. At the end, the findings need to be presented in the form of a project report for final evaluation.

VI SEMESTER
COMPUTER COMMUNICATION AND NETWORKS
ICS 361
3-1-0-4


DATA LINK CONTROL: Flow Control, Error Control, Performance Issues.

WIRELESS NETWORKS AND MOBILE IP: Introduction, IEEE 802.11 Project, Mobile IP Addressing, Agents, 3 Phases, Inefficiency in Mobile IP.


TEXT / REFERENCES:


LEXICAL ANALYSIS: The Role of the Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, Finite Automata, From Regular Expression to Automata-Conversion of an NFA to a DFA, Construction of an NFA from a Regular Expression. (10 hours)


SYNTAX DIRECTED TRANSLATION: Syntax-Directed Definitions, Evaluation Order for SDD’s- Dependency Graphs, Ordering the Evaluation of Attributes, Applications of Syntax-Directed Translation -Construction of Syntax Trees. (5 hours)

INTERMEDIATE CODE GENERATION: Variants of Syntax Trees, Three Address Code-Addresses and Instructions, Quadruples and Triples, Types and Declarations- Type Expressions, Type Equivalence, Declarations, Translation of Expressions- Operations Within Expressions. (6 hours)

CODE GENERATION: Issues in Design of Code Generator, The Target Language, Basic Blocks and Flow Graphs, Optimization of Basic Blocks- The DAG Representation of Basic Blocks, Peephole Optimization. (7 hours)

RUN TIME ENVIRONMENTS: Storage Organization, Stack Allocation of Space- Activation Trees, Activation Records. (3 hours)

COMPILER DESIGN LABORATORY:
Preliminary Scanning Applications, Identification of tokens in a given program, Design of Lexical Analyzer, Design of parser, Design of code generator

TEXT / REFERENCES:


ELECTIVE - I

ICS 363 3-0-0-3

BIG DATA ANALYTICS:

INTRODUCTION: Types of digital data, Introduction to Big Data and Big Data Analytics.

NOSQL: Introduction to NoSQL, Types and Advantages of NoSQL, Comparison of SQL, NoSQL and NewSQL. MongoDB: Features, Data types, Query Language; Cassandra: Features, Data types, Query Language

HADOOP: Core Hadoop components, Hadoop Ecosystem, YARN and MapReduce, Understanding I/O in MapReduce, Processing common serialization formats, Big data serialization formats, Organizing and optimizing data in HDFS, MapReduce with NOQL as a data source, Applying MapReduce patterns to Big Data

BEYOND MAPREDUCE: Hive: Basics, Architecture, Data Types, File Formats, Query Language User Defined Function; Pig: Introduction, Pig Latin, Data Processing operators; Data stream processing with Spark

TEXT / REFERENCES:

• Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley India Pvt. Ltd., 2015
• Alex Holmes, "Hadoop in Practice", (2e), Manning Publications, 2015.
• Tom White, "Hadoop: The definitive guide", (4e), O’reilly, Yahoo Press, 2015.

COMPUTER GRAPHICS:

Introduction: Introduction to computer graphics, Output technology – Video display devices, Raster scan systems, Random scan systems, Graphics Software; line drawing algorithms, circle and ellipse generating algorithms, clipping operations – point, line, and polygon clipping algorithms.

Geometrical Transformation And Viewing: Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, Three Dimensional geometric transformations- 3D matrix representation, Composition of 3D transformations, Three dimensional viewing – viewing pipeline, viewing coordinates, Viewing in 3D- Projections, Mathematics of planar geometric projections.
Representing Curves And Visible Surface Determination: Parametric continuity conditions, Geometric continuity conditions, Hermite curves, Bézier curves. Visible surface detection methods-classification, Algorithms-z-buffer algorithm, List priority algorithm, Scan line algorithm, Area sub division algorithm. (8 hours)


Surface Rendering Methods And Animations: Ray tracing methods, Basic ray tracing algorithm, Animation: Conventional and Computer Assisted animation, Animation Languages, Methods of controlling Animation, Basic rules of animation. (4 hours)

TEXT / REFERENCES:

ELECTIVE - II
ICS 364 3-0-0-3

PRINCIPLES OF CRYPTOGRAPHY:

INTRODUCTION:Security Goals, Cryptographic Attacks, Services and Mechanisms, Techniques (2 hours)

CLASSICAL ENCRYPTION TECHNIQUES:Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Block Ciphers and the Data Encryption Standard- Block Cipher Principles, The Data Encryption Standard (DES), DES Example, The Strength of DES, Block Cipher Operation- Multiple Encryption and Triple DES, Electronic Codebook Mode, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode (10 hours)

MATHEMATICS OF CRYPTOGRAPHY: Modular Arithmetic, Modulo operator, Set of Residues, Congruence, Operations in \( Z_n \), Inverse, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem. Basic concepts in number theory, Divisibility and The Division Algorithm, The Euclidean Algorithm, Modular Arithmetic. (6 hours)

ADVANCED ENCRYPTION STANDARD: The Origin of AES, AES Structure, AES Round Functions, AES Key Expansion, an AES Example (3 hours)

PSEUDORANDOM NUMBER GENERATION AND STREAM CIPHERS: Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation Using a Block Cipher, Stream Ciphers, RC4 (4 hours)

CRYPTOGRAPHIC HASH FUNCTIONS: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3, Message Authentication Requirement, Message Authentication Function, Message Authentication Codes, Digital Signatures (5 hours)

TEXT / REFERENCES:

MOBILE APPLICATION DEVELOPMENT:

GETTING STARTED WITH MOBILITY: Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the mobile app development environment along with an emulator, a case study on Mobile app development (4 hours)

BUILDING BLOCKS OF MOBILE APPS: App user interface designing – mobile UI resources (Layout, UI elements, Drawable, Menu), Activity- states and life cycle, interaction amongst activities. App functionality beyond user interface - Threads, Async task, Services – states and life cycle, Notifications, Broadcast receivers, Telephony and SMS APIs (8 hours)

DATA HANDLING IN MOBILE APPS: Native data handling – on-device file I/O, shared preferences, mobile databases such as SQLite, and enterprise data access (via Internet/Intranet), Content Providers (6 hours)

GRAPHICS AND MULTIMEDIA: Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record, working with images and camera (6 hours)

LOCATION AWARENESS AND SENSORS IN MOBILE APPS: Adding Support for location based services and native hardware access (sensors such as accelerometer and gyroscope), maps, android sensor framework, motion, position and environment sensors. (6 hours)

TESTING MOBILE APPS AND TAKING APPS TO MARKET: Debugging mobile apps, White box testing, Black box testing, and test automation of mobile apps, JUnit for Android, Robotium, MonkeyTalk, Versioning, signing and packaging mobile apps, distributing apps on mobile market place (6 hours)

TEXT / REFERENCES:
- Anubhav Pradhan, Anil V Deshpande, “Composing Mobile Apps, learn, explore apply using Android”, (1e), Wiley India Pvt. Ltd., 2014.
- Barry burd, “Android Application Development All in one for Dummies”, (2e), John Wiley and Sons Inc., 2012
DIGITAL IMAGE PROCESSING:


SPATIAL DOMAIN: Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods. (7 hours)


IMAGE RESTORATION: Noise models, Restoration in the presence of noise only spatial filtering, Periodic noise reduction by frequency domain filtering, Estimating the Degradation Function. (6 hours)

MORPHOLOGICAL IMAGE PROCESSING: Preliminaries, Dilation and Erosion, Opening and Closing, The hit-or-miss transformation, Some basic Morphological algorithms, Extension to Gray-Scale Images (6 hours)

IMAGE SEGMENTATION: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation (8 hours)

TEXT / REFERENCES:


SOFTWARE TESTING AND ANALYSIS:

FUNDAMENTALS OF TEST AND ANALYSIS: Software Test and Analysis in a Nutshell – Engineering Processes and Verification, Basic questions, When Do Verification and Validation Start and End, Techniques to be applied, A Framework for Test and Analysis – Validation Verification, Degrees of Freedom, Varieties of Software. (2 hours)

FUNCTIONAL TESTING OVERVIEW: Boundary Value Testing, Equivalence Class Testing, Decision Table-Based Testing. (10 hours)

STRUCTURAL TESTING: Overview, Statement Testing, Branch Testing, Condition Testing, Path testing, Procedure call testing. (5 hours)

DEPENDENCE AND DATA FLOW MODELS: Definition-Use Pairs, Data Flow Analysis with Arrays and Pointers, Data flow testing: Overview, Definition-Use Associations, and Data Flow Testing Criteria. (5 hours)

MODEL-BASED TESTING: Overview, Deriving Test Cases from Finite State Machines, Testing Decision Structures, Deriving Test Cases from Control and Data Flow Graphs. (5 hours)

TEST-ADEQUACY ASSESSMENT USING PROGRAM MUTATION: Introduction, Mutation and Mutants, Test Assessment Using Mutation, Mutation operators. (4 hours)

TEST EXECUTION: Overview, From Test Case Specifications to Test Cases, Scaffolding, Test Oracles, Capture And Replay (2 hours)

TEXT / REFERENCES:


ELECTIVE - IV 3-0-0-3

PRINCIPLES OF PROGRAMMING LANGUAGES:

INTRODUCTION: What is a Programming Language?, Abstractions in Programming Languages, Computational Paradigms, Language Definition, Language Translation. (2 hours)
LANGUAGE DESIGN PRINCIPLES: History and Design Criteria, Efficiency, Regularity, Further Language Design Principles (2 hours)
SYNTAX: Lexical Structure of Programming Languages, Context-Free Grammars and BNFs Parse Trees and Abstract Syntax Trees, Ambiguity, Associativity, and Precedence EBNFs and Syntax Diagrams, Parsing Techniques and Tools, Lexics Versus Syntax Versus Semantics (6 hours)
BASIC SEMANTICS: Attributes, Binding, and Semantic Functions, Declarations, Blocks, and Scope, The Symbol Table, Name Resolution and Overloading, Allocation, Lifetimes, and the Environment, Variables and Constants, Aliases, Dangling References, and Garbage. (6 hours)

EXPRESSIONS AND STATEMENTS: Expressions, Conditional Statements and Guards, Loops and Variation on WHILE, The GOTO Controversy, Exception Handling. (4 hours)
OBJECT-ORIENTED PROGRAMMING: Software Reuse and Independence, Java: Objects, Classes, and Methods, Inheritance Dynamic Binding (3 hours)
FUNCTIONAL PROGRAMMING: Programs as Functions, Functional Programming in an Imperative Language, Scheme: A Dialect of LISP (4 hours)
LOGIC PROGRAMMING: Logic and Logic Programs, Horn Clauses, Resolution and Unification (3 hours)
PARALLEL PROGRAMMING: Introduction of Parallel Processing, Parallel Processing and Programming Languages, Threads, Semaphores, Monitors, Message Passing, Parallelism in Non-imperative Languages (6 hours)

TEXT / REFERENCES:

MACHINE LEARNING:

INTRODUCTION: Machine learning, supervised learning, unsupervised learning, Mathematical preliminaries, Review of linear algebra, probability theory review, overview of convex optimization, Hidden Markov model, Multivariate Gaussian distribution, Gaussian processes

CLASSIFICATION & REGRESSION: Bayesian decision theory, maximum likelihood ratio, parametric classification, regression, multivariate methods, K-nearest neighbour classification


UNSUPERVISED LEARNING: Clustering K-means hierarchical clustering, competitive learning, radial basis functions, EM, Mixture of Gaussians, Factor analysis, Belief propagation.

GRAPHICAL MODELS: Naive Bayes classifier, Hidden Markov Model, Linear Regression, Independent component analysis.

COMBINING MULTIPLE LEARNERS: Generating diverse learners, Voting, error correcting output codes, Bagging, Boosting.

TEXT / REFERENCES:


SEMINAR

ICS 367 0-0-3-1

Students need to present a seminar on a topic of recent developments in their subject filed.
Functions with two or more variables, partial differentiation, chain rule, composite and implicit function differentiation, total differentials, error and approximation. Maxima and minima for functions of two or more variables, Lagrange’s method of undetermined multipliers. (8 hours)

Multiple integrals: double and triple integrals, change of order of integration, Jacobian of polar, cylindrical and spherical coordinate systems, change of variables, Application of multiple integrals to find area and volumes. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process. (8 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency, Inverse of invertible matrices by row operations. (6 hours)

Vectors - Vector differentiation, Divergence, Gradient and Curl and their physical interpretation and simple applications. Vector integration, Greens theorem in the plane, Gauss Divergence theorem, Stoke’s theorem and simple applications. (10 hours)

Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (2 hours)

Beta and Gamma functions & their properties. (4 hours)

**TEXT/ REFERENCES:**


**PHYSICS – II**

Electric Fields: Coulomb’s law, The electric field, Continuous charge distribution, Charged particles in uniform electric field. (3 hours)

Gauss’s Law: Gauss’s law and derivation, Applications to various charge distributions, Conductors in electrostatic equilibrium. (3 hours)
Electric Potential: Potential difference in uniform electric field, Potential and energy due to point charges, Electric field and potential, Continuous charge distributions, Potential due to charged conductor, Applications of electrostatics.  

(4 hours)

Capacitance and Dielectrics: Calculating capacitance, Combinations of capacitors, Energy in a charged capacitor, Capacitors with dielectrics, Dipole in electric field, Atomic description of dielectrics.  

(3 hours)

Current and Resistance: Electric current, Resistance, Electrical conduction, Resistance and temperature, Superconductors, Electrical power.  

(3 hours)


(3 hours)

Magnetic Fields: Magnetic fields and forces, Magnetic force acting on a current-carrying conductor, Torque on a current loop in a uniform magnetic field, Motion of a charged particle in uniform magnetic field, Applications, Hall effect.  

(3 hours)

Sources of the Magnetic Field: The Biot-Savart law, The magnetic force between two parallel conductors, Ampere’s law, The magnetic field of a solenoid, Magnetic flux, Gauss’s law in magnetism, Displacement current and the general form of Ampere’s law, Magnetism in matter.  

(4 hours)

Faraday’s Law: Faraday’s law of induction, Motional emf, Lenz’s law, Induced emf and electric fields, Generators and motors, Eddy currents, Maxwell’s equations.  

(3 hours)


(3 hours)


(4 hours)

TEXT/REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

PHYSICS LABORATORY:

To perform any 12 of the following experiments:

43. Field along the axis of a coil
44. Energy band gap of a semiconductor
45. Newton’s rings
46. Blackbody radiation
47. Photoelectric effect
48. Charging and discharging of a capacitor / RC time constant
49. Series and parallel resonance circuits
50. e/m – Thomson’s method
51. Fermi energy of a metal
52. Hall effect
53. Zener diode characteristics
54. Hysteresis loss in magnetic materials
55. Half wave and full wave rectifier circuits, C-filter circuit
56. Resistivity of a semiconductor by four probe method

CHEMISTRY

ICH 121

Electrochemistry: Introduction to electrochemical cell and its types, Liquid junction potential, EMF of the cell and its determination, Standard cell, Origin of electrode potential, Single electrode potential, Nernst equation for electrode potential, Types of electrodes- hydrogen electrode, Calomel electrode and glass electrode, Numericals. (5 hours)


Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Ionic product of water, hydrolysis, hydrolysis of salts of four types, hydrolysis constant, relation between $K_h$, $K_a/K_b$ and $K_w$, degree of hydrolysis, Common ion effect, solubility product and its applications. Numericals. (4 hours)


Thermochemistry - Hess’s law and its applications. Limitations of first law.


Chemical Kinetics:

Rate of a reaction, order and molecularity of a reaction, rate law, integrated rate equation and half-life (first and second order reaction), energy of activation, theories of reaction rate- collision theory and transition state theory. Numericals (4 hours)


Covalent bond: Covalent bond formation, valence bond theory, Molecular orbital theory & their application to diatomic molecules, Concept of resonance, Valence shell electron pair repulsion concept (VSEPR), Properties of covalent bond.


Secondary bonding: Hydrogen bond: Conditions of formation & types of hydrogen bonding with illustrative examples. Vander Waals forces. (10 hours)

Organic reactions and mechanisms: Classification of organic compounds, IUPAC system of Nomenclature, Organic reactions and their Mechanisms- Homolytic and heterolytic
fission, carbonium ions, carbanions, carbon free radicals, substitution reactions, addition reactions, elimination reactions, rearrangement reactions, Isomerism - structural and stereoisomerism. (8 hours)

TEXT/REFERENCES:


CHEMISTRY LAB

31. Acid-base titration (Acidimetric/Alkalimeter)
32. Determination of hardness of water
33. Determination of chloride content of water
34. Determination of percentage of copper in brass
35. Determination of percentage of nitrogen ammonia in fertilizer
36. Determination of rate constant of hydrolysis of ethyl acetate
37. Colorimetric determination of copper
38. Conductometric titration of a mixture of strong & weak acids vs strong base
39. Determination of pKa value of a weak acid using pH meter
40. Redox titration using potentiometer

ENGINEERING GRAPHICS –II

IME 121 0-0-3-1

Software: AutoCAD

INTRODUCTION: Importance of sectioning the object, Development of surfaces of solids, Isometric projection, Orthographic projection and its practical applications. (3 hours)

SECTIONS OF SOLIDS: Introduction, Horizontal vertical and inclined section planes and true shape of sections. Drawing sectional views with true shape of section. Simple cases of solids resting on HP or VP with axis perpendicular to reference planes, inclined to one reference plane. Section plane perpendicular to VP, inclined to HP and inclined to VP. (9 hours)

DEVELOPMENT OF SURFACES: Parallel line development for prisms (Triangle, Rectangle, Square, Pentagon and Hexagon) and cylinders (Including simple cut solids), Radial line development for pyramids (Triangle, Square, Rectangle, Pentagon and Hexagon) and cones (Including simple cut solids). (9 hours)

ISOMETRIC PROJECTIONS AND VIEWS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)
ORTHOGRAPHIC CONVERSIONS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/REFERENCES:


ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

IEE 121

Review of DC circuit analysis, network reduction techniques. (2 hours)

Single-phase AC Circuits: Alternating voltages and currents, generation of single phase alternating voltage, average value and RMS value of periodic sinusoidal and non-sinusoidal wave forms, form factor. (3 hours)

Representation of time-varying quantities as Phasors; j Operator; Representation of Phasor in polar, rectangular and exponential forms. (2 hours)

Basic AC circuits: sinusoidal alternating current in a pure resistor, pure inductor and a pure capacitor, waveforms of voltage, current, and power, Phasor diagram, inductive and capacitive reactances.

Steady-state analysis of RL, RC, and RLC series circuits: concept of impedance and Phasor diagram, expression for average power, power factor. Parallel AC circuits: admittance, conductance, susceptance. Analysis of series parallel circuits, Phasor diagrams, active power, reactive power and apparent power, complex power, power triangle, improvement of power factor. (9 hours)

Three-phase AC Circuits: Generation of 3-phase balanced sinusoidal voltages, waveform of 3-phase voltages, phase sequence, star and delta connections, line voltage and phase voltage, line current and phase current, analysis of 3-phase circuit with star/delta connected balanced and unbalanced loads, Phasor diagram of voltages and currents, power measurement by two-wattmeter method with unbalanced and balanced loads. (6 hours)

Electrical Power System: Power system components, Overview of Electrical Machines. (2 hours)

Semiconductor Diode and its applications: I-V Characteristic, Static and dynamic Resistance, Half and Full Wave Rectifiers with and without filter, Zener regulator, 78XX regulator, Special purpose diodes. (9 hours)

BJT and its applications: I-V Characteristics, Cut-off, active and saturation mode of operation, CB, CC and CE configuration, Transistor Biasing: fixed and voltage divider bias. Transistor as
an amplifier: RC coupled Amplifier, Transistor as a Switch: Relay Driver Circuit. (9 hours)


TEXT / REFERENCES:
- Kothari D. P. & Nagarath I. J., Basic Electrical Engineering, TMH 2013
- Nagasarkar T. K. & Sukhija M. S., Basic Electrical Engineering, OUP 2012
- Hughes E., Electrical and Electronic Technology (9e), Pearson Education, 2008

LOGIC DESIGN

IEC 121 3-1-0-4

Number systems and Codes: Number systems - Binary, Octal & Hexadecimal systems, inter-conversions, addition and complement form subtraction.
Codes: BCD, EXCESS-3 codes, Gray codes, error detection and correction codes (Parity & Hamming code); BCD arithmetic. (6 hours)

Introduction to logic circuits: Digital logic gates, Universal gates, De Morgan’s theorem, Boolean postulates and theorems, Simplification of Boolean expressions and Implementation of Boolean functions using logic gates.
Minimization methods: Simplification in SOP & POS forms, Karnaugh map (up to 5 variables), VEM, Quine McCluskey method. Implementation using basic gates. (7 hours)

Combinational circuit design: Analysis and synthesis of Combinational circuits: Arithmetic circuits (Half adder, Full adder, half subtractor, Full subtractor, BCD adder, Adder/Subtractor using 2’s complement), Code converters, Magnitude comparators, Multiplexers & De-multiplexers, Encoders & Decoders. (12 hours)

Digital system design using PLDs: Types of PLDs, Merits and demerits of PLDs, Implementation of Boolean Functions using PLD’s (PAL, PLA & PROM). (4 hours)

Synchronous sequential circuit design: Comparison between combinational and sequential circuits, Latches, flip flops (SR, D, JK, and T flip-flops), Master-slave Flip-flops. Counters (ripple and synchronous), Ring & Johnson counters, Shift registers.
Design and analysis of synchronous sequential circuits: serial binary adder, sequence generators and sequence detector. (12 hours)
Introduction to HDL: HDL introduction, types, merits and demerits; Behavioral, Data flow and Structural modelling for combinational and sequential circuits using VHDL. (7 hours)

TEXT/ REFERENCES:


III SEMESTER

MATHEMATICS III

Differential equations - basic concepts and definitions, solution of exact equations, evaluation of integrating factors, solution of first order linear differential equations, Bernoulli’s equation, solution by inspection, application of first order differential equations. (6 hours)

Some simple numerical methods for solutions of first order equations: Taylor series method, Euler’s method, modified Euler’s method, Runge-Kutta methods of order two and four. (6 hours)


Introduction to Laplace transforms, transforms of elementary functions, periodic functions, Step functions, Dirac Delta functions, inverse transforms, convolution theorem, and solution of initial value problems by Laplace transforms method. (12 hours)

Complex variables - Analytic functions, Cauchy - Riemann equations, Harmonic functions, Line integrals, Cauchy's integral theorem, Cauchy's integral formulae, Laurent series, Residue calculus. (12 hours)

Partial differential equations - basic concepts, solutions of simple partial differential equations, method of separation of variables and indicated transforms to solve partial differential equations. (4 hours)

TEXT / REFERENCES:

ANALOG ELECTRONIC CIRCUITS

Bipolar transistor: Structure of Bipolar Transistor, Operation of Bipolar Transistor in Active Mode: Collector Current, Base and Emitter Currents, Bipolar Transistor Models and Characteristics: Large-Signal Model, Small-Signal Model, Early Effect, operation of Bipolar Transistor in Saturation Mode

(6 hours)


(6 hours)

MOS Transistor: Structure and operation of MOSFET, I-V Characteristics, Channel-Length Modulation, Trans conductance, MOS Device Models: Large-Signal and Small-Signal Model, PMOS Transistor, Comparison of Bipolar and MOS.

(8 hours)

MOS Amplifier: Amplifier Topologies, Biasing, Realization of Current Sources, Common-Source Stage: CS Core, CS Stage with Current-Source Load, CS Stage with Diode Connected Load, CS Stage with Degeneration, CS Core with Biasing, Common-Gate Stage: CG Stage with Biasing, Source Follower: Source Follower Core, Source Follower with Biasing.

(8 hours)


(6 hours)


(6 hours)

Oscillators: General Considerations, Heartley and Colpitts Oscillator, Phase Shift Oscillator, Ring Oscillator.

(4 hours)

Power Amplifier: General Considerations, Different Classes of Power amplifiers, Class A amplifier, Class B amplifier and Class AB amplifier, Power efficiency of all Classes.

(4 hours)

TEXT / REFERENCES:
ELECTROMAGNETIC THEORY

IEC 233  3–1–0–4

Review of Vector analysis: Review of basic vector algebra, Cartesian, cylindrical and spherical co-ordinate systems. (4 hours)

Electrostatics: Coulomb's law and its applications, Electric field intensity and Electrostatic potential due to point charges, line charge, surface charge and volume charge distribution. Electric flux and electric flux density, Gauss's law and its applications, divergence and Gauss divergence theorem, Ohm's law, continuity equations and relaxation time, capacitance, energy and energy density in electrostatic fields, boundary conditions: dielectric-dielectric, dielectric-conductor. Poisson's and Laplace's equations, solution to Laplace's equation (problems of one dimension). (14 hours)

Magnetostatics: Magnetic field intensity, Biot-Savart's law, magnetic flux and magnetic flux density, Ampere's law and its applications, Stoke's theorem, scalar and vector magnetic potentials, boundary conditions, magnetic dipole, Faraday's laws of electromagnetic induction, motional induction in a conductor, torque on a conductor, self and mutual inductance, energy and energy density in a magnetic field. (10 hours)

Electromagnetic Waves: Maxwell's equations in integral and point form for free space and material media, for sinusoidal time-varying fields, electric and magnetic wave equations and their solutions, uniform plane wave propagation in various media, relation between electric and magnetic fields, characteristics of plane waves in various media, Poynting vector and complex Poynting vector theorem. (10 hours)

Reflection of Electromagnetic Waves: Normal incidence of plane waves from dielectric-dielectric and dielectric-conductor medium, Transmission and reflection coefficients and standing wave ratio, oblique incidence of plane waves, Brewster's angle, total reflection. (10 hours)

TEXT / REFERENCES:

NETWORK ANALYSIS

IEE 231  3–1–0–4

Network Equations: Nodal and Loop analysis of networks for AC and DC excitation, Analysis of Coupled Circuits using loop analysis. (4 hours)

Network Theorems: Superposition, Reciprocity, Thevenin’s, Norton’s and Maximum Power Transfer theorems. (7 hours)
Initial and Final conditions in networks: Behavior of circuit elements under switching condition and their representation. Evaluation of initial and final conditions in RL, RC and RLC circuits for DC and AC excitations.  

First order and Second order differential equations: General and particular solutions of RL, RC and RLC circuits for DC and AC excitation.


Linear wave shaping: Response of RC circuits to step, pulse, square wave and ramp input.

Network Functions for one port and two port network: Driving point functions, transfer functions.

Two port network: Open circuit impedance parameters, Short circuit admittance parameters, Transmission parameters, Hybrid parameters, Relationship between two port parameters, parallel connection of two port networks, Series connection of two port networks, Cascade connection of two port networks.

**TEXT / REFERENCES:**


**MICROCONTROLLERS**

**IEE 234 4– 1– 0 – 4**

Introduction to microprocessors and microcontrollers, Evolution of microprocessors and microcontrollers, Embedded system and general purpose systems, CISC and RISC architecture, Princeton and Vonneuman architecture.

The 8051 architecture, On chip features, Registers, Assembly language programming, 8051 instruction set, addressing modes, Programming using 8051 instruction set.

Pin diagram of 8051 microcontroller, signal description, oscillator and Reset circuit, I/O ports.

Timer/ Counter: Programming 8051 timers, counter programming. Serial communication: Basics of serial communication, RS232 serial communication standard, programming the 8051 serial port for data transmission and reception.

Interrupts: 8051 interrupts, programming timer interrupts, programming external hardware interrupts, programming the serial communication, interrupt priority.

System design using 8051: Interfacing keyboards, seven segment LED display, LCD display, ADC, DAC and stepper motor to 8051.

Programming 8051 in ‘C’, programming examples (including interfacing exercises).
Interfacing external memory to 8051, I/O expansion using PPI, 8255, Interfacing 8255 to 8051 and programming. (5 hours)
Development tools: Simulators, debuggers, assembler and compilers, linkers, in circuit emulators for microcontrollers. (6 hours)

**TEXT / REFERENCES:**

- Ajay. V. Deshmukh, Microcontrollers theory and applications, TMH, 2007

**DIGITAL ELECTRONICS LABORATORY**

**IEC 232**

Study of logic gates: Introduction to Logic gates.
Simplification of Boolean expressions and implementation using logic gates.
Universal logic.
Study of code converters: Odd/even Parity generator/checker, Binary to Gray code converter
BCD to XS-3 code converter
Design and testing of Combinational circuits: Half & Full adder/subtractor, BCD adder,
Binary parallel adder/subtractor.
Design and testing of Sequential Circuits: Latches, Flip-flops, Ripple counters,
Synchronous Counters, Ring & Johnson Counters, Shift registers
Serial adder, Sequence generator and Sequence detector
HDL Programming for combinational and sequential circuits.

**TEXT / REFERENCES:**

- K. A. Krishnamurthy, Digital Lab Primer, Pearson Education.

**CIRCUIT SIMULATION LABORATORY**

**IEE 232**

1. Circuit Simulation using MATLAB/ SIMULINK:
MATLAB basics
Steady-state analysis of circuits: Solution of algebraic equation.
Transient analysis of circuits: Solution of system equations using ODE solvers.
Introduction to SIMULINK.
Introduction to GUIDE.

2. Circuit Simulation using PSPICE
   Introduction to PSPICE
   Steady state analysis of DC circuits, single & three-phase AC circuits, and coupled circuits.
   Transient analysis of DC & AC circuits.
   Frequency response of circuits
   Analysis of simple diode circuits.
   Analysis of BJT & FET circuits.

TEXT / REFERENCES:

- www.mathworks.com
- Rashid M.H, Spice for Circuits and Electronics using PSPICE, PHI, 2004
- Conant Roger., Engineering Circuit Analysis with Pspice and Probe, MGH, 1993

IV SEMESTER

ENGINEERING ECONOMICS & MANAGEMENT

IHS 241 3-1-0-4


Time value of money: Time value of money, interest factors for discrete compounding, nominal & effective interest rates, present and future worth of single, uniform, gradient cash flow.

Economic analysis of alternatives: Bases for comparison of alternatives, present worth amount, capitalized equivalent amount, annual equivalent amount, future worth amount, capital recovery with return, rate of return method, incremental approach for economic analysis of alternatives, replacement analysis.

Break-even and minimum cost analysis: Break even analysis for single product and multi product firms, break even analysis for evaluation of investment alternatives, minimum cost analysis.

Depreciation: Physical & functional depreciation, methods of depreciation - straight line, declining balance, sum-of-the-years digits, sinking fund and service output methods.
Financial management: Nature and objectives, scope and functions. Sources of long term finance - Characteristics of equity capital, preference capital, debenture capital & term loans. (2 hours)

Valuation of securities: Concept of valuation, bond valuation and bond valuation models, bond value theorems, yield to maturity, equity valuation; dividend capitalization approach, ratio approach. (4 hours)

Financial statement analysis: Balance sheet and profit & loss statement, meaning & contents, ratio analysis, financial ratios such as liquidity ratios, leverage ratios, turn over ratios, and profitability ratios, time series analysis, common size analysis, DuPont analysis, drawbacks of financial statement analysis. (5 hours)

MANAGEMENT: Introduction: Definition of management and systems approach, nature & scope. Functions of managers. Corporate social responsibility. (4 hours)

Planning: Types of plans, steps in planning, process of MBO, how to set objectives, strategies, policies & planning premises. Strategic planning process and tools. (6 hours)

Organizing: Nature & purpose of organising, span of management, factors determining the span, basic departmentation, line & staff concepts, functional authority, art of delegation, decentralisation of authority. (6 hours)

Staffing: HR planning, recruitment, development and training. (4 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (6 hours)

Basic control process, Critical control points & standards, Control techniques: Budgets, non-budgetary control devices. Overall & preventive controls: Budget summaries: Profit & loss control, control through ROI, direct, preventive control. (2 hours)

TEXT / REFERENCES:

IC SYSTEMS

IEC 241 3-1-0–4
Differential amplifier: Analysis of emitter coupled differential amplifier, Characteristics of differential amplifier using small signal model, Determination of CMRR, Methods improving CMRR using constant current source. (4 hours)

Operational amplifier: Block diagram of an operational amplifier, Ideal and practical characteristics of Operational amplifier, Inverting and non-inverting amplifiers, Offset voltages
and currents, Balancing of operational amplifier, Measurement of input and output impedance, CMRR, Slew rate.  

Linear applications of operational amplifier: Sign changer, scale changer, Phase shifter, summing amplifier, Integrator, Differentiator, V to I converters and I to V converters, Instrumentation amplifiers, Bridge amplifiers, Active filters, higher order LPF, HPF, BPF, BEF, All pass filter, Narrow Band pass filter. (5 hours)

Non-linear applications of Operational amplifier: Precision AC/DC converters, Peak detectors, Sample and hold circuit, Log and Antilog amplifiers, Analog multipliers and dividers. Comparators, Applications of comparators: Zero crossing detector, Schmitt trigger, Square wave and triangular wave generators, Pulse generators. (10 hours)

Data Acquisition: Binary weighted register DAC, R-2R ladder network DAC, Flash type ADC, counter type ADC, Successive approximation ADC, and Dual slope integrating ADC. (10 hours)

Timers: Basic Timer circuit, Timer IC 555 used as astable and mono-stable (negative edge triggered) multi-vibrator, Schmitt trigger. (5 hours)

Phase locked loops: Principle of operation of PLL, VCO IC 566 and PLL IC 565, and Applications of PLL as frequency multiplier. (5 hours)

Voltage regulators: Study of series voltage regulator with pre regulator and short circuit protection circuits, Analysis and design of linear series voltage regulators using IC’S 78XX and 79XX series, LM317, LM337, 723 IC’S. (4 hours)

TEXT / REFERENCES:


**SIGNALS AND SIGNAL PROCESSING**

**IEE 241**

**3-1-0-4**

Introduction to Signals and Systems: Definitions of signals and systems, classification of signals, basic operations on signals, elementary signals and functions, systems viewed as interconnections of operations, properties of systems. (8 hours)

Time domain representations for linear time-invariant (LTI) systems: Introduction, convolution: Impulse response representation for LTI systems, properties of the impulse response representation for LTI systems. Block diagram representations. (8 hours)

Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier transform representations for periodic signals, Sampling Theorem, Reconstruction of continuous-time signals from samples. (4 hours)

Z-Transform: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform (Using Partial fraction method), Transform analysis of LTI systems. (8 hours)

Frequency Response of Analog Filters: Frequency response of an LTI system, Butterworth filters, Chebyshev filters (Qualitative discussion). (2 hours)

Digital Filters: Relation between DTFT and Z-transform, Discrete Fourier Transform (DFT), N-point DFT computation. Introduction to digital filters: Finite impulse response (FIR) and infinite impulse response (IIR) filters, Ideal frequency responses of frequency selective filters. (6 hours)

TEXT / REFERENCES:


ELECTIVE – I - VLSI DESIGN

IEC 243 3- 1 -0 –4

Introduction: VLSI technology trends, performance measures and Moore’s law. (2 hours)

MOS devices and Circuits: MOS transistors study of depletion and enhancement mode operations, threshold voltage and numericals, second order effects in MOSFETs, analysis of NMOS and CMOS inverter circuits. (6 hours)

Fabrication of ICs: Lithographic process of MOS and CMOS fabrication, N-well, P-well and twin tub processes, Latch up in CMOS SOI process, VLSI yield and economics. (6 hours)

MOS Circuit design & Layouts: Pass transistors and transmission gates. Implementation of Boolean functions and combinational circuits using switch logic & gate logic. BiCMOS inverters and circuits, pseudo NMOS inverter, dynamic and clocked CMOS inverters. clocking strategies, flip flops and sequential circuits, dynamic memory elements, R/2 register stages. static and dynamic memory cells. RAM, ROM, PLA circuits for both combinational and sequential circuits. Stick diagrams, design rules and layouts for NMOS and CMOS, scaling of MOS circuits. (20 hours)

Basic circuit concepts and performance estimation: Sheet resistance, standard unit of capacitance, estimation of delay in NMOS and CMOS inverters, driving of large capacitive loads, super buffers, power dissipation in CMOS. (8 hours)

Sub system design: Design strategies, design issues and structured approach, design examples such as adders, ALUs and shifters, design of sequential circuits using dynamic memory elements. (8 hours)

Advanced Devices: Nano CMOS Technology, GaAs transistors. (4 hours)

TEXT / REFERENCES:
• Amar Mukherjee, “Introduction to NMOS & CMOS VLSI systems Design”, Prentice Hall.

ELECTIVE – I - POWER SYSTEM ANALYSIS

IEE 243  
3- 1 -0 –4

Introduction, General layout of a power system, conventional ways of generating electric power.

Representation of power systems: One line diagram, impedance diagram, Thevenin's model, three-winding transformers. Admittance & impedance model for power systems & network calculation.  
(10 hours)

(8 hours)

Asymmetrical faults: Symmetrical components, sequence impedances and sequence networks of power systems, analysis of unsymmetrical faults in generators and power systems under no-load and loaded conditions.  
(13 hours)

Load flow studies-Load flow equations, solution by Gauss-Siedel and Newton-Raphson methods.  
(5 hours)

Stability studies: Steady-state and transient-state stability, swing equation, Equal area criterion, Numerical solution of Swing equation, critical clearing time.  
(10 hours)

Introduction to distributed generation systems.  
(2 hours)

TEXT / REFERENCES:

• Grainger & Stevenson, Power System Analysis, TMH 2003
• Hadi Saadat, Power System Analysis, MGH, 1999.
• Khan B. H., Non-conventional Energy Resources, TMH, 2006

ELECTIVE – II - DIGITAL SYSTEM DESIGN USING VERILOG

IEC 244  
3- 1 -0 –4

(6 hours)

(10 hours)
Digital Testing and Testability: Fault models, path sensitization and D algorithms, Boolean difference, PODEM, ITG, DFT methods: Ad-hoc and scan path. (10 hours)


System level design using Verilog: System level design of real-world examples using Verilog such as seven segment LED displays, ALU and UART. (4 hours)

TEXT / REFERENCES:

- Parag K. Lala, Fault tolerant and Fault testable hardware design, BS Publication, 1990.
- M. J. S. Smith, Application Specific ICs, Pearson 1997.

ELECTIVE – II - ELECTRICAL MACHINES

IEE 244 3-1-0-4

D.C. Machines: Construction, principle of generator and motor, emf equation, types, characteristics; torque equation, speed control, starter, testing. (8 hours)
Transformers: types, principle, equivalent circuit, O.C and S.C. tests, losses, efficiency and regulation, All-day efficiency, polarity test, Parallel operation, tap changers, Auto-transformer; Connection of single phase transformers for three phase operation. (10 hours)
Three phase induction motors: types, principle, equivalent circuit, no-load and blocked rotor tests, induction generator, starting. Speed control. (8 hours)
Synchronous machines: Constructional features, e.m.f. equation, Armature reaction: Effect of power factor on armature reaction - Non-salient pole alternator: Synchronous impedance, O.C. and S.C. characteristics - Power input & power output, voltage regulation. Synchronization: Governor characteristics, alternator connected to infinite bus, Salient pole alternator: Two reaction theory, Phasor diagram, voltage regulation, slip test power angle characteristics. (12 hours)

Synchronous motors: Principle of operation, power input and power developed, performance characteristics, V- curve, inverted V curve, synchronous condenser, methods of starting, Synchronizing power and torque, hunting, periodicity of hunting, damping. (10 hours)

TEXT / REFERENCES:

- P. S. Bimbhra, Electrical Machinery (7e), Khanna publishers, 2012
- D. P. Kothari & I. J. Nagrath, Electric Machines (4e), TMH, 2013
- Langsdorf E.H., Theory of Alternating Current Machinery (2e), TMH, 2004
LINEAR IC LABORATORY

IEC 242
0-0-3-1

1. IC voltage regulators
2. Linear applications of op-amps
3. Nonlinear applications of op-amps
4. IC 555 Timer applications
5. PLL and its applications

TEXT / REFERENCES:

MICROCONTROLLER LABORATORY

IEE 242
0-0-6-2

Assembly language Programming in 8051 using Keil software:
- Data Transfer, Block move & Branching Instructions.
- 8-Bit Arithmetic and Logical operations.
- BCD, Multibyte and other Arithmetic operations.
- Searching and Sorting.
- Counters and Code conversions.

Introduction to 8051 Microcontroller kit
Interfacing Exercises using Assembly Language Programming:
- Interrupts.
- Interfacing DAC with 8051.
- Interfacing LCD for message display and Interfacing Hex key pad to 8051.

Interfacing Exercises using High Level Language ‘C’ programming:
- Interfacing ADC with 8051.
- Interfacing Stepper Motor with 8051.

Mini project using 8051 microcontroller [Assembly / ‘C’ language.

TEXT / REFERENCES:
- Ajay. V. Deshmukh, Microcontrollers theory and applications, TMH, 2007
V SEMESTER
PROJECT WORK

IEC / EE 351

Students need to form batches with maximum four in numbers and required to identify the problem in their area of interest within their discipline of study under the supervision of a faculty (Guide) for 12 to 14 weeks. At the end, the findings need to be presented in the form of a project report for final evaluation.

VI SEMESTER
LINEAR AND DIGITAL CONTROL SYSTEMS

IEC 361

Block diagrams and signal flow graphs: Transfer function, block diagram, simplification of systems, signal flow graphs, gain formula, state diagram, transfer function of discrete data systems, zero order hold. (7 hours)
System modeling: Modeling of electrical and mechanical systems (translational & rotational), system equations, and its electrical equivalent (analogous) networks. (7 hours)
Time domain analysis: Stability, Routh-Hurwitz criterion, time response for continuous data systems, type and order of systems, steady state error for linear systems, unit step response for second order systems, root locus properties and construction. (9 hours)
Frequency domain analysis: Introduction, second order prototype system, Bode diagram, gain and phase margins, Nyquist stability criterion. (7 hours)
Compensators and controllers: Feedback and feed forward controls, proportional, integral, PI, PD and PID controllers, lead, lag and lead-lag compensators. (7 hours)
Digital control systems: Mapping between s and z plane, Jury’s test, bilinear transformation, steady state error. (3 hours)
Controllers: Z transform based control algorithms, PID controllers – direct digital controllers. (4 hours)
State space representation: Stability analysis, state transition matrix, Eigen values, controllability and observability. (4 hours)

TEXT / REFERENCES:

- Nagrath and Gopal, “Control system engineering”, 3rd edition, PHI.

MEASUREMENTS AND INSTRUMENTATION

IEE 361

Basic concepts of measurements: System configuration, problem analysis; Case Study: ECG Monitoring System; Virtual Instrumentation: Basic concepts; Introduction to LABVIEW: Basic
Features; Basic characteristics of measuring devices and instrumentation system: Static and Dynamic characteristics, Sources of Errors/Calibration. (6 hours)

Transducers: Active/Passive, Mechanical/Electrical, Basic requirements of a transducer, Classification, characteristics, selection; Electrical transducers: variable resistance transducers - strain gauges, Variable capacitance transducers, Variable inductive transducers – LVD, Hall-effect, semiconductor, Opto-electric, Piezo-electric transducers (Principle of operation, advantages and disadvantages, application. (8 hours)

Analog signal conditioning: Basic blocks – Signal isolation; filters- Noise cancellation filters – configurable universal filters; level shifters; sample and hold; Instrumentation amplifiers; modulators & demodulators; v/f and i/f converters. (4 hours)

Data conversion: Accuracy, resolution, conversion time, settling time; DAC–weighted resistor D to A converter, R-2R ladder network; ADC – Successive approximation, integrating, Flash ADC. (4 hours)

Signal transmission: Digital data transmission, classification, types of protocols, clock extraction, Multiplexing; Bus protocols – RS 232, IEEE 488, CAN bus, USB, Bluetooth, GPS, Ethernet. (6 hours)

I/O Devices: Analog displays and recorders, digital I/O devices; Measurement Displays: Electro-Mechanical Displays & Electro-Optic Displays, seven segment, dot-matrix display, LED, LCD; RECORDING: Graphical recording, Magnetic recording, Electro-optic recording; displays. (4 hours)

Oscilloscopes: Oscilloscope function, Types; Digital storage oscilloscopes; Measurements using CRO: dual mode, x-y mode, Lissajous patterns. (4 hours)

Measuring Instruments: Permanent Magnet Moving Coil, Moving Iron and Electro-dynamometer Type, Applications. (4 hours)

Measurement of Resistance, Inductance & Capacitance: AC Bridges. (4 hours)
Instrument Transformers; CT and PT. (2 hours)
Virtual Instrument: Implementation issues; Choice of Data Acquisition Cards; Case study - Digital multi-meter, Digital frequency meter, Digital Energy Meter. (2 hours)

TEXT / REFERENCES:

MEASUREMENTS AND INSTRUMENTATION LABORATORY

Design & implementation of measurement systems on microcontroller platform - Sensing power signals -Sensing ECG signal - Realisation of instruments such as volt meter, ammeter, wattmeter.
Design & Realisation of common analog signal conditioning blocks using Analog System

Design starter kit - ASLKv2010 - Study of ADC & DAC - Real time data acquisition, measurement & monitoring on Virtual instrumentation platform.
ELECTIVE – III

IEC/IEE 362 3-0-0-3

ANALOG COMMUNICATION:

Spectral analysis: Review of Fourier theory, Energy spectral density, power spectral density, auto correlation and cross correlation of energy and power signals, spectral characteristics of periodic signals. (5 hours)

Amplitude modulation: Introduction, time and frequency domain analysis, modulation index for sinusoidal AM, average power for sinusoidal AM, effective voltage and current for sinusoidal AM, single tone AM, AM by several sine waves. Generation of AM using square law modulator and switching modulator, detection of AM using square law detector and envelope detector, super-hetetrodyne receiver. (8 hours)

Double Side Band Suppressed Carrier (DSBSC) Modulation: Introduction, time and frequency domain analysis, generation using balanced modulator and ring modulator, coherent detection, Costas loop, quadrature carrier multiplexing. (4 hours)

Single Side Band (SSB) Modulation: Introduction, time and frequency domain analysis, generation using filter method and phase discrimination method, coherent detection, FDM, VSB modulation. (4 hours)

Angle modulation: Introduction to phase modulation (PM) and frequency modulation (FM), FM time and frequency domain analysis, modulation index for sinusoidal FM, average power for sinusoidal FM, single tone FM, generation of FM using direct method and indirect method, detection of FM using slope detector, zero cross detector and phase locked loop, amplitude limiters in FM, automatic frequency control (AFC), FM stereo transmitter and receiver, FM receiver, pre-emphasis and De-emphasis filters. (8 hours)

Noise: Introduction, thermal noise, shot noise, signal to noise ratio (SNR), SNR of a tandem connection, noise factor, amplifier noise in terms of F, noise factor of amplifiers in cascade, noise factor and equivalent input noise generators, noise factor of a lossy network, noise equivalent temperature, narrow band pass noise, noise in AM system, noise in AM DSBSC system, noise in SSB system, pre-emphasis and de-emphasis in FM, noise in FM system. (7 hours)

TEXT / REFERENCES:

SOLID STATE LIGHTING AND CONTROLS:

Introduction to Lighting Technology: Lighting fundamentals, terminologies, generation of radiation, CCT, CT, CRI, CIE Chromaticity diagram, Light generation principles–Incandescence & luminescence, Classification, Review of light sources-evolution. (4 hours)

Solid state lamps: SSL basics, life cycle of a photon, Photon emission in LEDs, Photon efficiency, Optical Characteristics of LED– Light Escape Cone, Lambertian pattern, methods to increase extraction efficiency, numerical. (4 hours)

White Light Generation: Characterization of LEDs for illumination application- low, medium and high Power LEDs, Techniques – Blue Chip with Phosphor, UV with several phosphor & RGB LEDs, advantages, disadvantages, challenges and color issues of white LEDs. (4 hours)

Electrical Characteristics of LEDs: V-I Characteristics, current controlled and voltage controlled source, advantages and disadvantages, current limiting techniques, Types of regulators-linear-active and passive current sources, switch mode, advantages and disadvantages. (6 hours)

LED driver design: Power management topologies (switch mode) – Buck, Boost, Buck Boost, applications, Numerical. (5 hours)

LED Dimming and control: Types-analog, digital, advantages, disadvantages, applications, Color control feedback schemes – Temperature Feed Forward, Flux Feed Back, TFF & FFB & Color Coordinate Feedback, advantages and disadvantages. (6 hours)

Thermal management of LEDs: Significance, causes, Thermal Resistance, Thermal Resistance Model with heat flow path, Factors considered for heat sink selection, heat sink design considerations, Numerical, SSL testing standards, Data sheet analysis for optimal design and product selection. (4 hours)

Remote Phosphor Technology: Construction & advantages, OLED – Principle, types, application & advantages. (3 hours)

TEXT / REFERENCES:

- Extract from Current Literature

MATLAB FOR ENGINEERING:

Introduction to MATLAB: Numeric, Cell, and Structure Arrays - Functions and Files - Decision-Making Programs - Linear Algebraic Equations- data processing and visualization- (10 hours)

Data handling & plotting: Importing & organizing data - Advanced Plotting. (4 hours)
Siumulink: System Dynamics, Model Building and Regression; curve fitting & interpolation; ODE & PDE Solvers; Simulation of linear models of mechanical and electrical systems using Simulink; data acquisition and analysis; building GUI; Converting MATLAB code to executable format. (16 hours)

Project based learning: Building interactive applications (demos & mini project). (6 hours)

**TEXT / REFERENCES:**

- www.mathworks.com

**DIGITAL SIGNAL PROCESSING:**

Z-transform and its application to the analysis of LTI systems: Review of time and frequency analysis of signals and systems. Review of Z-transform, analysis of LTI system in Z-domain, system function, pole-zero analysis, stability, unilateral Z-transform, solution of difference equations. (6 hours)

Discrete Fourier Transform: Frequency domain sampling and reconstruction of discrete time signals – DFT, properties of DFT, use of DFT in linear filtering, filtering of long data sequences, DFT as linear transformation, efficient computation of DFT. FFT algorithms, radix 2 DITFFT and DIFFFT, in-place computation, pipeline FFT, Goertzel algorithm. (8 hours)

Implementation of Discrete time filters: Structures for FIR filters – Direct form, cascade form, frequency sampling and lattice structures. Structures for IIR filters – Direct forms, cascade and parallel form, lattice ladder structures. Finite word length effects. (6 hours)

Design of IIR and FIR filters: Classical design by impulse invariance, bilinear transformation and matched Z-transform, characteristics and design of commonly used filters - Butterworth, Chebyshev and elliptic filters. Spectral transformation, direct design of IIR filters. Linear phase FIR filters - symmetric and anti-symmetric impulse response. Design of FIR filters using windows, frequency sampling design. (10 hours)

Power spectrum estimation: Effect of time domain windowing on power spectrum, non-parametric methods of PSD estimation - Periodogram, Bartlett, Welch and Blackman-Tukey methods (qualitative analysis only). Parametric methods of PSD estimation - AR, ARMA and MA modeling (qualitative analysis only). (6 hours)

**TEXT / REFERENCES:**

DIGITAL COMMUNICATION:

Signal detection: Model of digital communication system, Gram-Schmidt orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to the noisy input, detection of known signals in noise, probability of error, correlation receiver, matched filter receiver. (5 hours)

Pulse modulation systems: Pulse amplitude modulation (PAM), band width requirements and reconstruction methods, time division multiplexing, pulse duration modulation (PDM), generation of PDM signals and reconstruction methods. Sampling, quantization and encoding techniques, application to pulse code modulation (PCM), quantization noise in PCM, companding in PCM systems, Time division multiplexing (TDM) and examples of PAM and PCM systems. The T1 PCM system in telephony. The delta modulator and its operation, quantization noise and slope overload in delta modulators. Comparison of delta modulation and PCM. (8 hours)

Baseband digital data transmission: Baseband digital communication systems, multilevel coding using PAM, pulse shaping and band width consideration, inter symbol interference (ISI). Nyquist condition for zero ISI, band limited Nyquist pulses, the eye diagram. Duo binary and modified duo binary encoding, Optimum detection of a Baseband data communication systems. Performance limitation of Baseband data communication due to noise probability of error expression for multi-level data signals. (6 hours)

Digital modulation techniques: Band pass (modulated) digital data systems, binary digital modulation, PSK, DPSK, and FSK. Mary data communication systems, quadrature amplitude modulation (QAM), systems, QPSK, OQPSK, and MSK. Introduction to OFDM. Effects of noise in modulated digital communication systems, optimum binary systems. Probability of error expression for binary (coherent and non coherent) communications, probability of error in QAM systems, comparison of digital modulation systems, Application of modems for transmission over telephone lines. (10 hours)

Spread Spectrum System (SSS): PN sequences and its properties, Direct sequence SSS, frequency hopping SSS. Applications – Ranging multi path, CDMA (7 hours)

TEXT / REFERENCES:


LIGHTING SCIENCE: DEVICES AND SYSTEMS:


Photometric quantities and units: Definitions of Luminous flux, Luminous intensity, Illuminance, Luminance – Laws of illuminance: Inverse square law, Lambert’s cosine law –
Relation between photometric quantities. Luminous efficacy – Light watt – Luminous exitance – Difference between luminance and brightness – Comparison of Photometric and Radiometric quantities, Point by Point method – Horizontal illuminance – Vertical illuminance – Limitations of Point by Point method and tutorials.


Interior lighting design: Objectives – Factors affecting the performance of lighting system (Size and shape of the room, reflectance, windows, maintenance, temperature and objects in the environment), Types of lighting methods, Design Terminologies: LDL, LOR, DLOR, ULOR, UFF, LFF, FFR and Photometric test data – Zonal factor – Calculation of total luminous flux output (Zonal integration method), Define CU, CU calculation methods and Lumen method of lighting design for average illuminance – Luminaire layout – Spacing to Mounting Height ratio, design lighting layout for an various interior lighting applications, Glare – Types of glare – Direct, Indirect and Reflected glares – Veiling reflections – Methods to reduce glare and evaluation of glare, Complete energy efficient lighting solution to meet quantity and quality of illuminance as per standards.


TEXT / REFERENCES:

OBJECT ORIENTED PROGRAMMING USING C++:

Introduction: Overview of C++, sample C++ program, different data types, operators, expressions, and statements, arrays and strings, pointers & user-defined types function components, argument passing, inline functions, function overloading, recursive functions.

Classes & Objects: Class specification, class objects, scope resolution operator, access members, defining member functions, data hiding, constructors, destructors, parameterized
constructors, static data members, functions, friend functions, passing objects as arguments, returning objects, arrays of objects, dynamic objects, pointers to objects, copy constructors, applications of operator overloading using friend functions.

(8 hours)

Inheritance: Base class, inheritance and protected members, protected base class inheritance, inheriting multiple base classes, constructors, destructors and inheritance, passing parameters to base class constructors, granting access, virtual base classes.

(8 hours)

Virtual functions, polymorphism: Virtual function, calling a virtual function through a base class reference, inheritance of virtual functions, hierarchical virtual functions, pure virtual functions, abstract classes, early and late binding.

(4 hours)

I/O system basics, file I/O: C++ stream classes hierarchy, stream I/O, file streams and string streams, file operations, overloading I/O operators, error handling, formatted I/O.

(6 hours)

Exception handling: Benefits of exception handling, throwing an exception, try block, catching an exception, exception specifications, stack unwinding, re-throwing an exception, catching all exceptions.

(4 hours)

TEXT / REFERENCES:


LINEAR ALGEBRA FOR SIGNAL PROCESSING:

Linear equations: System of linear equations and its solution sets, elementary row operations and echelon forms, matrix operations, invertible matrices, LU - factorization, determinant, rank.

(7 hours)

Vector spaces: Vector spaces, subspaces, bases and dimension, coordinates, matrices as linear transformations, null space and column space, pseudo. Inverse and applications, projection operator.

(8 hours)

Eigenvalues and Eigenvectors: Characteristic equation, diagonalization, Jordan canonical form, special matrices, positive definite matrices and applications.

(7 hours)

Orthogonality and least squares: Inner product spaces, Schwarz’s inequality and applications, Gram-Schmidt process, generalized Fourier series, QR factorization, least squares and their applications.

(7 hours)

Symmetric matrices and quadratic forms: Diagonalization, quadratic forms, constrained optimization, singular value decomposition and related applications.

(7 hours)

TEXT / REFERENCES: 
ELECTIVE – V

IEC/IEE 364 3-0-0-3

OPTICAL FIBER COMMUNICATION:

Planar dielectric waveguides: Derivation and solution of Eigenvalue equation for planar symmetric dielectric waveguides, TE and TM modes, birefringence in planar dielectric waveguides, power calculations. (6 hours)

Step and graded index fibers: Derivation and graphical solution of wave equation for step index fibers with emphasis on single mode fibers, concept of V-number and its significance, power calculations, birefringence in single mode fibers, Hi-Bi fibers, application of optical fibers in communication networks. (7 hours)

Distortion of optical pulses propagating through fibers: Intermodal and intra modal (chromatic/material and waveguide) dispersion, propagation of Gaussian optical pulses through dispersive fibers, dispersion compensation mechanisms. (6 hours)

Fiber amplifiers: Concept of optical amplification, erbium doped fiber amplifier (EDFA), SOA. (5 hours)

Advanced modulation and demodulation formats for optical fiber communications: Coherent detection of ASK, FSK and PSK. Optical DQPSK, DOPSK and QAM, optical CDMA. (6 hours)

Wave propagation through anisotropic media: Concept of permittivity tensor and index ellipsoid, linear electro-optic effect (Pockel’s effect), bulk optic amplitude and intensity modulators, integrated optic amplitude and intensity modulators based on Mach-Zehnder interferometer. (6 hours)

TEXT / REFERENCES:


LIGHTING CONTROLS: TECHNOLOGY AND APPLICATIONS:
Lighting controls & Strategies: Lighting control system - Basic functions - Input/output devices
- Introduction to lighting control strategies - Occupancy Sensor - Load scheduling, Dimming
control – Energy management strategies. (3 hours)

Occupancy sensor, Load scheduling & Dimming control: Occupancy sensing techniques: PIR -
Ultrasonic, PIR + Ultrasonic – Acoustic + PIR - Energy savings from sensing techniques -
Switching and lamp life, Load scheduling control: Types – Lighting control panel – occupant
override - Stand-alone v/s Interconnected panels - Centralized & Localized control - Control
Zones and Energy Codes - Single-line riser diagram, Dimming control : Types of dimming –
Dimming control for light sources. (8 hours)

Lighting control system design: Programming the project - Energy Management and
Sustainability - Basis of design (Conceptual design) - Written controls narrative and its benefit -
Zones, Design development – Placing the controller and equipment specification. (4 hours)

Commissioning and energy codes: Benefits of commissioning – Commissioning process as per
standards - Performance testing – Equipment verification - Commissioning & LEED - Energy
codes (ASHRAE/IESNA & IECC). (3 hours)

Daylight harvesting: Introduction – Daylight v/s Sunlight – Constraints - Daylight harvesting
and LEED - Light Control Impacts these LEED Categories and Credits – Energy saving
Control techniques – Daylight harvesting systems – Control zones – Granular zoning –
photosensors - Spatial response, Dead band - Wireless sensors – Centralized and distributed
control. (3 hours)

Control signals & Protocols: Introduction - Analog control – Digital control - Standard
protocols for lighting control : DMX controller - DALI – ZigBee - ZigBee network applications
- Wireless RF lighting control - Benefits of lighting control – Basic system - Features of IEEE
802.11 - Integration with hardwired controls. (9 hours)

Energy management and building control system: Principles – Impact of lighting control on
HVAC – Power quality issues – Integrated versus separate lighting control. (2 hours)

Applications of lighting control system Design patterns to different applications: Auditoriums
- Class rooms - Conference rooms - File/storage system - Laboratories – library Reading areas -
Open & private offices. (4 hours)

TEXT / REFERENCES:
- Craig DiLouie , Advanced lighting control: Energy saving productivity, Technology and
Applications, Fairmont Press, Inc, 2004
- Extracts from current literature.

SOFT COMPUTING:

Fundamentals: Fundamentals of Artificial Neural Networks, McCulloch – Pitts model,
Activation functions, Feed forward and feedback networks, learning rules – Hebbian,
Perceptron, delta, Widrow-Hoff, winner take all. (8 hours)

Single-layer feed forward networks: Classifiers, Decision regions, Discriminant functions,
minimum distance classification. (2 hours)

Multi-layer feed forward networks: Linearly non-separable pattern classification, generalized
delta learning rule, error back propagation training algorithms. (6 hours)

Single layer feedback network: Hopfield network, associative memories, energy function, Bi-
directional associative memory. (4 hours)
Application: Application of neural networks: Control applications, A-D conversion, Character recognition. (6 hours)

Fuzzy logic: Introduction, membership function, classical sets & fuzzy sets, fuzzy set operations, Fuzzy relations, extension principles. Linguistic variables, Fuzzy IF_THEN statements, Inference rules, Defuzzification methods. (6 hours)

Application: Application of fuzzy logic to control systems using fuzzy logic tool box. Introduction to fuzzy-neural systems. (6 hours)

Genetic Algorithms: Introduction, fitness function, cross-over, mutation, application to simple problems. (2 hours)

TEXT / REFERENCES:


EMBEDDED SYSTEM DESIGN:

Introduction: Embedded systems overview (definition, salient characteristics, examples), optimizing design metrics, processor technology, IC technology, design technology, trade off. (2 hours)

Processors, Hardware & Software: Custom single purpose processors – combinational logic, sequential logic, custom single purpose processor design, optimizing the design. General purpose processors – Basic architecture, operation, programmers view, and general purpose processor design. (8 hours)

Typical embedded system: Core of the embedded system, memory, sensors & actuators, communication interface, embedded firmware and other system components. (7 hours)

Hardware and software co-design: Fundamental issues, computational models, techniques used to integrate hardware and software, design flow and development tools. (3 hours)

Operating systems: Basics, types of OS, tasks, process & threads, multiprocessing and multitasking, concurrent processes, communication among processes (shared memory and message passing), synchronization among processes, implementation, simple problems on scheduling algorithms. (7 hours)

Embedded C programming: Embedded C programming concepts, programming 8051 controller using embedded C. (7 hours)

Embedded development life cycle (EDLC): Objectives and phases of EDLC, case studies. (2 hours)

TEXT / REFERENCES:

ELECTIVE – VI

IEC/IEEE 365

CIPHER SYSTEM:

Introduction: Security goals, cryptographic attacks, services and mechanism, techniques. (2 hours)
Number theory: Time estimation, divisibility, Euclidian algorithm, divisibility, congruence, Chinese remainder theorem, Euler function, modular exponentiation. (4 hours)
Basic cryptographic techniques: Shift, linear and affine transformation, enciphering matrices (Hill cipher), Vigenere and Beaufort cipher systems. (6 hours)
Introduction to modern symmetric key cipher: Modern block cipher, stream cipher, Fiestel cipher, simplified DES, DES, block cipher influenced by DES, RC.5, Blowfish algorithm. (2 hours)
Advanced encryption standard: Algebraic structure, Galois field, AES encryption and decryption algorithm, block cipher modes. (6 hours)
Asymmetric key cipher: Knapsack problem, Merkle - Hellman, RSA, Rabin, Elgamal and elliptic curve cryptography. (6 hours)
Message integrity and message authentication: MD hash function, SHA.512, Whirlpool algorithms, digital signatures and authentication protocols. (6 hours)

TEXT / REFERENCES:


ENERGY AUDITING AND MANAGEMENT:

Energy Audit: Purpose, Scope, Types, Methodologies, Reporting, Instruments, Energy Auditor Responsibilities, Case Studies. (3 hours)

Energy Economics: Economic analysis of investments, Simple payback method, return on investment, net present value, internal rate of return, life cycle costing, energy performance contracts and role of ESCOs.

TEXT / REFERENCES:

- IEEE Std. 739-1995, “IEEE recommended practice for energy management in industrial and commercial facilities”.

DATA STRUCTURES AND ALGORITHMS:

Data Structures: Arrays; linked lists; trees; stacks; queues; graphs, data structure operations

Linked Lists: Introduction, representation of linked lists in memory, traversing a linked list, searching a linked list, memory allocation, garbage collection, Insertion into a linked list, deletion from a linked list, doubly linked list.  

Stacks: Introduction, array representation of stacks, arithmetic expressions, Polish notation, Quicksort, recursion, Tower of Hanoi Queues: Introduction, representation, priority queues, Circular queues, double ended queue.  


Sorting: Introduction, insertion sort, Selection sort, merging, merge sort, radix sort
Searching: Introduction, searching and data modification, linear search, binary search, Hashing - Hash Tables, Hash functions, Open addressing.  

Greedy Algorithms: Prim's & Kruskal's algorithms for minimum spanning trees, shortest paths, optimal tape storage, job scheduling with deadlines, Knapsack problem, Huffman Code
Divide & Conquer: General technique, maximum and minimum, Multiplying long integers, Strassen's matrix multiplication, finding the closest pair of points. Dynamic Programming: Matrix chain ordering, all pairs shortest paths, Optimal BST.

TEXT / REFERENCES:


**COMPUTER ORGANIZATION AND ARCHITECTURE:**

Introduction: Overview of architecture of typical computers, accumulator based, and general register machines and stack machines. Instruction set, instruction formats, types and addressing modes, reverse polish notation, op-code encoding techniques. (8 hours)

ALU design: Review of number system, basic ALU organization, and general register design. Combinational shifter design. Adders, CLA, CSA, multiplier design, high speed multiplier design. Booth’s and modified Booth’s algorithm, Wallace tree structure, arithmetic processors. IEEE floating point representation. (7 hours)

Memory organization: Memory hierarchies, main memory and cache memory, memory management techniques, cache mapping functions - associative and direct. Introduction to virtual memory, cache coherence protocols. (6 hours)

Input/output organization: Isolated I/O, memory mapped I/O, programmed I/O, interrupt driven I/O, DMA, data transfer methods and bus arbitration. (3 hours)

Control unit: Instruction processing and control unit, instruction cycle and processor concepts, single bus processor, multiple bus processor, hardwired control unit, micro programmed control unit. (6 hours)

Advanced concepts: Pipelining and parallel processing, instruction pipelining and pipeline hazards. RISC architecture in modern processors, performance enhancement strategies, concept of superscalar architecture, VLIW architecture, vector computing and array processing, multiprocessor systems and servers. (6 hours)

**TEXT / REFERENCES:**


**SEMINAR**

IEC / IEE 366

0-0-3-1

Students need to present a seminar on a topic of recent developments in their subject filed.
B.Sc. (MECHANICAL)

II SEMESTER

MATHEMATICS II

IMA 121 3-1-0-4

Functions with two or more variables, partial differentiation, chain rule, composite and implicit function differentiation, total differentials, error and approximation. Maxima and minima for functions of two or more variables, Lagrange’s method of undetermined multipliers. (8 hours)

Multiple integrals: double and triple integrals, change of order of integration, Jacobian of polar, cylindrical and spherical coordinate systems, change of variables, Application of multiple integrals to find area and volumes. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process. (8 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency, Inverse of invertible matrices by row operations. (6 hours)

Vectors - Vector differentiation, Divergence, Gradient and Curl and their physical interpretation and simple applications. Vector integration, Greens theorem in the plane, Gauss Divergence theorem, Stoke’s theorem and simple applications. (10 hours)

Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (2 hours)

Beta and Gamma functions & their properties. (4 hours)

TEXT/ REFERENCES:


PHYSICS – II

IPH 121 3-0-3-4

Electric Fields: Coulomb’s law, The electric field, Continuous charge distribution, Charged particles in uniform electric field. (3 hours)

Gauss’s Law: Gauss’s law and derivation, Applications to various charge distributions, Conductors in electrostatic equilibrium. (3 hours)
Electric Potential: Potential difference in uniform electric field, Potential and energy due to point charges, Electric field and potential, Continuous charge distributions, Potential due to charged conductor, Applications of electrostatics. (4 hours)

Capacitance and Dielectrics: Calculating capacitance, Combinations of capacitors, Energy in a charged capacitor, Capacitors with dielectrics, Dipole in electric field, Atomic description of dielectrics. (3 hours)

Current and Resistance: Electric current, Resistance, Electrical conduction, Resistance and temperature, Superconductors, Electrical power. (3 hours)

Direct Current Circuits: Electromotive force, Resistors in series and parallel, Kirchhoff’s rules, RC circuits, Electrical meters. (3 hours)

Magnetic Fields: Magnetic fields and forces, Magnetic force acting on a current-carrying conductor, Torque on a current loop in a uniform magnetic field, Motion of a charged particle in uniform magnetic field, Applications, Hall effect. (3 hours)

Sources of the Magnetic Field: The Biot-Savart law, The magnetic force between two parallel conductors, Ampere’s law, The magnetic field of a solenoid, Magnetic flux, Gauss’s law in magnetism, Displacement current and the general form of Ampere’s law, Magnetism in matter. (4 hours)

Faraday’s Law: Faraday’s law of induction, Motional emf, Lenz’s law, Induced emf and electric fields, Generators and motors, Eddy currents, Maxwell’s equations. (3 hours)

Inductance: Self-inductance, RL circuits, Energy in a magnetic field, mutual inductance, Oscillations in an LC circuit, The RLC circuit. (3 hours)


TEXT/ REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

PHYSICS LABORATORY:

To perform any 12 of the following experiments:

57. Field along the axis of a coil
58. Energy band gap of a semiconductor
59. Newton’s rings
60. Blackbody radiation
61. Photoelectric effect
62. Charging and discharging of a capacitor / RC time constant
63. Series and parallel resonance circuits
64. e/m – Thomson’s method
65. Fermi energy of a metal
66. Hall effect
67. Zener diode characteristics
68. Hysteresis loss in magnetic materials
69. Half wave and full wave rectifier circuits, C-filter circuit
70. Resistivity of a semiconductor by four probe method

**CHEMISTRY**

ICH 121  3–0-3-4

Electrochemistry: Introduction to electrochemical cell and its types, Liquid junction potential, EMF of the cell and its determination, Standard cell, Origin of electrode potential, Single electrode potential, Nernst equation for electrode potential, Types of electrodes- hydrogen electrode, Calomel electrode and glass electrode, Numericals. (5 hours)


Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Ionic product of water, hydrolysis, hydrolysis of salts of four types, hydrolysis constant, relation between $K_h$, $K_a/K_b$ and $K_w$, degree of hydrolysis, Common ion effect, solubility product and its applications. Numericals. (4 hours)


Thermochemistry - Hess’s law and its applications. Limitations of first law.


Chemical Kinetics:
Rate of a reaction, order and molecularity of a reaction, rate law, integrated rate equation and half-life (first and second order reaction), energy of activation, theories of reaction rates- collision theory and transition state theory. Numericals (4hours)


Covalent bond: Covalent bond formation, valence bond theory, Molecular orbital theory & their application to diatomic molecules, Concept of resonance, Valence shell electron pair repulsion concept (VSEPR), Properties of covalent bond.


Secondary bonding: Hydrogen bond: Conditions of formation & types of hydrogen bonding with illustrative examples. Vander Waals forces (10 hours)

Organic reactions and mechanisms: Classification of organic compounds, IUPAC system of Nomenclature, Organic reactions and their Mechanisms- Homolytic and heterolytic
fission, carbonium ions, carbanions, carbon free radicals, substitution reactions, addition reactions, elimination reactions, rearrangement reactions, Isomerism - structural and stereoisomerism. (8hours)

TEXT/ REFERENCES:


CHEMISTRY LAB

41. Acid-base titration (Acidimetric/Alkalimeter)
42. Determination of hardness of water
43. Determination of chloride content of water
44. Determination of percentage of copper in brass
45. Determination of percentage of nitrogen ammonia in fertilizer
46. Determination of rate constant of hydrolysis of ethyl acetate
47. Colorimetric determination of copper
48. Conductometric titration of a Mixture of strong & weak acids vs strong base
49. Determination of pKa value of a weak acid using pH meter
50. Redox titration using potentiometer

ENGINEERING GRAPHICS –II

IME 121

Software: AutoCAD

INTRODUCTION: Importance of sectioning the object, Development of surfaces of solids, Isometric projection, Orthographic projection and its practical applications. (3 hours)

SECTIONS OF SOLIDS: Introduction, Horizontal vertical and inclined section planes and true shape of sections. Drawing sectional views with true shape of section. Simple cases of solids resting on HP or VP with axis perpendicular to reference planes, inclined to one reference plane. Section plane perpendicular to VP, inclined to HP and inclined to VP. (9 hours)

DEVELOPMENT OF SURFACES: Parallel line development for prisms (Triangle, Rectangle, Square, Pentagon and Hexagon) and cylinders (Including simple cut solids), Radial line development for pyramids (Triangle, Square, Rectangle, Pentagon and Hexagon) and cones (Including simple cut solids). (9 hours)

ISOMETRIC PROJECTIONS AND VIEWS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)
ORTHOGRAPHIC CONVERSIONS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/REFERENCES:


**BASIC MECHANICAL ENGINEERING**

IME 122 3-1-0-4

Properties of Steam and Boilers: Steam formation, Types of steam, Steam properties- Enthalpy, Simple numericals for finding enthalpy and dryness fraction. (5 hours)

Steam Boilers: Classification, Working principle of Babcock & Wilcox Boiler, Lancashire, locomotive boiler, boiler mountings, accessories (4 hours)

Prime Movers: Classification of Prime movers, Working principle of steam, gas and water turbines, Concept of impulse and reaction steam turbines, compounding. (5 hours)

Power plants: Introduction, Working principle of thermal, nuclear, hydel and solar power plants. (4 hours)

Refrigeration: Principle and working of vapour compression refrigeration system, Desirable properties of an ideal refrigerant, Definition of COP, Unit of refrigeration. (2 hours)

I.C. Engines: Classification, Working of 2-stroke, 4-stroke C.I and S.I Engines with P-V diagrams, Definitions and simple numericals for determining Indicated Power, Brake Power, Mechanical efficiency, Indicated thermal efficiency, and Brake thermal efficiency, Working of simple carburetor, Types and properties of lubricants, Splash lubrication system. (8 hours)

Power Transmission: Definition, Belt drives- open and crossed , Velocity ratio, Stepped cone pulley, Fast and loose pulley, Length of belt, Tension in the belt, Slip, Creep (No derivations), Introduction to rope drive and chain drives, Gear Drives-Types of gears, Velocity ratio for Gear trains, Simple and compound gear trains, Numericals on belt and gear drives. (8 hours)

Machine Tools: Lathe -Classification, Block diagram of engine lathe, Specification of lathe, List of lathe operations. Drilling- Classification of drilling machines, Block diagram of radial drilling machine, List of drilling operations. (5 hours)

Casting and Forging: Types of moulding sand and its desirable properties, Patterns- Single piece and split piece pattern, Pattern allowances, Steps in the preparation of two box green sand mould, Defects in casting, Introduction to forging. (3 hours)

Welding: Classification, Principle of Resistance spot welding, Electric arc welding and oxy-acetylene gas welding, Gas flames, Introduction to soldering and brazing. (2 hours)

Introduction to Engineering Materials: Ferrous and Non-ferrous metals and its properties, Introduction to heat treatment. (2 hours)
TEXT/ REFERENCES:


STRENGTH OF MATERIALS

IME 123

3-1-0-4

Stress, Strain and Deformation of Solids: Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads. (10 hours)

Beams - Loads and Stresses:Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow. (10 hours)

Torsion:Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts. (8 hours)


Analysis of stresses in two dimensions: Biaxial state of stresses – Thick & Thin cylindrical shells and spherical shells – Deformation in thick & thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr’s circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion. (10 hours)

TEXT/ REFERENCES:

III SEMESTER

MATHEMATICS III

IMA 231 3-1-0-4

Differential equations - basic concepts and definitions, solution of exact equations, evaluation of integrating factors, solution of first order linear differential equations, Bernoulli’s equation, solution by inspection, application of first order differential equations. (6 hours)

Some simple numerical methods for solutions of first order equations: Taylor series method, Euler’s method, modified Euler’s method, Runge-Kutta methods of order two and four. (6 hours)


Introduction to Laplace transforms, transforms of elementary functions, periodic functions, Step functions, Dirac Delta functions, inverse transforms, convolution theorem, and solution of initial value problems by Laplace transforms method. (12 hours)

Complex variables - Analytic functions, Cauchy - Riemann equations, Harmonic functions, Line integrals, Cauchy's integral theorem, Cauchy's integral formulae, Laurent series, Residue calculus. (12 hours)

Partial differential equations - basic concepts, solutions of simple partial differential equations, method of separation of variables and indicated transforms to solve partial differential equations. (4 hours)

TEXT / REFERENCES:

Basic concepts: Macroscopic and Microscopic approach, Basic definitions-thermodynamic system, state, process, cycle, intensive and extensive properties, thermodynamic equilibrium, quasi-static process, irreversible process, Zeroth Law, path and point function. (3 hours)

Work and heat transfer: Thermodynamic definition of work, Displacement work (pdv work), pdv work for various processes, Heat transfer- a path function. (3 hours)

First law of thermodynamics: First Law for a non-flow system undergoing a cyclic and non-cyclic process, numericals, Energy- a property of a system, PMM1, Steady flow energy Equation (SFEE) for simple devices-numericals. (6 hours)

Second law of thermodynamics and Entropy: Need for second law, cyclic heat engines, reversed heat engines, Kelvin-Planck and Clausius statements, PMM2, Carnot cycle, Carnot theorem, concept of entropy, Clausius inequality, entropy change non-flow processes, numericals. (8 hours)


Reciprocating air compressors: Single stage- work of compression, Effect of clearance, Volumetric efficiency, need for multi-stage compression, intercooling, minimum work of compression- simple numericals. (5 hours)

Refrigeration: Principles of refrigeration, Properties of refrigerants, Air refrigeration - numericals, Vapour compression and Vapour absorption types, Coefficient of performance. (4 hours)

Elements of heat transfer: Conduction in plane, cylindrical and composite wall, electrical network analogy, Conduction with convective boundary, Numericals, Convection heat transfer-definition, mechanism, Nusselt number, Fundamentals of radiation heat transfer, Black body concept, Grey body, emissivity, Kirchoff's law, Stephen- Boltzmann law. (6 hours)

Performance testing of IC engines: Measurement of BP, IP, FP, various efficiencies, heat balance sheet and performance characteristics. Numericals. (3 hours)

TEXT / REFERENCES:

Foundry: Moulding, Types of moulding, Moulding materials, Moulding sand, Composition of moulding sand. Sand Testing - Permeability test, Strength test, Moisture content test, Clay content test, Grain fineness test. (5 hours)

Casting: Types of casting- Investment casting, Permanent mould casting, Slush casting, Pressure die casting (Hot chamber & Cold chamber), Centrifugal casting and Continuous casting, Advantages & limitations of casting process. (5 hours)

Welding: Classification of welding processes, Metal arc welding, Consumable and non-consumable arc welding process, Submerged arc welding, Atomic-hydrogen welding, TIG, MIG, Electro-slag, Resistance welding - Spot, Seam, Projection. Special type of welding - Thermite welding, Friction welding, Explosive welding, Electron beam welding, Laser beam welding, Advantages, limitations and applications of welding. (6 hours)

Mechanical working of metals: Cold, Warm, Hot working. Sheet metal forming- Shearing, Shearing operations – Punching, Blanking, Embossing, Coining, Lancing, Slitting, Bending, Bulging, Curling and Roll forming. (4 hours)

Theory of metal cutting: Orthogonal and oblique cutting, Cutting parameters like cutting speed, feed, depth of cut and their selection criteria, Machinability parameters, Tool life and wear. Merchant’s analysis, Taylor’s equation, Factors affecting tool life. Simple problems on shear plane angle, Cutting force and tool life calculation. (5 hours)

Lathe: Constructional features, Classification of lathe, Accessories and attachments of lathe, Back gear arrangement, Lathe operations, Speed, feed and depth of cut. Calculations of machining time. (5 hours)

Drilling: Classification, Construction and specification of Radial drilling machine, Types of drill bits, Elements of a twist drill, Computation of drilling time. (3 hours)

Milling: Types of milling machines, Column and Knee type milling machine, Attachments, Milling operations, Plain milling cutters, Simple and compound indexing, Machining time calculations. (5 hours)

Shaping and Planing: Shaper- Working principle & operations. Planer - Comparison between shaper and planer, Double housing planer, Operations. (3 hours)

Grinding: Grinding wheel – Abrasive particles, Bonding materials, Designation and selection, Dressing and truing. Classification of grinding machines, Constructional features and principles of cylindrical, surface and centreless grinding machines. (4 hours)

Rapid prototyping: Basic process, Working principle of Fused deposition modeling, Stereo lithography, Selective laser sintering, Applications, advantages and limitations of rapid prototyping. (3 hours)

TEXT / REFERENCES:

MATERIAL SCIENCE AND METALLURGY

IME 233

Introduction: Need, purpose and importance of the subject, Crystal structures (Cubic and HCP structures), Computation of packing factor of cubic and HCP structure, Co-ordination number, Miller indices, Crystal imperfections-point & Line defects. (5 hours)

Solidification: Meaning, Degree of super cooling, Homogeneous and Heterogeneous nucleation, Mechanism of solidification – Nucleation and Crystal growth, Dendritic growth. (3 hours)

Phases in solids: Phases-Single phase and multiphase, Gibb’s phase rule, Solid solutions and Types, Intermediate phases, Equilibrium diagrams(only binary) – Construction and Explanation of Isomorphous and Eutectic systems, Equilibrium and Non-equilibrium cooling, Invariant reactions (Euctectic, Peritectic and Eutectoid), Lever rule and its application on Isomorphous and Eutectic systems, Equilibrium and Non-equilibrium cooling of an alloy and congruent melting alloy phase. (9 hours)

Iron-Carbon systems: Introduction- allotropy and Polymorphism, Cooling curve for pure iron, Fe-C equilibrium diagrams, Study of iron-carbon system in detail with emphasis on the invariant reactions. (6 hours)

Heat treatment: Principle and Objectives of heat treatments, Isothermal transformation diagram- Construction and Explanation, Factors affecting shape and Position of isothermal transformation diagram, Continuous cooling curves on isothermal transformation diagram, Processes like annealing, Normalizing, Hardening, Tempering and Case hardening with heat treatment cycle, Jominy hardness test. (9 hours)

Ferrous-alloys: Composition, Properties and Applications of alloy steels (plain carbon steels, stainless steels, free machining steels, HSS and Maraging steels, Cast irons-grey, White and Malleable cast irons. Non-ferrous alloys - Types and Explanation of brasses, Bronzes and Al-Cu alloys. (4 hours)

TEXT / REFERENCES:

- Clark Donald S., Physical metallurgy for engineers, 1962
Properties of fluids: Mass density, specific weight, relative density, specific volume, coefficient of dynamic viscosity, kinematic viscosity, Newtonian and Non-Newtonian fluids, ideal and real fluids, surface tension, capillarity, vapor pressure, bulk modulus and compressibility. (4 hours)

Fluid statics: Intensity of pressure, Pascal’s law, pressure variation in static fluid, pressure measurement by manometers. (4 hours)

Hydrostatic forces on surfaces: Resultant hydrostatic force and centre of pressure on horizontal, vertical, inclined and curved plane surface submerged in a liquid. (4 hours)

Buoyancy: Equilibrium of floating bodies, Metacenter and Metacentric height, determination of metacentric height (Experimental and Analytical). Stability of floating and submerged bodies. (4 hours)

Kinematics of fluid flow: Methods of describing the fluid motion, path line, stream line, streak line and stream tube. Types of flow, Continuity equation for one and three dimensional flow, fluid velocity and acceleration. (4 hours)

Dynamics of fluid flow: Energy possessed by fluid, Euler’s equation of motion along a stream line and reducing it to Bernoulli’s equation, Impulse momentum equation. (4 hours)

Dimensional analysis: Fundamental and derived units of dimensions, dimensional homogeneity, Rayleigh’s method and Buckingham’s Pi-theorem, similitude, types of similarity, significance of dimensionless numbers. (4 hours)

Fluid flow measurements: Venturi meter, Orifice, Orifice meter, Pitot tube and V-notch and Rectangular notch. (4 hours)

Viscous Flow: Reynolds experiment, Reynolds Number, critical Reynolds number laminar flow through circular pipe (Hagen Poiseuille’s equation), laminar flow between fixed parallel plates. (4 hours)

Flow through pipes: Major loss and Minor losses in pipe flow, Darcy and Chezy equation, Siphon, Hydraulic gradient and Total energy line. (4 hours)

TEXT / REFERENCES:

control piston slap, Piston rings, Connecting rod, Crank shaft, Valves and valve operating mechanisms, Valve timing diagram. (6 hours)

Fuel supply system: Fuel pumps for petrol and diesel engines, Mixture strength requirements for SI engine, Defects of a simple carburetor and their remedies, Types of carburetors, Constant choke and constant vacuum carburetors. Fuel injector and Multi Point Fuel Injection system. (3 hours)

Ignition, Cooling and Lubrication systems: Battery ignition system, ignition advance methods, Comparison between battery and magnetic ignition system, starting system – Bendix drive, Generator. Methods of engine cooling, Air cooling, Water cooling, Thermosyphon cooling, Forced cooling, Thermostatic cooling. Objectives of Lubrication, Types of lubrication systems, Splash lubrication, Full pressure lubrication, Semi-Pressure lubrication, Crankcase ventilation. (3 hours)

Clutch and Gear box: Clutches- Purpose and requirements, Single plate clutch, Multi-plate clutch, Centrifugal and semi centrifugal disc clutch, Fluid flywheel. Gear box - Purpose, Constant mesh gear box, Synchronesh gear box, Epicyclic (Automatic) gear box and torque converter. Overdrive mechanism, Calculation for torque transmitted by single plate clutch and multi-plate clutch, Power for propulsion of the vehicles, Road resistance and tractive effort, Relation between vehicle speed and gear ratio. (7 hours)

Drive to wheels and Tyres: Torque reaction, Driving thrust, Braking torque, Hotchkiss drive, Torque tube drive, Universal joint, Constant Velocity joint, Propeller shaft, Differential gear box, Types of rear axle. Tyres - Desirable tyre properties, tube and tubeless tyres. (5 hours)

Steering system: Steering geometry, Camber, Castor, Toe-In and Toe-Out, Steering mechanism: Davis and Ackerman steering gear mechanism, Steering linkages for rigid axle and independent suspension systems. Numerical problems related to conditions for pure rolling, Turning circle radius, Centre point steering and semi centre point steering. (6 hours)

Suspension system: Requirements of a good suspension systems, Effect of pitching, rolling and yawing, Types of suspension: Leaf springs, Coil spring, Rubber springs and Torsion bar. Independent front and rear suspension, Telescopic shock absorber. (3 hours)

Brakes: Braking requirements, Brake efficiency and stopping distance, Fading of brakes, Types of brakes: Drum and Disc brakes, Mechanical brakes, Hydraulic brakes, Servo brakes, Air brakes, Balance beam compensator, Antilock braking system, Numerical related to brake torque and minimum stopping distance with front Wheel, rear wheel and four wheel braking, Weight transfer and heat dissipation. (3 hours)

TEXT / REFERENCES:

COMPUTER AIDED MECHANICAL DRAWING

IME 236


3D part modeling, assembly and sectional/explored views using AutoCAD 3D: Vertical stuffing box, Simple eccentric, Drill jig, Square tool post, Non-return valve, Screw jack, Swivel bearing, Strap type connecting rod end, Machine vice.

Mini project: Projects on drafting, part modeling, assembly and sectional/explored views in mechanical engineering applications.

TEXT / REFERENCES:

STRENGTH OF MATERIALS LAB [0 0 3 1]

IME 237

List of Experiments:
1. Tension test on mild steel
2. Compression test on cast iron
3. Hardness tests - Rockwell, Brinell, Vicker’s
4. Charpy impact test
5. Izod test on mild steel
6. Shear test on mild steel
7. Torsion test on mild steel
8. Fatigue test on mild steel
9. Test on leaf and helical spring
10. Bending and Compression test on wood
11. Microstructure study of metals
12. Heat treatment of steel

TEXT / REFERENCES:
• Technical Teacher’s Training Institute, Laboratory Manual of Strength of Materials, Oxford University Press, 1983.

IV SEMESTER

ENGINEERING ECONOMICS & MANAGEMENT

IHS 241 3-1-0-4


(1 hour)

Time value of money: Time value of money, interest factors for discrete compounding, nominal & effective interest rates, present and future worth of single, uniform, gradient cash flow.

(4 hours)

Economic analysis of alternatives: Bases for comparison of alternatives, present worth amount, capitalized equivalent amount, annual equivalent amount, future worth amount, capital recovery with return, rate of return method, incremental approach for economic analysis of alternatives, replacement analysis.

(4 hours)

Break-even and minimum cost analysis: Break even analysis for single product and multi product firms, break even analysis for evaluation of investment alternatives, minimum cost analysis.

(2 hours)

Depreciation: Physical & functional depreciation, methods of depreciation - straight line, declining balance, sum-of-the-years digits, sinking fund and service output methods.

(2 hours)


(2 hours)

Valuation of securities: Concept of valuation, bond valuation and bond valuation models, bond value theorems, yield to maturity, equity valuation; dividend capitalization approach, ratio approach.

(4 hours)

Financial statement analysis: Balance sheet and profit & loss statement, meaning & contents, ratio analysis, financial ratios such as liquidity ratios, leverage ratios, turn over ratios, and profitability ratios, time series analysis, common size analysis, DuPont analysis, drawbacks of financial statement analysis.

(5 hours)


(4 hours)

Planning: Types of plans, steps in planning, process of MBO, how to set objectives, strategies, policies & planning premises. Strategic planning process and tools.

(6 hours)

Organizing: Nature & purpose of organising, span of management, factors determining the span, basic departmentation, line & staff concepts, functional authority, art of delegation, decentralisation of authority.

(6 hours)
Staffing: HR planning, recruitment, development and training. (4 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (6 hours)

Basic control process, Critical control points & standards, Control techniques: Budgets, non-budgetary control devices. Overall & preventive controls: Budget summaries: Profit & loss control, control through ROI, direct, preventive control. (2 hours)

TEXT / REFERENCES:


THEORY OF MACHINES

IME 241

Basic concepts: Mechanism and machine, Kinematic pair, link, chain and inversions, constrained and unconstrained motion, four bar mechanism, single and double slider crank mechanisms with inversions, quick return mechanism, toggle mechanism, Oldham Coupling, Hooke's coupling. (9 hours)

Velocity and Acceleration: Velocity - Relative velocity of coincident points on separate links, Determination of velocity in mechanisms by relative velocity method. Instantaneous Centres - Definitions, Three-centres-in-line theorem and its application to locate number of instantaneous centres, determination of velocity by instantaneous centre method. Acceleration - Determination of acceleration in mechanism by relative acceleration method. (9 hours)

Cams and Balancing: Types of Cams, types of followers, Cam profiles, graphical methods for simple harmonic motion and uniform acceleration and retardation, radial and oscillating followers. Balancing of rotating masses in single plane and different planes (Graphical Method). (10 hours)

Toothed gearing: Law of gearing, Spur Gears - Definitions, Terminology, cycloidal and involute teeth, path of contact, arc of contact, minimum number of teeth on the pinion to avoid interference, Terminology of helical and bevel gears. (8 hours)

Gear trains: Simple, Compound, Reverted and Epicyclic gear trains. (Tabular method). Torque calculations, Automobile differential mechanism. (5 hours)

Belts and rope drives: length of belts, effect of Slip and belt thickness, velocity ratio, ratio of tensions, power transmitted, centrifugal tension and its effect on power transmitted, condition for maximum power transmission by a flat belt. (4 hours)

Vibrations: Definitions, Types- longitudinal, transverse, torsional. Displacement, velocity and acceleration. Undamped free vibration of spring-mass system. (3 hours)
TEXT / REFERENCES:

DESIGN OF MACHINE ELEMENTS

IME 242

Introduction: Materials and their properties - Ductile and brittle fracture, Strain energy, Resilience, Toughness, Hardness, Creep, Hertz contact stresses, Material specification. Strength concepts - Principal stresses, Theories of failure, Factor of safety, Strength under combined axial, bending & torsional loads, Stress concentration. (7 hours)

Fatigue: S-N diagram, Low cycle and high cycle fatigue, Endurance limit, Variables affecting fatigue strength, Fluctuating stresses, Goodman & Soderberg equations, Modified Goodman diagram, Stresses due to combined loading. (5 hours)

Shafts and Keys: ASME code for design of transmission shafts, Mises Hencky theory for transmission shafting, Stress concentration, Design of shafts subjected to bending in two planes in addition to axial loads. Keys: Types of keys, Stress in keys, Design of square, rectangular, taper keys and splines. (10 hours)

Threaded fasteners: Stresses in bolts, Effect of initial tension, Bolts subjected to various eccentric loading conditions. (3 hours)

Power screws: Stresses in power screw, Efficiency of power screw, Force & torque requirement to lift load in power screw jack. (3 hours)

Springs: Types of springs, Helical coil springs (compression or extension springs of round/square/ rectangular wires). Spring materials, Stress & deflection of springs subjected to steady, Fluctuating & impact loads, Energy stored in springs, Critical frequency, Concentric springs. (6 hours)

Spur and Helical gears: Nomenclature, Stresses in gear teeth, involute gears, Lewis equation for beam strength of tooth, form factor & velocity factor. Design for static, dynamic and wear load. (8 hours)

Bearings: Construction, application, design, merits and demerits of journal bearings. Rolling Contact Bearing - types, capacity of bearings, bearing life, equivalent bearing load and bearing selection. (6 hours)

TEXT / REFERENCES:
INTERNAL COMBUSTION ENGINES

IME 243

3-0-0-3


(4 hours)


(4 hours)


(9 hours)

Combustion chamber designs for SI and CI engines: Different combustion chamber designs in SI engines, DI and IDI Combustion chambers in CI engines.

(3 hours)

Engine pollutant formation and control: Introduction to pollution, Nitrogen Oxides, kinetics of NO\textsubscript{X} formation in SI engine and CI engine. CO emission, UBHC emission, flame quenching, HC emission from SI and CI engines. Particulate emissions, soot formation, oxidation and adsorption and condensation.

(8 hours)

Emission control methods and modern developments: Exhaust and non-exhaust emissions: Exhaust emission control methods- thermal reactors, catalytic converters and particulate traps, chemical methods like ammonia injection. EGR technique, Non- exhaust emissions - evaporative emissions and crank case emissions and its control. Wankel engine, Stratified charge engine.

(8 hours)

TEXT / REFERENCES:


Measurement of pressure: Definition of Pressure. List of instruments used to measure pressure. Methods of pressure measurement - Elastic pressure elements (Bourdon Tube, Bellows, Diaphragm), McLeod Gauge and Bridgman gauge, Related problems. (4 hours)

Measurement of temperature: Methods of temperature measurement Pressure thermometer, Electrical Resistance thermometer, Thermocouples, Pyrometer (Disappearing filament type optical pyrometer) & Problems, Bimetallic thermometer. (3 hours)

Measurement of strain: Types of electrical resistance strain gauges, Theory of operation of wire wound strain gauge, Gauge Factor, Strain gauge bridge circuit, Calibration Circuit, Temperature compensation, Strain measurement on static and rotary shaft, Orientation of strain gauges. Simple problems related to measurement of strain using strain gauge. (5 hours)


Limits, Fits and Tolerances: Terminology (as per Indian Standards IS 919), Grades of Tolerances, Letter symbols for tolerances, Fits – definition, Types of fits – Clearance, Interference and Transition. Simple numerical on limits and fit. (3 hours)

Gauges: Taylor’s principle for design of gauges – Statements and explanation, Gauge Maker’s tolerance – as per 3rd system (present British standards), Numerical on design of gauges (complete shaft and hole pair) , Types of gauges – Plug gauge, Ring gauge, Taper plug gauge, Taper Ring gauge and slip gauges. (3 hours)

Measurement of form errors: Straightness measurement– using straight edge, using Autocollimator. Squareness measurement – Engineer’s Square tester, Optical Square. Simple numerical on Straightness, Flatness and Squareness measurement. (4 hours)

Surface texture measurement: Definitions - I, II, III, IV order (including their causes), Roughness and Waviness, lays, Indian standards symbols for Roughness, Analysis of traces – Ra, Rz, Rt, Rq, Sampling length, hrms and Centerline Average (CLA), Simple numerical on surface roughness. (4 hours)

Screw threads: Definitions of elements of external screw threads, Pitch error in threads: Progressive and Periodic, Measurement of the elements of the threads – Effective diameter using screw thread micrometer, two wire and three wire methods, Best size wire, Simple numerical on screw threads. (4 hours)

Note: One tutorial class/week is reserved for conducting the mini project. The students must complete their mini project in 12 hours (out of 48 hours) and submit the report which will earn 1 credit.
FLUID MECHANICS LABORATORY

IME 245

List of Experiments:

1. Measurement of flow using Venturi meter
2. Measurement of flow using Orifice meter
3. Calibration of V notch and Rectangular notch
4. Calibration of Orifice
5. Measurement of force due to impact of jet on vanes
6. Determination of friction factor of pipes
7. Performance test on Hydraulic ram
8. Performance test on single stage and two stage Centrifugal pump
9. Performance test on Reciprocating pump
10. Performance test on Gear pump
11. Performance test on Impulse turbine
12. Performance test on Impulse - reaction turbine

TEXT / REFERENCES:


WORKSHOP PRACTICE

IME 246

List of Exercises:

1. Preparation of models using welding techniques.
2. Exercises on turning
3. Gear cutting
4. Shaping and grinding operations
5. Machining using CNC Turning Center and Vertical Machining Center.
TEXT / REFERENCES:

THERMAL ENGINEERING LABORATORY

IME 247

List of Experiments:

1. Determination of viscosity of oil using viscometers
2. Determination of flash and fire point of oil using open cup and closed cup apparatus
3. Determination of lower calorific value of gaseous fuel using Boy’s Gas Calorimeter
4. Determination of dryness fraction of steam using separating and throttling calorimeter
5. Performance test on single cylinder, low speed, 4 stroke, vertical diesel engine
6. Performance test on single cylinder, low speed, 4 stroke, vertical petrol engine
7. Measurement of area using Planimeter
8. Performance test on two stage Air Compressor
9. Performance test on rotary Air Blower
10. Performance test on MPFI engine
11. Morse test on a multi cylinder petrol engine
12. Performance test on Refrigeration plant and Air Conditioning plant

TEXT / REFERENCES:

V SEMESTER

PROJECT WORK

IME 351

Students need to form batches with maximum four in numbers and required to identify the problem in their area of interest within their discipline of study under the supervision of a faculty (Guide) for 12 to 14 weeks. At the end, the findings need to be presented in the form of a project report for final evaluation.
VI SEMESTER
PRODUCTION AND OPERATIONS MANAGEMENT
IME 361 3-1-0-4

Introduction: Introduction to production and operations management, Types of production systems- continuous, job order and custom work, Production consumption cycle, Functions of production and operations management. Organization aspects, Centralized and decentralized production planning. (5 hours)

Plant location: Factors affecting plant location, Qualitative methods of location, Quantitative methods of location- Load distance method and Centre of gravity analysis. (3 hours)

Product development and design: Factors affecting product development and design, Product analysis, Economic analysis, Standardization, Simplification and Specialization, Preferred numbers, Product life cycle, Process analysis, Use of outline process chart, flow process chart and activity charts. Production master programs. (6 hours)

Capacity planning: Design capacity, System Capacity and System Efficiency, Factors affecting system capacity, Steps in capacity planning, Determination of equipment and manpower requirements, Decision tree analysis for capacity planning, Break-even analysis in capacity planning, single and multi-product P-V charts. (5 hours)

Forecasting: Importance and uses of forecasting, Type of forecasts, Qualitative methods of forecasting - Historical estimate, Sale force estimate, Market Research and Delphi methods, Quantitative methods of forecasting – Simple and Weighted moving averages, Exponential smoothing, Linear regression analysis, Correlation analysis and Seasonality, Forecast control - Measures of forecast accuracy. (8 hours)

Aggregate planning: Pure and mixed strategies of aggregate planning, Aggregate planning using trial and error approach. (4 hours)

Job shop scheduling: Meaning and importance, Factors affecting job shop scheduling, Index method, Priority sequencing rules such as FCFS, SPT, EDD and Critical Ratio, Determination of mean flow time, average job lateness and average number of jobs in the system, Sequencing of ‘n’ jobs through 2 machines, ‘n’ jobs through 3 machines and 2 jobs through ‘n’ machines. (6 hours)

Inventory management: Introduction, Classification of inventories, Economic order quantity, Inventory control models – EOQ determination with instantaneous delivery and finite delivery and with or without shortages, Effect of quantity discount, Safety stock, Reorder level, lead time, ABC Analysis. (8 hours)

MRP: Introduction, Product structure tree, MRP inputs & outputs, MRP logic, Problems. (3 hours)

TEXT / REFERENCES:
HEAT TRANSFER
IME 362 3-1-3-5

Introduction: Modes of heat transfer, governing laws and its derivatives, concept of driving potential, thermal resistance and conductance, combined mechanism of heat transfer, overall heat transfer coefficient, initial and boundary conditions. (4 hours)

Steady state conduction: General heat conduction equation in Cartesian coordinates, thermal diffusivity, heat conduction through plane and composite walls, thermal contact resistance, radial heat flow through cylinder and composite cylinders, critical thickness of insulation, radial heat flow through sphere and composite spheres, log mean and geometric mean area, plane, cylinder and sphere with uniform rate of internal heat generation, effect of variable thermal conductivity. Heat transfer from extended surfaces: General energy equation for the fin, heat transfer from fin of uniform cross section heated at one end and both ends, efficiency and effectiveness, error in thermometry. (15 hours)

Convection heat transfer: Introduction, application of dimensional analysis to free and forced convection, dimensionless numbers and their physical significance, characteristic length, boundary layer concept, hydrodynamic and thermal boundary layer in external and internal flow, empirical correlations for forced and free convection. (6 hours)

Boiling and condensation: Fundamentals of boiling heat transfer, boiling regimes, correlations for boiling, film and drop-wise condensation, Nusselt theory, heat transfer in condensation. (4 hours)

Heat exchangers: Types of heat exchangers, fouling factor, overall heat transfer coefficient, analysis of parallel and counter flow heat exchanger – LMTD and NTU method, LMTD correction factor, heat transfer in evaporators and condensers. (6 hours)

Radiation: Thermal radiation, absorption, reflection and transmission of radiation, black body, Stefan-Boltzmann, Kirchoff’s, Planck’s and Wien’s displacement Laws, radiation intensity and total emissive power, Heat transfer between black surfaces and between gray surfaces, radiation shields, electrical analogy of solving radiation problems (only between two bodies/surfaces). (9 hours)

Transient conduction: Introduction, lumped parameter analysis, Biot and Fourier number, time constant and response of temperature measuring instruments. (4 hours)

TEXT / REFERENCES:

HEAT TRANSFER LABORATORY:

List of Experiments:
1. Heat transfer through free convection
2. Heat transfer through forced convection
3. Heat transfer through pin fin.
4. Heat transfer through composite wall and cylinder
5. Thermal conductivity of insulating powder and metals
6. Analysis of parallel and counter flow heat exchanger
7. Analysis of shell & tube heat exchanger
8. Measurement of emissivity
9. Calibration of thermocouples
10. Determination of Stephen Boltzman constant

TEXT / REFERENCES:

ELECTIVE – I

IME 363 3-0-0-3

AUTOMATIC CONTROL ENGINEERING:

Concepts: Simple open and closed loop systems, concept of feedback, block diagrams, transfer functions. Representation of Control Components and Systems Representation, differential equations for mechanical systems, electrical systems, hydraulic systems and thermal systems, Integrating devices, hydraulic servomotor, temperature control system, speed control system, Liquid level Control System, and Flow Control System, Block representation of system elements, example of the use of block diagrams, Block diagram Reduction. (5 hours)

System responses: Damping ratio and natural frequency, First order and second order system response to step input, Ramp input and sinusoidal input, response of a system to external disturbance. Modes of control, characteristics of proportional control, integral control, derivative control, proportional plus derivation control and two position control. System type numbers and steady-state error, System stability criteria, Routh criteria, system types. (6 hours)

Frequency response: Polar and rectangular plots for the frequency response, graphical view point, experimental determination of frequency response, System analysis using polar plots (Nyquist criterion). (5 hours)

System analysis using logarithmic plots: Bode diagrams: Stability analysis using Bode diagrams, simplified Bode diagrams. (5 hours)

System analysis using root locus plots: Root Locus plots for simple transfer functions, graphical relationships setting the system gain, system transient response, system frequency response. (5 hours)
System compensation: Series and feedback compensation physical devices for system compensation. (4 hours)

Digital computer control: Concepts and control configurations, An example of direct digital control, Difference Differential equations. (3 hours)

State space analysis of control systems: Analysis of systems, Concept of state, state variable and state model, state model of linear systems, Eigen Values, Transfer function derivation from the state model, Solution of time invariant state equation. (3 hours)

TEXT / REFERENCES:


SUPPLY CHAIN AND LOGISTICS MANAGEMENT:

Introduction: Introduction to supply chain, Objective of a supply chain, Importance of supply chain decisions, Decision phases in a supply chain, Process view of a supply chain, Examples of a supply chain. (3 hours)

E Business: Role of distribution in the supply chain, Factors influencing distribution network design, Design options for a distribution network, Indian agricultural produce distribution channels, Distribution networks in practice. (6 hours)

Network design: Role of network design in supply chain, Factors influencing network design decisions, framework of network design decisions, Models for facility location and capacity allocations, Role of IT in network design, Making network design decisions in practice. (6 hours)

Transportation: Role of transportation in supply chain, Modes of transportation and their performances, Transportation infrastructures and policies, Design options for a transportation network, Trade-offs in transportation design, Tailored Transportation, Role of IT in transportation, Risk management in transportation, Making transportation decisions in practice. (5 hours)

Sourcing decisions: Role of sourcing in supply chain, In-house outsource, Third and fourth party logistics providers, Supply scoring and assessment, Supplier selection – auctions and negotiations, Contracts and supply chain performance, Design collaborations, procurement process, Sourcing planning and analysis, Role of IT in sourcing, Risk management in Sourcing, Making sourcing decisions in practice. (8 hours)

Pricing and revenue management :Role of pricing and revenue management in supply chain, Pricing and revenue management for multiple customer segments, pricing and revenue management for perishable assets, Pricing and revenue management for seasonal demand,
pricing and Revenue management for bulk and spot contracts, Role of IT in pricing and revenue management, Using pricing and Revenue management in practice. (5 hours)

Information Technology: Role of IT in supply chain, Customer relationship management, Internal supply chain management, Supplier relationship management, Transaction management foundation, Future IT in supply chain, Risk management in IT, Supply chain IT in practice. (3 hours)

**TEXT / REFERENCES:**


**ELECTIVE – II**

**IME 364**

**ELEMENTS OF MECHATRONICS SYSTEMS:**

Introduction: Definition, basic concepts and elements of mechatronic systems, needs and benefits of mechatronics in manufacturing. (3 hours)


Drives and Actuators: Solenoids, relays, DC motors, Servo motor, BLDC Motosr, AC Motors, stepper motors, Piezoelectric actuators, Shape memory alloys. Hydraulic & Pneumatic devices – Power supplies, valves, cylinder sequencing. (7 hours)

Data acquisition and translation and presentation systems: Signal conditioning – Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, Multiplexer, Counters, decoders, ADC, DAC. Display-LED, LCD, Printers, Magnetic Recording. (8 hours)

Controllers and Algorithms: Microprocessor – Fundamentals, architecture of 8085, programming of 8085, Microcontrollers, Programmable Logic Controllers (PLC). (7 hours)

Applications: NC/CNC machines, robots, automatic camera, temperature monitoring system, engine management system, washing machine. (3 hours)

**TEXT / REFERENCES:**

NON - CONVENTIONAL ENERGY SOURCES:

Introduction: Energy-different forms of energy, Energy sources, Need for renewable energy sources, India’s production and reserves of Commercial energy sources and potential of Renewable energy resources, Benefits and limitations. (3 hours)

Solar energy and radiation: Solar air heaters, Cooking, Drying, Distillation, Space heating, Refrigeration, Power generation-low, medium and high temperature cycle. Solar radiation - Solar constant, Solar radiation at the earth’s surface, Measurement of solar radiation, solar radiation geometry (Basic earth sun angles and derived solar angles), Empirical equations for predicting the availability of solar radiation, solar radiations on tilted surface, Numerical examples. (5 hours)

Liquid flat-plate collectors: Principles of the conversion of solar radiation into heat, Description of flat plate collector, Performance analysis, Transmissivity of cover systems, Transmissivity-absorptivity product, Overall loss coefficient , One dimensional analysis, Collector efficiency factor and Heat removal factor, Numerical examples, Effects of various parameters on performance testing. (5 hours)

Wind energy: Principles of wind power, Total power, maximum power (Betz theory), Actual power, Types of windmill, Wind turbine operation, Forces on the blades and thrust on turbines, Numerical examples, Site selection, Advantages and limitations. (5 hours)

Ocean energy: Wave energy, energy and power from the wave. Wave energy conversion by floats - Oscillating float air pump and Buoy-Dolphin type, Numerical examples, Advantages and limitations. Tidal energy, Tidal energy conversion by single pool system and two pool system, Numerical examples, Advantages and limitations. Principle of OTEC, Open cycle, closed cycle and hybrid cycle systems, Advantages and limitations. (4 hours)


Biomass energy: Types of biomass, Biogas production from organic waste by an aerobic fermentation – three stages of production, Influencing factors for the generation of biogas, Types of biogas plants – floating gas holder plant, Fixed dome plant, Community biogas plant, Numericals on cow-dung digester (Design is not involved), Ethanol production – from wood by acid hydrolysis and from sugar cane, Thermo-chemical method of bio-conversion-combustion-updraft gasifier and down draft gasifier, pyrolysis method. (5 hours)

Direct energy conversion: Conversion of thermal energy into electricity – Thermo-electric converters, Thermo- ionic converters, numerical examples, Conversion of chemical energy into electricity-Fuel Cells, H2-O2 acidic fuel cell, Conversion of electromagnetic energy into electricity-Working principle of solar cells, MHD generators, Types of MHD converters, related numerical examples. (5 hours)

TEXT / REFERENCES:

HEAT TREATMENT OF METALS AND ALLOYS:


Age hardening and thermo-mechanical treatments: Controlled rolling, Ausforming, Isoforming, Marstraining, Cryoforming, Thermomechanical annealing, Thermomechanical treatment of non-ferrous alloys.

Steel specification, classification and heat treatment of Steels and Cast iron: IS and AISI classification of steel, Heat treatment and Application of plain carbon steels, Commercial steels, high speed steels, Stainless steels, Maraging steels, Spring, Valve, Bearing and HSLA steels, Cast iron and Heat treatment- Grey, White cast irons, Malleable iron, Malleableization of white cast iron, Spheroidal graphite (SG) iron.


TEXT / REFERENCES:

- Bolton W., Engineering materials technology, Heinmann Newness, New Delhi, 2001

POWER PLANT ENGINEERING:

Introduction: Choice of site for power station, load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor, effect of variable load on power plant, selection of the numbers and size of units, Economics of power generation.

Hydro-Electric plants: Storage and pondage, flow duration and mass curves, hydrographs, low, medium and high head plants, pumped storage plants, penstock, water hammer, surge tanks,

(7 hours)

Boiler accessories and chimneys: Generation of steam using forced circulation, high and supercritical pressures. A brief account of La Mont, Benson, Velox, Schmidt and Loeffler. Natural, forced, induced and balanced draft. Calculations involving height of chimney to produce a given draft. Accessories for the steam generator such as superheaters, desuperheaters, control of superheaters. Economisers, Air Pre-heaters and re-heaters. Cooling towers and ponds: Different types.

(7 hours)

Diesel and Gas turbine plant: Engines for Power generation: General arrangement of Diesel Power Plant, Fuel storage and supply system, Cooling and lubrication system, Filters, centrifuges, oil heaters, Intake and exhaust system, Supercharger, Methods of starting the diesel engine, Layout of a diesel power plant. Gas Turbine Power Plant: Advantages and disadvantages of the gas turbine plant. Open and closed cycle turbine plants with its accessories.

(6 hours)


(6 hours)

TEXT / REFERENCES:

- Frederick.T.Morse, Power Plant Engineering, East West Press.
- R.K .Rajput, Power Plant Engineering, Laxmi Publication (P) Ltd, 2010

ELECTIVE – IV

IME 366 3-0-0-3

OPERATIONS RESEARCH:


(3 hours)


(11 hours)

optimal solutions, Degeneracy and Unbalanced problems. Post optimality analysis. (3 hours)

Assignment problem: Solution algorithm for Assignment Problem. Unbalanced, multiple optimal solutions, Maximization and Application problems. (3 hours)

Travelling salesman/Job sequencing problem: Solution algorithm for Travelling Salesman Problem, Application to job sequencing problem (3 hours)

Game theory: Introduction to game theory, Two-person-zero sum games, Pure and Mixed Strategies, Solution methods for 2 x 2 games, Graphical method (2 x n games; m x 2 games), approximate method, Formulation as a L.P.P. (3 hours)

Queuing theory: Introduction to queuing theory, Poisson arrival rate and Exponential service times, System characteristics, Problems on the models- (M/M/1):(∞/FIFO), (M/M/1) : (N/FIFO), Simulation of queuing models - Steps in simulation, Application and Limitations, Monte- Carlo technique-Problems involving Waiting line situations and Selection of crew members. (3 hours)

Critical Path Method (CPM): General frame work, Introduction to elements of network, conventions adapted in drawing network, Analysing the network. Calculation of event and Activity times, Total Float, Free Float, Independent float, Critical path, Determination of project duration, Project Crashing. Applications and Limitations of CPM. (3 hours)

Project Evaluation and Review Technique (PERT): Calculation of Probabilistic/Expected event and Activity times, Variance of activity duration, Determination of critical path, probability/expectation of project completion. (3 hours)

**TEXT / REFERENCES:**

- Vohra N. D., Quantitative Techniques in Management, New Delhi, 2007.
- Kanthiswaroop, Gupta and Manmohan, Operations Research, Sultan Chand and Sons.

**ORGANIZATIONAL BEHAVIOR:**

Introduction: Definition of Organization Behaviour (OB), Contributing disciplines to OB, Basic OB Model. (3 hours)

Learning: Definition, Theories of learning: Classical & Operant Conditioning), Methods of shaping behaviour: Positive and Negative reinforcement, Schedule of reinforcement. (3 hours)

Values, attitudes and job satisfaction: Values: Definition, Types of values, Values across cultures. Attitudes: Definition, Components of attitudes, Sources of attitudes, and Types of attitudes: Job Satisfaction, Job involvement and Organizational commitment Determinants of Job satisfaction. (4 hours)

Personality: Determinants of Personality, Personality theories (MBTI and Big Five Model), Major personality attributes: Locus of Control, Machiavellianism, Self- Esteem, Self-Monitoring and Risk Taking. (4 hours)

Perception: Definition, Factors influencing perception, Attribution Theory, Selective perception, Halo effect, Contrast effect, Stereo-typing. (4 hours)
Basic motivation concepts: Definition, Maslow's hierarchy of needs, Theory X and Theory Y, Frederick Herzberg's Motivation and Hygiene Theory, Contemporary Theories: ERG, Davis McCleland theory of needs, Vroom's Expectancy theory, The Job Characteristic Model, Job Rotation, Job Enlargement and Job Enrichment. (4 hours)

Group dynamics: Group: Definition, Classification of groups, Stages of group development, Group Behaviour Model. (4 hours)
Leadership: Definition, Quality of a good leader, types and theories of leadership. (3 hours)

Conflict: Definition, Functional Vs Dysfunctional Conflict, Conflict Process, Dimensions of Conflict Handling Intentions. (3 hours)
Organizational change and Organizational development: Organizational Change: Forces for change, Resistance to Change, Lewin's Three-Step Model and Action research, Organizational Development (OD). (5 hours)

TEXT / REFERENCES:
- Moorhead Gregory and Griffin Ricky W., Organizational Behaviour, AITBS, New Delhi, 1999.

SEMINAR
IME 367 0-0-3-1

Students need to present a seminar on a topic of recent developments in their subject filed.
B.Sc. (MECHATRONICS)

II SEMESTER

MATHEMATICS II

IMA 121

Functions with two or more variables, partial differentiation, chain rule, composite and implicit function differentiation, total differentials, error and approximation. Maxima and minima for functions of two or more variables, Lagrange’s method of undetermined multipliers. (8 hours)

Multiple integrals: double and triple integrals, change of order of integration, Jacobian of polar, cylindrical and spherical coordinate systems, change of variables, Application of multiple integrals to find area and volumes. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process. (8 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency, Inverse of invertible matrices by row operations. (6 hours)

Vectors - Vector differentiation, Divergence, Gradient and Curl and their physical interpretation and simple applications. Vector integration, Greens theorem in the plane, Gauss Divergence theorem, Stoke’s theorem and simple applications. (10 hours)

Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (2 hours)

Beta and Gamma functions & their properties. (4 hours)

TEXT/ REFERENCES:


PHYSICS – II

IPH 121

Electric Fields: Coulomb’s law, The electric field, Continuous charge distribution, Charged particles in uniform electric field. (3 hours)

Gauss’s Law: Gauss’s law and derivation, Applications to various charge distributions, Conductors in electrostatic equilibrium. (3 hours)
Electric Potential: Potential difference in uniform electric field, Potential and energy due to point charges, Electric field and potential, Continuous charge distributions, Potential due to charged conductor, Applications of electrostatics. (4 hours)

Capacitance and Dielectrics: Calculating capacitance, Combinations of capacitors, Energy in a charged capacitor, Capacitors with dielectrics, Dipole in electric field, Atomic description of dielectrics. (3 hours)

Current and Resistance: Electric current, Resistance, Electrical conduction, Resistance and temperature, Superconductors, Electrical power. (3 hours)

Direct Current Circuits: Electromotive force, Resistors in series and parallel, Kirchhoff’s rules, RC circuits, Electrical meters. (3 hours)

Magnetic Fields: Magnetic fields and forces, Magnetic force acting on a current-carrying conductor, Torque on a current loop in a uniform magnetic field, Motion of a charged particle in uniform magnetic field, Applications, Hall effect. (3 hours)

Sources of the Magnetic Field: The Biot-Savart law, The magnetic force between two parallel conductors, Ampere’s law, The magnetic field of a solenoid, Magnetic flux, Gauss’s law in magnetism, Displacement current and the general form of Ampere’s law, Magnetism in matter. (4 hours)

Faraday’s Law: Faraday’s law of induction, Motional emf, Lenz’s law, Induced emf and electric fields, Generators and motors, Eddy currents, Maxwell’s equations. (3 hours)

Inductance: Self-inductance, RL circuits, Energy in a magnetic field, mutual inductance, Oscillations in an LC circuit, The RLC circuit. (3 hours)


TEXT/REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

PHYSICS LABORATORY:

To perform any 12 of the following experiments:

71. Field along the axis of a coil
72. Energy band gap of a semiconductor
73. Newton’s rings
74. Blackbody radiation
75. Photoelectric effect
76. Charging and discharging of a capacitor / RC time constant
CHEMISTRY
ICH 121

Electrochemistry: Introduction to electrochemical cell and its types, Liquid junction potential, EMF of the cell and its determination, Standard cell, Origin of electrode potential, Single electrode potential, Nernst equation for electrode potential, Types of electrodes- hydrogen electrode, Calomel electrode and glass electrode, Numericals.


Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Ionic product of water, hydrolysis, hydrolysis of salts of four types, hydrolysis constant, relation between $K_h$, $K_a/K_b$ and $K_w$, degree of hydrolysis, Common ion effect, solubility product and its applications. Numericals.


Thermochemistry -Hess’s law and its applications. Limitations of first law.

Chemical Kinetics:
Rate of a reaction, order and molecularity of a reaction, rate law, integrated rate equation and half-life (first and second order reaction), energy of activation, theories of reaction rates- collision theory and transition state theory. Numericals

Covalent bond: Covalent bond formation, valence bond theory, Molecular orbital theory & their application to diatomic molecules, Concept of resonance, Valence shell electron pair repulsion concept (VSEPR), Properties of covalent bond.

Organic reactions and mechanisms: Classification of organic compounds, IUPAC system of Nomenclature, Organic reactions and their Mechanisms- Homolytic and heterolytic
fission, carbonium ions, carbanions, carbon free radicals, substitution reactions, addition reactions, elimination reactions, rearrangement reactions, Isomerism - structural and stereoisomerism. (8 hours)

**TEXT/ REFERENCES:**


**CHEMISTRY LAB**

51. Acid-base titration (Acidimetric/Alkalimeter)
52. Determination of hardness of water
53. Determination of chloride content of water
54. Determination of percentage of copper in brass
55. Determination of percentage of nitrogen ammonia in fertilizer
56. Determination of rate constant of hydrolysis of ethyl acetate
57. Colorimetric determination of copper
58. Conductometric titration of a Mixture of strong & weak acids vs strong base
59. Determination of pKa value of a weak acid using pH meter
60. Redox titration using potentiometer

**ENGINEERING GRAPHICS – II**

IME 121 0-0-3-1

**Software: AutoCAD**

**INTRODUCTION:** Importance of sectioning the object, Development of surfaces of solids, Isometric projection, Orthographic projection and its practical applications. (3 hours)

**SECTIONS OF SOLIDS:** Introduction, Horizontal vertical and inclined section planes and true shape of sections. Drawing sectional views with true shape of section. Simple cases of solids resting on HP or VP with axis perpendicular to reference planes, inclined to one reference plane. Section plane perpendicular to VP, inclined to HP and inclined to VP. (9 hours)

**DEVELOPMENT OF SURFACES:** Parallel line development for prisms (Triangle, Rectangle, Square, Pentagon and Hexagon) and cylinders (Including simple cut solids), Radial line development for pyramids (Triangle, Square, Rectangle, Pentagon and Hexagon) and cones (Including simple cut solids). (9 hours)

**ISOMETRIC PROJECTIONS AND VIEWS:** Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)
ORTHOGRAPHIC CONVERSIONS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/ REFERENCES:


BASIC MECHANICAL ENGINEERING

IME 122 3-1-0-4

Properties of Steam and Boilers: Steam formation, Types of steam, Steam properties- Enthalpy, Simple numericals for finding enthalpy and dryness fraction. (5 hours)
Steam Boilers: Classification, Working principle of Babcock & Wilcox Boiler, Lancashire, locomotive boiler, boiler mountings, accessories (4 hours)
Prime Movers: Classification of Prime movers, Working principle of steam, gas and water turbines, Concept of impulse and reaction steam turbines, compounding. (5 hours)
Power plants: Introduction, Working principle of thermal, nuclear, hydel and solar power plants. (4 hours)
Refrigeration: Principle and working of vapour compression refrigeration system, Desirable properties of an ideal refrigerant, Definition of COP, Unit of refrigeration. (2 hours)
I.C. Engines: Classification, Working of 2-stroke, 4- stroke C.I and S.I Engines with P-V diagrams, Definitions and simple numericals for determining Indicated Power, Brake Power, Mechanical efficiency, Indicated thermal efficiency, and Brake thermal efficiency, Working of simple carburetor, Types and properties of lubricants, Splash lubrication system. (8 hours)
Power Transmission: Definition, Belt drives- open and crossed, Velocity ratio, Stepped cone pulley, Fast and loose pulley, Length of belt, Tension in the belt, Slip, Creep (No derivations), Introduction to rope drive and chain drives, Gear Drives-Types of gears, Velocity ratio for Gear trains, Simple and compound gear trains, Numericals on belt and gear drives. (8 hours)
Machine Tools: Lathe -Classification, Block diagram of engine lathe, Specification of lathe, List of lathe operations. Drilling- Classification of drilling machines, Block diagram of radial drilling machine, List of drilling operations. (5 hours)
Casting and Forging: Types of moulding sand and its desirable properties, Patterns- Single piece and split piece pattern, Pattern allowances, Steps in the preparation of two box green sand mould, Defects in casting, Introduction to forging. (3 hours)
Welding: Classification, Principle of Resistance spot welding, Electric arc welding and oxy-acetylene gas welding, Gas flames, Introduction to soldering and brazing. (2 hours)
Introduction to Engineering Materials: Ferrous and Non-ferrous metals and its properties, Introduction to heat treatment. (2 hours)
TEXT/ REFERENCES:


ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

IEE 121

Review of DC circuit analysis, network reduction techniques. (2 hours)

Single-phase AC Circuits: Alternating voltages and currents, generation of single phase alternating voltage, average value and RMS value of periodic sinusoidal and non-sinusoidal wave forms, form factor. (3 hours)

Representation of time-varying quantities as Phasors; j Operator; Representation of Phasor in polar, rectangular and exponential forms. (2 hours)

Basic AC circuits: sinusoidal alternating current in a pure resistor, pure inductor and a pure capacitor, waveforms of voltage, current, and power, Phasor diagram, inductive and capacitive reactances.
Steady-state analysis of RL, RC, and RLC series circuits: concept of impedance and Phasor diagram, expression for average power, power factor. Parallel AC circuits: admittance, conductance, susceptance. Analysis of series parallel circuits, Phasor diagrams, active power, reactive power and apparent power, complex power, power triangle, improvement of power factor. (9 hours)

Three-phase AC Circuits: Generation of 3-phase balanced sinusoidal voltages, waveform of 3-phase voltages, phase sequence, star and delta connections, line voltage and phase voltage, line current and phase current, analysis of 3-phase circuit with star/delta connected balanced and unbalanced loads, Phasor diagram of voltages and currents, power measurement by two-wattmeter method with unbalanced and balanced loads. (6 hours)

Electrical Power System: Power system components, Overview of Electrical Machines. (2 hours)

Semiconductor Diode and its applications: I-V Characteristic, Static and dynamic Resistance, Half and Full Wave Rectifiers with and without filter, Zener regulator, 78XX regulator, Special purpose diodes. (9 hours)
BJT and its applications: I-V Characteristics, Cut-off, active and saturation mode of operation, CB, CC and CE configuration, Transistor Biasing: fixed and voltage divider bias. Transistor as an amplifier: RC coupled Amplifier, Transistor as a Switch: Relay Driver Circuit. (9 hours)


TEXT / REFERENCES:
- Kothari D. P. & Nagarath I. J., Basic Electrical Engineering, TMH 2013
- Nagasarkar T. K. & Sukhija M. S., Basic Electrical Engineering, OUP 2012
- Hughes E., Electrical and Electronic Technology (9e), Pearson Education, 2008

III SEMESTER
MATHEMATICS III
IMA 231

Differential equations - basic concepts and definitions, solution of exact equations, evaluation of integrating factors, solution of first order linear differential equations, Bernoulli’s equation, solution by inspection, application of first order differential equations. (6 hours)

Some simple numerical methods for solutions of first order equations: Taylor series method, Euler’s method, modified Euler’s method, Runge-Kutta methods of order two and four. (6 hours)


Introduction to Laplace transforms, transforms of elementary functions, periodic functions, Step functions, Dirac Delta functions, inverse transforms, convolution theorem, and solution of initial value problems by Laplace transforms method. (12 hours)

Complex variables - Analytic functions, Cauchy - Riemann equations, Harmonic functions, Line integrals, Cauchy's integral theorem, Cauchy's integral formulae. Laurent series, Residue calculus. (12 hours)

Partial differential equations - basic concepts, solutions of simple partial differential equations, method of separation of variables and indicated transforms to solve partial differential equations. (4 hours)

TEXT / REFERENCES:
ELEMENTS OF MECHATRONIC SYSTEMS

IMET 231

Introduction: Definition, basic concepts and elements of mechatronic systems, needs and benefits of mechatronics in manufacturing. (1 hour)


Drives and Actuators: Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors, Piezoelectric actuators, Shape memory alloys. Hydraulic & Pneumatic devices – Power supplies, valves, cylinder sequencing. (8 hours)

Data acquisition and translation: Signal conditioning – Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, Multiplexer, Pulse width Modulation Counters, decoders, ADC, DAC Signal Analysis - Linearization of data, Compensation, Signal Averaging, Fourier analysis. (7 hours)

Data presentation system: Display - Cathode ray oscilloscope, LED, LCD, Printers, Magnetic Recording. (2 hours)

Controllers and Algorithms: Microprocessor – Fundamentals, architecture of 8085, programming of 8085, Microcontrollers, Programmable Logic Controllers (PLC), Artificial Neural Networks (ANN), Fuzzy controls. (6 hours)

Applications: NC/CNC machines, robots, automatic camera, temperature monitoring system, engine management system, washing machine. Recent trends in mechatronics – MEMS, smart materials. (3 hours)

TEXT / REFERENCES:

- D.A. Bradley and others “Mechatronics” Chapman & Hall.
KINEMATICS OF MACHINES

IMET 232 2– 1– 0 – 3

Basic Concepts: Mechanism and machine, kinematic pair, link, chain and inversions, constrained and unconstrained motions, four bar mechanism, single and double slider crank mechanisms with inversions, quick return mechanism, toggle mechanism, Hooke’s coupling. (10 hours)

Velocity and Acceleration: Solution of simple mechanisms by relative velocity and acceleration method. (6 hours)

Cams: Types of cams, types of followers, cam profiles, graphical methods for S.H.M, Uniform velocity and Uniform acceleration and retardation, radial and oscillating followers.

Balancing: Balancing of rotating masses in single plane and different planes (Graphical Method). (9 hours)

Toothed gearing: Spur gears, diametral pitch, module, pressure angle, tooth profile, characteristics of involute gear, interference path and arc of contact, contact ratio, minimum number of teeth. Terminology of helical, bevel and worm gears. (7 hours)

Gear trains: Simple, compound, reverted & epicyclic, solution by tabular method only. Tooth load, torque calculations (Automobile differential box included). (6 hours)

Belts and rope drives: Slip, belt thickness, length of belts, velocity ratio, ratio of tensions, maximum power. (5 hours)

Friction: Flat pivot and collar friction, power loss due to friction, problems on single plate and multiplate clutches. (5 hours)

TEXT / REFERENCES:

- Burton Paul (1979), "Kinematic and Dynamic of Planer Machinery", Prentice Hall.

MATERIAL SCIENCE AND ENGINEERING

IMET 233 3– 0– 0 – 3
Introduction:
Need, purpose, and importance of the subject. Crystal Structures (cubic and HCP structures) – computations – packing factor of cubic and HCP structure, co-ordination number, Miller indices, crystal imperfections-point & line defects. (5 hours)

Solidification Mechanisms and Phase diagrams: Homogeneous and heterogeneous nucleation. Mechanism of solidification – nucleation and crystal growth, dendritic growth. Solid solutions and types, Intermediate phases, Equilibrium diagrams (only binary), – construction and explanation of isomorphous and eutectic systems, equilibrium and non-equilibrium cooling, invariant reactions (eutectic, peritectic, monotectic, eutectoid, and peritectoid) Lever rule and its application on isomorphous and eutectic systems and Iron – iron carbide system. (10 hours)

Ferrous-alloys and Non-ferrous alloys: Principle and objectives of heat treatments Heat treatment of ferrous alloys, TTT diagram, annealing, normalizing, hardening, tempering and case hardening with heat treatment cycle, Composition, properties and applications of alloy steels. Types and explanation of brasses, bronzes and Al-Cu alloys and Lead tin alloys. (5 hours)

Polymers and Composites: Classification of polymers, degree of polymerization, thermoplastics and thermosets, adhesives, dispersion strengthened composites particulate composites, fiber-reinforced composites and laminar composites. (5 hours)

Electronic, Magnetic and optical properties of materials: Conductivity of metals and alloys, deposition of thin films, insulators and dielectric properties, electrostriction, piezoelectricity and ferroelectricity, magnetic materials, magnetization, magnetic field, ferromagnetic and superparamagnetic materials, application of magnetic materials. Refraction, reflection, transmission, selective absorption and use of emission phenomena. (11 hours)

TEXT / REFERENCES:

ANALOG AND DIGITAL SYSTEM DESIGN

IMET 234

Operational amplifier: Differential amplifier, block diagram of op-amp, op amp parameters (AC & DC), open and closed loop operation of OP-AMP, frequency response, frequency compensation techniques. (4 hours)

Linear & non-linear applications of op-amp: Linear applications: adder, subtractor, integrator, differentiator, voltage follower, V-I and I-V converter, instrumentation amplifier non-linear applications: log and antilog amplifier, multiplier, divider, square root, active peak detector, rectifiers, clippers, clampers. Comparator and its applications, Schmitt trigger, window detector, sample & hold circuit. (10 hours)
Special functions: Multivibrators based on 555 and OP-AMP, PLL, VCO, ADC, DAC, three terminal regulator ICS, basic block schematic – 78XX & 79XX series - adjustable output voltage regulator LM 317

Number system and codes: Binary, octal, hexadecimal and decimal number systems and their inter conversion, BCD numbers (8421-2421), gray code, excess–3 code, cyclic code, code conversion, ASCII, EBCDIC codes. Binary addition and subtraction, signed and unsigned binary numbers, 1's and 2's complement representation.

Combinational logic: The half adder, the full adder, subtractor circuit. Multiplexer de-multiplexer, decoder, BCD to seven segment decoder, encoders.

Flip flop and timing circuit: Set-reset latches, D-flip-flop, R-S flip-flop, J-K flip-flop, master slave flip-flop, edge triggered flip-flop, T flip-flop.

Registers & counters: Synchronous/asynchronous counter operation, up/down synchronous counter, application of counter, serial in/serial out shift register, serial in/serial out shift register, serial in/parallel out shift register, parallel in/parallel out shift register, parallel in/serial out shift register, bi-directional register.

TEXT / REFERENCES:

ANALOG ELECTRONIC CIRCUITS

IEC 231

Bipolar transistor: Structure of Bipolar Transistor, Operation of Bipolar Transistor in Active Mode: Collector Current, Base and Emitter Currents, Bipolar Transistor Models and Characteristics: Large-Signal Model, Small-Signal Model, Early Effect, operation of Bipolar Transistor in Saturation Mode


MOS Transistor: Structure and operation of MOSFET, I-V Characteristics, Channel-Length Modulation, Transconductance, MOS Device Models: Large-Signal and Small-Signal Model, PMOS Transistor, Comparison of Bipolar and MOS.

MOS Amplifier: Amplifier Topologies, Biasing, Realization of Current Sources, Common-Source Stage: CS Core, CS Stage with Current-Source Load, CS Stage with Diode Connected Load, CS Stage with Degeneration, CS Core with Biasing, Common-Gate Stage: CG Stage with Biasing, Source Follower: Source Follower Core, Source Follower with Biasing.
Frequency Response: Fundamental Concepts: General Considerations, Relationship Between Transfer Function and Frequency Response, Miller’s Theorem, General Frequency Response, High-Frequency Models of Transistors: High-Frequency Model of BJT and MOSFET, Transit Frequency, Frequency Response of CE / CS, CB / CG and Source / Emitter Followers. (6 hours)


Oscillators: General Considerations, Heartley and Colpitts Oscillator, Phase Shift Oscillator, Ring Oscillator. (4 hours)

Power Amplifier: General Considerations, Different Classes of Power amplifiers, Class A amplifier, Class B amplifier and Class AB amplifier, Power efficiency of all Classes. (4 hours)

TEXT / REFERENCES:

CAD LAB

IMET 235

0– 0– 3 – 1

2D Drafting of individual and assembled machine components
2D drafting of orthographic and sectional views of individual and assembled machine components like bearings, joints, and power screws plumer block, screw jack, knuckle joint etc. (3 hours)
3D modeling of machine components and assembly
3D modeling of simple machine parts like plumer block, bench vice, CPU fan, butterfly valve etc… and create a draft of the assembly. (6 hours)

Kinematic Simulation
Simulation of simple mechanisms to obtain position, velocity and acceleration parameters of different mechanisms like 4 bar mechanism, slider crank mechanism etc. (3 hours)

TEXT / REFERENCES:
- Sham Tickoo, CATIA – for Engineers and Designers, Dreamtech Press, New Delhi 2005.
- Venugopal K., Engineering drawing and graphics + Auto CAD, Newage International Publishers, Delhi 2002
Study of logic gates: Introduction to Logic gates. Simplification of Boolean expressions and implementation using logic gates. Universal logic.

Study of code converters: Odd/even Parity generator/checker, Binary to Gray code converter BCD to XS-3 code converter

Design and testing of Combinational circuits: Half & Full adder/subtractor, BCD adder, Binary parallel adder/subtractor.

Design and testing of Sequential Circuits: Latches, Flip-flops, Ripple counters, Synchronous Counters, Ring & Johnson Counters, Shift registers

Serial adder, Sequence generator and Sequence detector

HDL Programming for combinational and sequential circuits.

TEXT / REFERENCES:
- K. A. Krishnamurthy, Digital Lab Primer, Pearson Education.

IV SEMESTER
ENGINEERING ECONOMICS & MANAGEMENT


Time value of money: Time value of money, interest factors for discrete compounding, nominal & effective interest rates, present and future worth of single, uniform, gradient cash flow.

Economic analysis of alternatives: Bases for comparison of alternatives, present worth amount, capitalized equivalent amount, annual equivalent amount, future worth amount, capital recovery with return, rate of return method, incremental approach for economic analysis of alternatives, replacement analysis.

Break-even and minimum cost analysis: Break even analysis for single product and multi product firms, break even analysis for evaluation of investment alternatives, minimum cost analysis.
Depreciation: Physical & functional depreciation, methods of depreciation - straight line, declining balance, sum-of-the-years digits, sinking fund and service output methods. (2 hours)

Financial management: Nature and objectives, scope and functions. Sources of long term finance - Characteristics of equity capital, preference capital, debenture capital & term loans. (2 hours)

Valuation of securities: Concept of valuation, bond valuation and bond valuation models, bond value theorems, yield to maturity, equity valuation; dividend capitalization approach, ratio approach. (4 hours)

Financial statement analysis: Balance sheet and profit & loss statement, meaning & contents, ratio analysis, financial ratios such as liquidity ratios, leverage ratios, turn over ratios, and profitability ratios, time series analysis, common size analysis, DuPont analysis, drawbacks of financial statement analysis. (5 hours)

MANAGEMENT: Introduction: Definition of management and systems approach, nature & scope. Functions of managers. Corporate social responsibility. (4 hours)

Planning: Types of plans, steps in planning, process of MBO, how to set objectives, strategies, policies & planning premises. Strategic planning process and tools. (6 hours)

Organizing: Nature & purpose of organising, span of management, factors determining the span, basic departmentation, line & staff concepts, functional authority, art of delegation, decentralisation of authority. (6 hours)

Staffing: HR planning, recruitment, development and training. (4 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (6 hours)

Basic control process, Critical control points & standards, Control techniques: Budgets, non-budgetary control devices. Overall & preventive controls: Budget summaries: Profit & loss control, control through ROI, direct, preventive control. (2 hours)

TEXT / REFERENCES:

Introduction to 8051 family, History of 8051, Architectural features of 8051, Programming model. Pin details, I/O Ports, Power down operation. (4 hours)

Addressing Modes, Instruction set of 8051 and Programming. (10 hours)

Programming the 8051 resources: Counters, Timers, Serial Interface, Interrupts, Measurement of frequency, period and pulse width of a signal. (8 hours)

Peripheral Interfacing – 8255, Memory interfacing, LCD, Stepper motor, Seven Segment Display, Digital to analog Converter, Analog to Digital converters, Case Study: Traffic Light Controller. (8 hours)

Introduction to PIC Microcontrollers- Architectural and Peripheral features, ALU, CPU, Memory map, clock, pipelining, addressing and I/O ports. (4 hours)

**TEXT / REFERENCES:**

- Udayashankara, S. Mallikarjunaswamy, “8051 Microcontroller – Hardware, Software and Applications

**PROGRAMMABLE LOGIC CONTROLLERS**

**IMET 242**

Introduction to PLC: What is PLC, Technical Definition of a PLC, Advantage of PLC, and Chronological Evolution of a PLC, Type of PLC, Parts of PLC and Block diagram PLC. I/O modules and interfacing, CPU processor, devices connected to I/O modules. Input-Output System Sinking and Sourcing, power supply module, PLC wiring Connection, Special I/O Modules. (6 hours)

PLC programming: programming Equipment, programming formats, construction of PLC ladder diagrams, Input and output instructions, operational procedures, programming examples using contacts and coils, latching, holding, drill press operation. Converting simple relay logic diagram to PLC ladder diagram. Digital logic implementation and conversion to ladder programming. (6 hours)

PLC functions: Timer functions and industrial applications, counters, counter function, Industrial applications, arithmetic functions, and number comparison. Data handling functions, and Bit pattern and changing a bit shift register, sequence functions. Analog PLC operation, Analog module systems, PID principles, position indicator with PID control, PID modules and networking of PLC. (8 hours)
Applications of PLC: Materials handling applications Automatic control of warehouse door, Automatic lubricating oil supplier, Conveyor belt motor control, Automatic car washing machine Bottle label detection, controlling of two axis and three axis robot. (Case study)

(4 hours)

Supervisory Control and Data Acquisition (SCADA) : SCADA introduction, brief history of SCADA, elements of SCADA. Features of SCADA. SCADA as a real time system, MTU-functions of MTU, RTU Functions of RTU, Protocol Detail, Communications in SCADA- types & methods used, components, Protocol structure and Mediums used for communications, SCADA Development for any one typical application. (case study).

(8 hours)

Distributed Control System: Evolution of DCS, Architecture of DCS, Hierarchical structure, different functional levels, database organization for DCS, data communication link, reliability and consideration in DCS, flow sheet symbols and advantages of DCS.

(4 hours)

TEXT / REFERENCES:

- John W. Webb and Ronald A. Reiss, “Programmable logic controllers-Principle and applications” fifth edition, PHI.
- Samuel M. Herb, “Understanding Distributed Processor Systems for Control”, ISA Publication. 1999
- W. Bolten, ”Programmable Logic Controllers “
- Kelvin Collins, “Programmable Logic Controllers and Industrial Automation” Exposure Publishing.

PROGRAMMABLE LOGIC CONTROLLERS LABORATORY

To understand the working of a programming logic controller and to implement the digital logic in PLC, Tank Filling Device Simulator System, Supervise Equipment, Gate Control System, Buffer Store Simulation, Selective Band Switch, Star-Delta - Starting Up, Starter Control, Dahl Ander Pole Changing, Road Works Traffic Lights, Cleaning System.

Mini Project: At the end of the semester students have to submit a mini project where the sensors and actuators are interfaced to PLC. The logic for the project would be written in the PLC controller.

TEXT / REFERENCES:

- Siemens PLC Manual.
- John W. Webb and Ronald A. Reiss, Programmable Logic Controllers - Principle and Applications, (5e), PHI.
- Festo Didactic Modular production system: processing, buffer, handling, distribution, storage station manual, Esslingen. 1996.
AUTOMATED MANUFACTURING SYSTEMS

IMET 243

Numerical control production systems: Development in machine tools, introduction to NC technology, basic components of CNC system - part programming, machine control unit, machine tool. Design consideration of CNC machines, methods of improving machine accuracy and productivity, machine structure, guideways, interpolators, control loops of CNC systems – control loop of point to point systems, control loop of contouring systems. (10 hours)

CNC programming: Concepts of CAM - tool path generation and control methods. Co-ordinate systems, CNC programming for turning center and machining center by manual method (word address format only), CNC programming with interactive graphics, manual data input, distributed numerical control, adaptive control machining system, automated inspection and testing: principle and methods, coordinate measuring machines. (8 hours)

Computer integrated manufacturing systems: Part families – part classification and coding, production flow analysis, computer integrated manufacturing system, types of manufacturing system, machine tools and related equipment. Flexible manufacturing system, FMS workstation, types of FMS layouts, Analysis of FMS (Bottle neck model) Computer aided process planning, computer integrated planning systems., shop floor control. (8 hours)

Material handling and identification technologies: Introduction to material handling, material transport equipments, analysis of material transport systems. Storage system performance and location strategies, automated storage systems, Factory data collection - automatic identification and data capture, bar code technology, RFID in manufacturing. (8 hours)

TEXT / REFERENCES:


INDUSTRIAL ROBOTICS

IMET 244

Introduction: Definition of Robots; Types of Robots; Robot Generation; Classification of Robots; Degrees of Freedom; Degrees of Movements; Robot Configuration; End effectors; sensors and actuators;Selection of Robots; Definition and factor affecting the Control Resolution, Spatial Resolution, Accuracy and Repeatability; Specification of a robot; MTBF; MTTR; Need for industrial robots; Robot application; Robot programming languages.Economic, safety and social considerations. (12 hours)
Robot Kinematics and Dynamics: Kinematic analysis coordinate & vector transformation using matrices, the orientation matrix & translator vector, homogeneous transformation matrices, three dimensional homogeneous transformations, Denavit Hartenberg convention-implementing the dh convention, obtaining the dh displacement matrices. Applications of DH method- three axis robot arms, three axis wrists, six axis robot manipulators. Jacobian matrix for positioning, the Jacobian matrix for positioning & orienting, Inverse Jacobian. Differential motions. (16 hours)

Trajectory planning: Introduction, the necessity of interpolators, the generation of motion commands, the trajectory planning, basic structure of interpolators. The solvability of the inverse, kinematics problem. Particular solutions for the inverse kinematics problem - two – axis planar mechanisms. (4 hours)

Autonomous mobile robots: Introduction, locomotion - key issues for locomotion, legged mobile robots, leg configurations & stability, examples of legged robot locomotion. Case studies. (4 hours)

**TEXT / REFERENCES:**

**SIGNALS AND SIGNAL PROCESSING**

**IEE 241**

Introduction to Signals and Systems: Definitions of signals and systems, classification of signals, basic operations on signals, elementary signals and functions, systems viewed as interconnections of operations, properties of systems. (8 hours)

Time domain representations for linear time-invariant (LTI) systems: Introduction, convolution: Impulse response representation for LTI systems, properties of the impulse response representation for LTI systems. Block diagram representations. (8 hours)


Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier transform representations for periodic signals, Sampling Theorem, Reconstruction of continuous-time signals from samples. (4 hours)

Z-Transform: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform (Using Partial fraction method), Transform analysis of LTI systems. (8 hours)

Frequency Response of Analog Filters: Frequency response of an LTI system, Butterworth filters, Chebyshev filters (Qualitative discussion). (2 hours)

Digital Filters: Relation between DTFT and Z-transform, Discrete Fourier Transform (DFT), N-point DFT computation. Introduction to digital filters: Finite impulse response (FIR) and infinite impulse response (IIR) filters, Ideal frequency responses of frequency selective filters. (6 hours)

**TEXT / REFERENCES:**

MICROCONTROLLER LABORATORY

IEW 242

Assembly language Programming in 8051 using Keil software:
• Data Transfer, Block move & Branching Instructions.
• 8-Bit Arithmetic and Logical operations.
• BCD, Multibyte and other Arithmetic operations.
• Searching and Sorting.
• Counters and Code conversions.

Introduction to 8051 Microcontroller kit

Interfacing Exercises using Assembly Language Programming:
• Interrupts.
• Interfacing DAC with 8051.
• Interfacing LCD for message display and Interfacing Hex key pad to 8051.

Interfacing Exercises using High Level Language ‘C’ programming:
• Interfacing ADC with 8051.
• Interfacing Stepper Motor with 8051.

Mini project using 8051 microcontroller [Assembly / ‘C’ language].

TEXT / REFERENCES:

• Ajay. V. Deshmukh, Microcontrollers theory and applications, TMH, 2007

SEMESTER - V

PROJECT WORK

IMET 351

Students need to form batches with maximum four in numbers and required to identify the problem in their area of interest within their discipline of study under the supervision of a faculty (Guide) for 12 to 14 weeks. At the end, the findings need to be presented in the form of a project report for final evaluation.

SEMESTER - VI
Introduction to MEMS and Microsystems: Products, Evolution of micro-fabrication, microelectronics, miniaturization, application in the automotive and other industries. (2 hours)

Working principles of Microsystems: Microsensors – Acoustic wave sensors, Bio-medical sensors and bio sensors, Chemical sensors, Optical sensors, Pressure sensors, Thermal sensors. Microactuation – By thermal forces, Shape memory alloys, piezoelectric crystals and Electrostatic forces, MEMS with Micro actuators, Micro accelerometers, Microfluidics, Problems. (4 hours)

Scaling laws in miniaturization: Scaling in geometry, Scaling in rigid body dynamics, Scaling in electrostatic, electromagnetic forces, Scaling in electricity, Scaling in heat transfer and fluid mechanics. (5 hours)

Materials for MEMS and Microsystems: Substrates and wafers, Silicon as a substrate material, silicon compounds, silicon piezo-resistors, Gallium arsenide, Quartz, Polymers, Packaging materials, Problems. (4 hours)

Microsystems fabrication Processes: Photo lithography, Ion implantation, Diffusion, Oxidation, Chemical vapor deposition, Physical vapor deposition, Deposition by Epitaxy, Etching, Problems. (5 hours)

Micro-manufacturing: Bulk manufacturing, Surface micromachining, LIGA process. (5 hours)

Microsystems Design: Design consideration, Process design, Mechanical design, Design of a silicon die, Design of microfluidic Network system. Problems (5 hours)

Microsystems Packaging: Mechanical packaging of microelectronics, Microsystems packaging, Interfaces in Microsystems packaging, packaging technologies, 3 Dimensional packaging, Assembly of Microsystems, Packaging materials, Signal mapping and transduction. (4 hours)

TEXT / REFERENCES:


Introduction to Power Electronics- Power flow control switching, power electronic devices – power MOSFET and Power BJT , SCR – V-I , turn on, turn off characteristics, triggering methods, PWM methods, rectifiers – single phase – fully, half and semi controlled, half wave and full wave, full wave rectifier – RL loads, RLE loads with freewheeling diodes. (10 hours)

DC motors – Principle of operation, EMF equation, Types of motors, DC – series, shunt, separately excited, compound, basic equations, motor constants, torque speed characteristics, starting – conventional starters & soft starters, braking – regenerative and dynamic braking, speed control concepts, solid state motor drivers – choppers – buck, boost, buck-boost, single phase thyristor controlled rectifier – RLE load. (10 hours)
Induction Motors – three phase motors, Principle of operation, Types of motors, slip ring , squirrel cage, basic equations, torque speed characteristics, starting – conventional starters, soft starters, braking – regenerative and dynamic braking, speed control- v/f control concepts, solid state motor drivers – ac voltage regulators, inverters - VSI, CSI. Single phase induction motors-types, torque speed characteristics, Synchronous motors. (15 hours)

Motors in automation – Linear Induction motors , PM Synchronous motors - Servo motors, Switched reluctance motors, BLDC motors, stepper motor – types , Universal motor, torque motor, - construction, torque- speed characteristics, applications, merits and demerits. (8 hours)

Fundamental of motor- load interactions – Basic Components of electric drive, Advantages of electric drives, Closed loop speed control, speed – torque conventions, multi-quadrant operation of electric drives, Steady state equilibrium, equivalent moment of inertia, Determination of motor power rating. (5 hours)

TEXT / REFERENCES:

ELECTIVE – I & ELECTIVE – II

IMET 363 & IMET 364 3-0-0-3

AUTOMOBILE ENGINEERING:

Introduction: Automotive Engine classification, Multi Cylinder Arrangements. (1 hour)

Automotive Engine Parts:Cylinder Block, cylinder head, crank case, oil pan, cylinder liners, piston, arrangements to control piston slap, piston rings, connecting rod, crank shaft, valves and valve operating mechanisms, valve timing diagram. (3 hours)

Fuel Supply System:Fuel pumps for petrol engines, mixture strength requirements of S I engine, defects of simple carburetor and their remedies, types of carburetors, constant choke and constant vacuum carburetors. (3 hours)

Ignition System:Battery ignition system, Ignition advance methods, comparison between battery and magnetic ignition system. (2 hours)

Cooling System:Necessity, Methods of engine cooling. (2 hours)

Lubrication System:Objects of lubrication, systems of engine lubrication, crankcase ventilation. (2 hours)

Clutch & Gear Box:Clutches- Purpose and requirements, single plate clutch, multiplate clutch, centrifugal clutch, fluid flywheel. Gear box - Purpose, sliding mesh, gear box, constant mesh, gear box, synchromesh gear box, Epicyclic gear box & torque converter. Calculation for torque transmitted by plate and cone clutch, power for propulsion of the vehicles, road resistance & tractive effort, relation between vehicle speed and gear ratio. (8 hours)

Drive To Wheels:Propeller shaft and differential. (1 hour)

Steering System:Steering geometry, steering mechanism, steering linkages for rigid axle & Independent suspension systems. Numerical problems related to conditions for pure rolling, turning circle radius. (4 hours)
Suspension System: Objects, types of suspension springs, leaf springs, coil spring & torsion bar. Independent front suspension, telescopic type shock absorber. (2 hours)

Automobile Tyres: Desirable tyre properties, conventional tubed & tubeless tyre. (1 hour)

Brakes: Braking requirements, brake efficiency & stopping distance, fading of brakes, Types of Brakes: Drum and disc brakes, mechanical brakes, hydraulic brakes, servo brakes, air brakes, balance beam compensator. Numerical problems related to brake torque & minimum stopping distance with front wheel, rear wheel & four wheel braking, weight transfer & heat dissipation. (5 hours)

Electrical system: Lighting circuit for an automobile. Starting system – bendix drive. Generator. (2 hours)

TEXT / REFERENCES:

AUTOMOTIVE COMPONENT DESIGN:

TEXT / REFERENCES:
- Bhandari V., “Machine design”, Tata McGraw Hill publication,

AUTOTRONICS:
Fundamentals of Automotive Electronics, Current trend in Automobiles, Open loop and closed loop systems, Components for electronic engine management, Parameters to be controlled in SI and CI engines. (3 hours)
Sensors & Actuators: Introduction, basic sensor arrangement, types of sensors Hall Effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors, oxygen concentration sensor, lambda sensor, crankshaft angular position sensor, cam position sensor, Mass air flow (MAF) rate, Manifold absolute pressure (MAP), Throttle plate angular position, engine oil pressure sensor, vehicle speed sensor, stepper motors, relays, detonation sensor, emission sensors. (6 hours)

Digital Engine Control System: Open loop and close loop control system, engine cooling and warm up control, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control exhaust emission control. (6 hours)
SI Engine Management: Working of the fuel system components, Feedback carburetor system, throttle body injection and multi point fuel injection system, injection system controls Layout and working of SI engine management systems like Bosch Monojetronic, L-Jetronic and LH-Jetronic, Types of solid state ignition systems and their principle of operation, Contactless electronic ignition system, Electronic spark timing control, Advantages of electronic ignition system, three way catalytic converter. (7 hours)

CI Engine Management: Fuel injection system, parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems. (8 hours)

Vehicle Motion Control and Stabilization Systems: Control of gear shift, types of actuators and torque converter, Electronic steering, Electronic controlled steering system, Electronic clutch, Vehicle motion control - Adaptive cruise control, Electronic transmission control. Vehicle stabilization system - Antilock braking system, Traction control system, Electronic stability program. Electronic dash board instruments – Onboard diagnosis system, Future automotive electronic systems. (6 hours)

TEXT / REFERENCES:


HYBRID AND ELECTRIC VEHICLES:


Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Different motors – DC motors, Induction motors, PMDC, Switched reluctance motors, Configuration and control of Motor drives, power modulators, Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Control and Regenerative breaking: Different Electronic control Unit, Energy Management Strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies, fundamentals of regenerative braking. (8 hours)
Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems- Design of Series Hybrid Drive Train. (6 hours)


TEXT / REFERENCES:

INTELLIGENT CONTROLLERS:


Application: Application of neural networks: Control applications, Character recognition


Fuzzy Logic System Components: Fuzzification, Membership Value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

Application of fuzzy logic: control applications.(case study)


TEXT / REFERENCES:
MACHINE VISION AND IMAGE PROCESSING:

Image Acquisition and Analysis: Vision and image sensors, digitization, preprocessing, Vision system components, Basic optics, Basic Radiometry, Image formats, Image Noise, Image Representation, Color Space, conversion of color spaces. Image enhancement, operations on images, noise removal, Segmentation, Thresholding, Edge Detection Algorithms, morphological Operations, image analysis coding and representation of regions, dimensional analysis, Feature extraction Fourier transformations, spatial domain techniques. (12 hours)


Motion Estimation and Tracking: Optical flow estimation, Object tracking with Kalman filtering, Feature Extraction & Object recognition. (6 hours)

Case Studies/Application: Face recognition, Vehicle tracking, Computer Vision Toolbox, MATLAB Examples. (6 hours)

TEXT / REFERENCES:


ROBOT DYNAMICS AND CONTROL:


Nonlinear dynamics and control – Lyapunov stability theorem, Robust control, Feedback-Linearization Controllers, Lyapunov Designs, Variable-Structure Controllers, Saturation-Type Controllers. Inverse dynamics controllers, Force control, stiffness control, Impedance control, Hybrid Position/Force Control, Reduced state modeling and control.

TEXT / REFERENCES:

ROBOTIC PATH PLANNING:

Configuration Space – Obstacles space, dimensions of configuration space, topology of configuration space – homeomorphism and diffeomorphism, parameterization, transformations, example configuration space. Potential Functions – obstacle avoidance- additive and repulsive functions, gradient descent. Implementation in plane- computation, local minima problem, navigational potential functions, Non Euclidean potential functions, rigid body robots. (10 hours)

Algorithms – Analysis and complexity, running time, complexity, completeness. Visibility graph, Graph Search A*, Weighted A*, Anytime & Incremental Search (ARA*/D* Lite/Anytime D*), Real-time search (LRTA* and RTAA*), Road Maps - Generalized Voronoi Graph (GVG) - definition, properties, preimage theorem and critical points, GVG – transversality, connectivity, opportunistic path planning. (6 hours)

Cell Decomposition – Trapezoidal decomposition, Morse cell decomposition – variable slice, sensor based coverage, complexity coverage, Visibility based decomposition. Sampling Based Algorithms – Probabilistic Road Map (PRM) – definition, sampling, connection strategies, Single query sampling planners, Rapidly Exploring Random Trees (ERT), Control based planning. Manipulation planning, Optimal motion planning, Feedback motion planning, Randomised Kinodynamic Planning, RRT, RRG, RRT*, RRTs (12 hours)

Motion Planning – Motion planning under kinematics and dynamic constraints, Trajectory planning – Decoupled trajectory planning, Direct trajectory planning, Non-holonomic constraints, Path planning, Combined path planning and control (8 hours)

TEXT / REFERENCES:


ELECTIVE – III & ELECTIVE – IV

IMET 365 & IMET 366 3-0-0-3

ADDITIVE MANUFACTURING TECHNOLOGIES:

Introduction : Introduction to Rapid Manufacturing, Customization and Mass Customization, Classification of Rapid Manufacturing Processes (Additive/Subtractive/Formative), Process Chain for Additive and Other Rapid Manufacturing Processes ,Fundamental automated processes, 3D modeling ,Data conversion and Transmission ,Checking and preparing, Building, Post processing (6 hours)

Data Generation : STL Format, Data Formats for additive and Other Rapid Manufacturing Processes and associated details, STL file problems, consequence of building a valid and invalid tessellated model, STL file repair, other translators, Slicing Algorithms and related details,
Newly proposed formats, Data Conversion for Layered/additive manufacturing and Associated Difficulties, Data Validity Checks and Data repair procedures for Layered Manufacturing, Part Deposition Orientation and its Importance Direct Slicing. (6 hours)

Liquid based RP processes: Stereolithography apparatus (SLA), Solid ground curing (SGC), Solid creation system (SCS), Solid object Ultraviolet laser printer (SOUP), Soliform systems, other similar commercial RP Systems, Rapid freeze prototyping. (5 hours)

Powder based RP processes: Selective laser sintering (SLS), EOSINT systems, Three-Dimensional printing (3DP), Laser engineered Net shaping (LENS), Direct shell production casting (DSPC), Multiphase jet solidification (MJS), Electron beam melting (EBM). (4 hours)

Solid based RP processes: Laminated object manufacturing (LOM), Fused deposition modeling (FDM), Paper lamination technology (PLT), Multi-jet modeling system (MJM), Modelmaker and Patternmaster, Slicing solid manufacturing (SSM), Melted Extrusion Modeling (MEM), Multi-functional RPM system. (4 hours)

Rapid tooling: Indirect and direct rapid tool production, Role of Indirect methods in tool production, Metal deposition tools, epoxy tools, RTV tools, ceramic cast metal, Investment casting, Fusible metallic core sand casting. (4 hours)

Other Rapid Manufacturing Processes: Silicon Rubber Moulding, Metal Arc Spray System and other RT processes, Subtractive type, formative type. (3 hours)

Application: Rapid manufacturing process selection, Application and case studies, Application in design, engineering, analysis and planning, Application in manufacturing and tooling, automotive, biomedical industry, Application in jewelry, coin industry. (4 hours)

TEXT / REFERENCES:


COMPUTER NETWORKING & COMMUNICATION PROTOCOL:

Introduction to Reference Models: Introduction to data communication, Network architecture, Basics of OSI and TCP/IP reference models. (4 hours)

Transmission Media: Wired and wireless connectivity, FDM, TDM and CDMA, Circuit and packet switching, Frame relay and ATM switching, ISDN, Local area network protocols, IEEE standards for LAN, Satellite networks. (7 hours)

Data link layer design issues: its functions and protocols, link layer: error detection and correction techniques, Multiple access protocol, Ethernet, hubs and switches, PPP. (4 hours)

Network layer: Protocol and Packet format: Internet protocol, IPv6, Routing algorithms, IP addressing schemes, Internetworking and sub-netting. Transport layer: connectionless transport-
UDP, principles of reliable data transfer, congestion control algorithm. Application layer design issues: FTP, Electronic Mail in the Internet, P2P file sharing, HTTP (12 hours)

Quality of Services: ATM, Differentiated services Model, Flow identification, Scheduling, Factors affecting QOS parameters and service categories. QOS classes, (5 hours)

Network Management: Network Management protocol, SNMP, CMIP, Issues in the management of large networks, Concept of Traffic and service. voice and video data, ATM Traffic, Elements of ATM Traffic management-Traffic contracting. (4 hours)

TEXT / REFERENCES:

- Charle Kaufman, Radia Perlman, Mike Specines, Uyless Black "Computer Networks: Protocols Standards and Interfaces” PHI.

DATABASE MANAGEMENT SYSTEMS:

Introduction : Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators. (4 hours)

Relational Model: Structure of Relational Databases, Database Schemas, Keys, Relational Query Languages, Relational Operations. (2 hours)


SQL: SQL Data Definition, SQL Data Types and Schemas, Integrity Constraints, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Nested Subqueries, Additional Basic Operations Null Values, Modification of the Database. (6 hours)


Transaction Management: Transaction Concept, A simple Transaction model, Storage Structure, Transaction Atomicity and Durability, Transaction isolation, Serializability. (2 hours)

Data mining: Introduction, Association rules mining, market based analysis, Apriori Algorithm, Partition Algorithm, Pincer – Search Algorithm, Dynamic item set counting algorithm, FP-tree growth Algorithm, PC Tree, Multilevel association rules, Approaches to mining multilevel association rules, correlation analysis, Issues and challenges in Data mining. (8 hours)

Clustering Techniques: Introduction, Clustering paradigms, Partitioning Algorithms, k-Medoid & k-means Algorithms, CLARA, CLARANS, Hierarchical Clustering, DBSCAN. (3 hours)

Classification and Prediction: Introduction, Tree Construction principle, Best Split, Splitting Indices, Splitting Criteria, Decision Tree Construction Algorithm, Tree pruning. (3 hours)

TEXT / REFERENCES:
DESIGN OF MECHANICAL DRIVES:

Gears: Bevel Gears - nomenclature, straight teeth bevel gears, cone angle, virtual number of teeth, face width, gear tooth force analysis, static strength, dynamic strength, wear strength. Worm Gears - nomenclature, materials, reversibility, mechanical advantage, gear tooth force analysis, strength design, efficiency, heat dissipation. (10 hours)

Sliding Contact Bearings: Journal bearings, bearing modulus, sommerfeld number, coefficient of friction, mechanism of film lubrication, eccentricity and minimum oil film thickness, temperature rise, oil flow, heat generation & dissipation. (5 hours)

Belt Drives: Power transmission, flat and V- belts, ratio of belt tensions, centrifugal tension, power rating, V-flat drives, pulleys, selection of belts and pulleys. (3 hours)

Wire Rope Drives: Types & construction of wire ropes, loads & stresses in ropes, selection of wire ropes. (2 hours)

Chain Drives: Types of power chains, chordal action, sprocket size & teeth, chain speed, Selection of roller chains. (2 hours)

Mechanical Brakes: Block brakes, Band brakes, Pivoted shoe brakes, disc brakes, torque capacity, heat dissipation. (6 hours)

Miscellaneous Topics: Levers, seals, case studies involving field visit and making a design and report on the actual machineries. (8 hours)

TEXT / REFERENCES:


DYNAMICS AND CONTROL OF MECHATRONICS SYSTEMS:
Industrial Feedback controllers – Performance indices, PID controllers, tuning – Ziegler – Nicholas Tuning Methods, Design of PID controllers – Frequency Response Approach, Computational optimization, Modified PID scheme, Two degrees of freedom control, Zero placement Approach. (6 hours)

Introduction to State Space Analysis - State space representations - Canonical form, observable forms, diagonal form, Jordan form, eigen vectors and eigen values, invariance of eigen values, state space formulation of transfer functions, state space modeling of physical systems - inverted pendulum, ball and beam system, cruise control, armature controlled DC motor, vehicle suspension system (linear systems) (10 hours)


TEXT / REFERENCES:
- Gopal M.,”Modern Control System Theory”, 2/e, New Age International Ltd, 2005.

FPGA BASED DIGITAL SYSTEM DESIGN:
Hardware Description Language: Digital system design methodologies, hardware and software implementation options. Introduction to HDL languages, Xilinx ISE tool. Logic design with Verilog HDL: Structural, dataflow and Behavioral models of combinational and sequential logic, hierarchical modeling, test benches, logic simulation using Xilinx toolset, coding examples. (18 hours)

Design options for digital systems: Digital System implementation using MSI/LSI circuits like PAL, PLA, Programmable ASICs – PLDs, CPLDs, MPgas and FPGAs. FPGA Architectures: ACTEL, XILINX and ALTERA logic families, logic module, switching technology, I/O cells, Programmable interconnect. (10 hours)

Design for testability: Faults, testing combinational and sequential logic, Boundary scan. Synthesis and implementation. Case studies. (8 hours)

TEXT / REFERENCES:
INTRODUCTION TO ALGORITHMS:


Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search Method, Depth First Search, Breadth First Search.


Divide And Conquer: Mergesort, Quicksort, Binary Tree Traversals and Related Properties

Transform And Conquer: Presorting, Balanced Search Trees, Heaps and Heapsort, Problem Reduction


Greedy technique: Prim’s Algorithm, Kruskal’s Algorithm, Dijkstra’s Algorithm, Huffman Trees

TEXT / REFERENCES:


MACHINE TOOL TECHNOLOGY:

Introduction: Elementary treatment of metal cutting theory, element of cutting process, Cutting Tools Classification, Nomenclature of single point cutting tool, geometry of single point tool angles, chip formation and types of chips, built up edge and its effects chip breakers, mechanics of orthogonal cutting, Forces acting on a tool, Merchant’s force diagram, Velocity relations, specific energy in cutting, cutting forces, cutting speeds, feed, depth of cut, Lathe tool Dynamometer.

(10 hours)

Tool Wear: Tool Wear, Tool life Factors affecting tool life, Taylor’s Tool life Equation, Tool wear mechanisms, Types of tool wear, Heat distribution in metal cutting, Measurement of
temperature in metal cutting. (8 hours)

Cutting Tool Materials: Requirements of tool materials, advances in tool materials, HSS, Coated HSS, Carbides, Coated Carbides, Ceramics, Cold pressed, Hot Pressed, Ceramic Composites, CBN, Diamond- properties, Advantages and Limitations, Specifications for Inserts and tool holders. (6 hours)

CNC Tooling: Turning tool geometry, Milling tooling systems, types of motion controls in CNC machines, Tool presetting, automated tool & pallet changing, work holding devices, cutting process parameter selection. (6 hours)

JIGS & FIXTURES: Principles of design of jigs and fixtures and uses, classification of jigs & fixtures, principles of location, Locating devices, 3-2-1 principle of location pin location: Radial location, ‘V’ location, Diamond locators, types of clamping & work holding devices, typical examples of jigs and fixtures. (6 hours)

TEXT / REFERENCES:

MECHANICAL VIBRATIONS:
Introduction to mechanical vibration, vibration system and types, vibration analysis - degrees of freedom, mathematical modeling, equations of motion, SHM, natural frequency of single degree of freedom system – mathematical modeling, derivation of governing differential equation of motion for free undamped and damped systems, forced vibration – single degree of freedom system under harmonic excitation, steady state, reciprocating and rotating unbalance, transmissibility and isolation, base excitation with harmonic input. Two degree of freedom systems - natural frequencies and mode shapes, forced vibration. Natural frequency of multi-degree of freedom systems, vibration control, vibration testing and measurement.

TEXT / REFERENCES:
- Groover G.K., Mechanical Vibrations, Nemchand and Bros, Roorkee, 2012
- Singirisu Rao S, Mechanical Vibration, Pearson Education, Delhi, 2004
- Daniel Imnan J. Engineering Vibration, Prentice Hall, New Delhi, 2001

MICRO - MANUFACTURING SYSTEMS:
Introduction, working principles and process parameters, machine tools, applications of the micro manufacturing processes, challenges in meso, micro, and nanomanufacturing, industrial applications and future scope of micro-manufacturing processes. Different instruments related to micro manufacturing such as microsensors, microactuators, microsystems. Working principles, machine construction, and applications of micromachining, nanofinishing, microjoining, microforming, microcasting, micromolding, LIGA for micro/nano products and features, the diversified industrial applications of the micro-manufactured processes, and recent
research trends in this area.

**TEXT / REFERENCES:**


**NANOTECHNOLOGY:**

Introduction to nanotechnology, bottom-up and top-down approaches, physical and chemical properties, methods of preparation of nanoparticles, carbon nanostructures and their applications, physical chemistry of nanosystems, micro electro mechanical devices and technologies - microsensors, MEMS fabrication processes and applications, microscale and nanoscale heat conduction, nanofluids preparation and characterization, nanomaterials used in energy and environmental applications and their properties, future development of micro actuators, nano-lithography, photoresist patterning, photolithography, electron beam lithography, production of polygon mirrors, optic fibers, future trends in nanotechnology.

**TEXT / REFERENCES:**


**NOISE VIBRATION AND HARSHNESS:**

Sources of noise and vibration, design features, Marque values, noise quality. Pass-by noise requirements, target vehicles and objective targets, sound measurement, human sensitivity and weighting factors, combining sound sources, acoustical resonances. Properties of acoustic materials, transient and steady state response of one degree of freedom system applied to vehicle systems, transmissibility. Modes of vibration, test facilities and instrumentation, signal processing NVH control strategies, source ranking. Noise path analysis, design of experiments, and optimization of dynamic characteristics. Vibration absorbers and Helmholtz resonators, active control techniques.

**TEXT / REFERENCES:**

PRINCIPLES OF SOFTWARE ENGINEERING AND TESTING:

Introduction to the software engineering approach and challenges. Software requirements, problem analysis and requirement specifications, functional specification with use cases. Function oriented design principle, module level concepts, design notations and specifications, structured design methodology. Object oriented design, OO analysis and OO design, OO concepts, unified modeling Language. Programming principle, guidelines, coding process. Testing, black box testing, white box testing. Integration testing as a type of testing, and phase of testing, scenario testing, defect bash. Regression testing types, best practices.

TEXT / REFERENCES:

PRODUCTION AND OPERATION MANAGEMENT:

Introduction, production consumption cycle, forecasting- quantitative and qualitative methods. Forecast control, measures of forecast accuracy product development and design, product life cycle, process design, process charts, flow diagrams and man machine charts capacity planning, breakeven analysis, single and multi-product P-V charts, aggregate planning, trial and error approach, use of transportation algorithm, job shop scheduling, Sequencing of “n” jobs through 2 machines, “n” jobs through 3 machines and 2 jobs through “n” machines inventory management and line balancing, resource conversion and concepts, planning models and behavioural applications, case studies.

TEXT / REFERENCES:
SYSTEM MODELING AND SIMULATION:

Principles of modeling and simulation, modeling and simulation of mixed systems, transfer function, block diagram, state space representation of SISO, MIMO, modeling of dynamic systems, construction, analysis, practical applications, linear systems, methods of model order determination, impulse and frequency response methods, system identification, algorithms for parameter estimation, gradient algorithm, least square algorithm, ARX, ARMAX applications of LS and ARMA methods, regression methods, introduction to nonlinear modeling, identification NARMAX model, case studies UAV quad-rotor, hard discs, maglev systems, ball and beam systems.

TEXT / REFERENCES:

- George Pelz, Mechatronic Systems Modeling and Simulation with HDLs, Wiley, 2003
- Devdas Shetty, Richard Kolk, Mechatronics System Design, (2e), Cengage Learning, 2010

WIRELESS SENSOR NETWORKS:

Challenges for wireless sensor networks, single node architecture, hardware components, energy consumption of sensor nodes, network architecture, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, wireless channel and communication fundamentals, frequency allocation, modulation and demodulation, MAC protocols, contention-based protocols, SMAC – BMAC, TRAMA, IEEE 802.15.4 MAC protocol, Q-MAC (Query MAC), Q-MAC (QoS MAC). Routing challenges and design, SPIN COUGAR, ACQUIRE, LEACH, PEGASIS, GF, GAF, GEAR, Aggregation techniques – TAG, Tiny DB traditional transport control protocols. Wireless LANs: 802.11, 802.11a/b/g, 802.16-WiMAX, UWB communications, wireless personal area networks, BlueTooth. Healthcare monitoring system using wireless sensor networks, remote home lighting and appliance control system, automatic speed control and vehicle tracking using GSM and GPS technologies.

TEXT / REFERENCES:

- Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong Pub, Wireless Sensor Networks Signal Processing and Communications, John Wiley & Sons.
MACHINE LEARNING:


TEXT / REFERENCES:

- Duda and Hast, “Pattern Classification”, 2nd edition.

SEMINAR

IMET 367 0-0-3-1

Students need to present a seminar on a topic of recent developments in their subject filed.
B.Sc. (AERONAUTICAL/AVIATION)

II SEMESTER

MATHEMATICS II

IMA 121

3-1-0-4

Functions with two or more variables, partial differentiation, chain rule, composite and implicit function differentiation, total differentials, error and approximation. Maxima and minima for functions of two or more variables, Lagrange’s method of undetermined multipliers. (8 hours)

Multiple integrals: double and triple integrals, change of order of integration, Jacobian of polar, cylindrical and spherical coordinate systems, change of variables, Application of multiple integrals to find area and volumes. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process. (8 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency, Inverse of invertible matrices by row operations. (6 hours)

Vectors - Vector differentiation, Divergence, Gradient and Curl and their physical interpretation and simple applications. Vector integration, Greens theorem in the plane, Gauss Divergence theorem, Stoke’s theorem and simple applications. (10 hours)

Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (2 hours)

Beta and Gamma functions & their properties. (4 hours)

TEXT/ REFERENCES:


PHYSICS – II

IPH 121

3-0-3-4

Electric Fields: Coulomb’s law, The electric field, Continuous charge distribution, Charged particles in uniform electric field. (3 hours)

Gauss’s Law: Gauss’s law and derivation, Applications to various charge distributions, Conductors in electrostatic equilibrium. (3 hours)

Electric Potential: Potential difference in uniform electric field, Potential and energy due to point charges, Electric field and potential, Continuous charge distributions, Potential due to charged conductor, Applications of electrostatics. (4 hours)
Capacitance and Dielectrics: Calculating capacitance, Combinations of capacitors, Energy in a charged capacitor, Capacitors with dielectrics, Dipole in electric field, Atomic description of dielectrics. (3 hours)

Current and Resistance: Electric current, Resistance, Electrical conduction, Resistance and temperature, Superconductors, Electrical power. (3 hours)

Direct Current Circuits: Electromotive force, Resistors in series and parallel, Kirchhoff’s rules, RC circuits, Electrical meters. (3 hours)

Magnetic Fields: Magnetic fields and forces, Magnetic force acting on a current-carrying conductor, Torque on a current loop in a uniform magnetic field, Motion of a charged particle in uniform magnetic field, Applications, Hall effect. (3 hours)

Sources of the Magnetic Field: The Biot-Savart law, The magnetic force between two parallel conductors, Ampere’s law, The magnetic field of a solenoid, Magnetic flux, Gauss’s law in magnetism, Displacement current and the general form of Ampere’s law, Magnetism in matter. (4 hours)

Faraday’s Law: Faraday’s law of induction, Motional emf, Lenz’s law, Induced emf and electric fields, Generators and motors, Eddy currents, Maxwell’s equations. (3 hours)

Inductance: Self-inductance, RL circuits, Energy in a magnetic field, mutual inductance, Oscillations in an LC circuit, The RLC circuit. (3 hours)


TEXT/REFERENCES:

- Serway & Jewett; Physics for Scientists and Engineers with Modern Physics; Volume 2; 6e, Thomson.
- Halliday, Resnick, Krane; Physics; Volume 2; 5e, John Wiley and Sons, Inc.

PHYSICS LABORATORY:

To perform any 12 of the following experiments:

85. Field along the axis of a coil
86. Energy band gap of a semiconductor
87. Newton’s rings
88. Blackbody radiation
89. Photoelectric effect
90. Charging and discharging of a capacitor / RC time constant
91. Series and parallel resonance circuits
92. e/m – Thomson’s method
93. Fermi energy of a metal
94. Hall effect
95. Zener diode characteristics
96. Hysteresis loss in magnetic materials
97. Half wave and full wave rectifier circuits, C-filter circuit
98. Resistivity of a semiconductor by four probe method

CHEMISTRY
ICH 121 3-0-3-4

Electrochemistry: Introduction to electrochemical cell and its types, Liquid junction potential, EMF of the cell and its determination, Standard cell, Origin of electrode potential, Single electrode potential, Nernst equation for electrode potential, Types of electrodes- hydrogen electrode, Calomel electrode and glass electrode, Numericals.


Chemical Kinetics:
Rate of a reaction, order and molecularity of a reaction, rate law, integrated rate equation and half-life (first and second order reaction), energy of activation, theories of reaction rates-collision theory and transition state theory. Numericals


Organic reactions and mechanisms: Classification of organic compounds, IUPAC system of Nomenclature, Organic reactions and their Mechanisms- Homolytic and heterolytic fission, carbonium ions, carbanions, carbon free radicals, substitution reactions, addition reactions, elimination reactions, rearrangement reactions, Isomerism - structural and stereoisomerism.
TEXT/REFERENCES:


CHEMISTRY LAB

61. Acid-base titration (Acidimetric/Alkalimeter)
62. Determination of hardness of water
63. Determination of chloride content of water
64. Determination of percentage of copper in brass
65. Determination of percentage of nitrogen ammonia in fertilizer
66. Determination of rate constant of hydrolysis of ethyl acetate
67. Colorimetric determination of copper
68. Conductometric titration of a Mixture of strong & weak acids vs strong base
69. Determination of pKa value of a weak acid using pH meter
70. Redox titration using potentiometer

ENGINEERING GRAPHICS –II

IME 121 0-0-3-1

Software: AutoCAD

INTRODUCTION: Importance of sectioning the object, Development of surfaces of solids, Isometric projection, Orthographic projection and its practical applications. (3 hours)

SECTIONS OF SOLIDS: Introduction, Horizontal vertical and inclined section planes and true shape of sections. Drawing sectional views with true shape of section. Simple cases of solids resting on HP or VP with axis perpendicular to reference planes, inclined to one reference plane. Section plane perpendicular to VP, inclined to HP and inclined to VP. (9 hours)

DEVELOPMENT OF SURFACES: Parallel line development for prisms (Triangle, Rectangle, Square, Pentagon and Hexagon) and cylinders (Including simple cut solids), Radial line development for pyramids (Triangle, Square, Rectangle, Pentagon and Hexagon) and cones (Including simple cut solids). (9 hours)

ISOMETRIC PROJECTIONS AND VIEWS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

ORTHOGONPHIC CONVERSIONS: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/REFERENCES:
STRENGTH OF MATERIALS

IME 123

Stress, Strain and Deformation of Solids: Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads. (10 hours)

Beams - Loads and Stresses: Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow. (10 hours)

Torsion: Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts. (8 hours)


Analysis of stresses in two dimensions: Biaxial state of stresses – Thick & Thin cylindrical shells and spherical shells – Deformation in thick & thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr’s circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion. (10 hours)

TEXT/REFERENCES:

INTRODUCTION TO AEROSPACE ENGINEERING AND AVIONICS

IAV 121

Fundamental Thoughts of Aerospace Engineering: History of flight, Ballooning, The source of all aerodynamic forces, Equation of state for a perfect gas, specific volume, anatomy of aircraft and spacecraft, Standard Atmosphere and relationship. (8 hours)

Aerodynamics: Basics of Aerodynamics, Standard atmosphere, Incompressible and compressible flow, elementary thermodynamics, laws of conservations, speed of sound, measurement of airspeed. (8 hours)

Aircraft Flight: Airfoil Nomenclature, Lift, Drag and Moment co-efficient, Elements of Airplane Performance – Equation of Motions for level flight, climbing flight, gliding flight, take-off and landing, Stability and Control, Space vehicle, trajectory and launch vehicle. (8 hours)

Introduction to Space flight mechanics: The two-body problem, Earth-satellite operations, rocket performance, space environments, interplanetary trajectories. (5 hours)


Avionics Systems Essentials I:-Displays, HMI, I/O Devices: Trends in Display Technology, Alphanumeric Displays, Character Displays etc., Basic Components of Displays, CRT Displays, LCDs etc., and their characteristics, Civil and Military Aircraft Cockpits, MFDs, MFK, HUD, DVI, HOTAS, Helmet Mounted Display, Synthetic and enhanced vision, Situation Awareness, Panoramic/big Picture Display, Virtual Cockpit-Civil and Military Electrical Power Requirement Standards, Comparing the Military and Civil Requirements and Tips for Power System Design. (6 hours)


TEXT/REFERENCES: