MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

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 FOURTH SEMESTER

(2023 - 2025)

Applicable for the 2023 Admission Batch

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BACHELOR OF SCIENCE PROGRAMME IN ENGINEERING
RULES & REGULATIONS

1. INTERNATIONAL TRANSFER PROGRAM (ITP) IN ENGINEERING:

International Centre for Applied Sciences (ICAS), Manipal is offering a full time, 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, more than 2,000 students have entered about 100 foreign universities (spread across USA, UK, Australia, Germany, 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
- Chemical
- Civil
- Computer Science & Engineering with Specializations in
  - Artificial Intelligence & Machine Learning (AI&ML)
  - Big Data Analytics (BDA)
  - Cyber Security
- Electrical & Electronics
- Mechanical
- Mechatronics

All 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 academic term is of approximately 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.

Credit Based System: Each subject/course, theory as well as practical, is expressed in terms of a certain number of credits. The credits are determined by the number of contact hours per week. For theory courses, 1 hour of lecture/tutorial per week is assigned 1 credit. For laboratory/practical courses, 3 contact hours per week is assigned 1 credit. A student earns full credits and passes a subject if he/she secures letter grade C or higher in the 4-point fixed grading system, as explained in section 5.6

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
- Starting and Ending of the end semester examination
- Result declaration
- Paper seeing & Revaluation
- Make-up examination
- General Holidays and Co-curricular & Extra-curricular Events

5. ACADEMIC/EXAMINATION REGULATIONS

5.1 Attendance Requirement

- All students must attend every lecture, tutorial and practical (laboratory) classes.
- A minimum of 75% attendance is compulsory to the classes (both theory & laboratory) 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 (both theory & practicals) and will get detained, as per the institute/university attendance regulations.
- In case of laboratory classes, completing all the experiments is a pre-requisite for in-semester/end-semester assessment.

5.2 In-Semester Assessment

- A total weightage of 50 marks is reserved for In-semester Assessment (IA) in theory subjects.
- Two internal tests, each for 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. However, depending upon the subject, faculty can even focus on after-class assignments/engagements by giving mini projects, solving a set of problems, etc.

- 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.

- In case of laboratory courses, In-semester Assessment is for 60 marks which is a continuous evaluation, reflecting the performance of the student in the conduct of the experiment, regularity and timely submission of records/reports. If the laboratory course has a mini-project component, then 20 marks (out of 60) will be earmarked for project report submission & presentation.

5.3 End-Semester Assessment

- The maximum marks for the theory examination are 100. Out of this, 50 marks are for the in-semester assessment and 50 for the end-semester examination.
- The minimum marks (cut-off) for passing a subject is 50% of the total, when the end-semester theory (or practical) & the in-semester assessment marks are put together. Further, in case of theory subjects, a minimum of 35% marks is to be scored in each subject (18 marks out of 50), in the end semester examination, to pass the subject and there will be no choices in the end-semester exam. question paper, as per MAHE university norms.
- The student performance in laboratory (practical) courses is evaluated out of a maximum of 100 marks. Out of this, 60 marks are for the in-semester assessment and 40 for the end-semester lab. examination component. 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.

5.4 Duration of the Examination & Tests

The end-semester examination will be of three hours duration and the in-semester assessment tests will be of one-hour duration each. All the tests and examinations will be conducted in digital mode using e-pads, as per the university norms.

5.5 Mini Projects

Students need to take-up mini projects under the guidance of faculty in a minimum of one in the third semester as well as in the fourth semester laboratory courses.

5.6 Grading System

- Four Point, Fixed Grading system is followed in each course, as follows:

Letter Grade	Percent Equivalent Marks	Grade Value
A (Outstanding)	100 – 90	**4.0**
B+ (Very Good)	89 – 80	**3.5**
B (Good)	79 – 70	**3.0**
C+ (Above Average)	69 – 60	**2.5**
C (Average)	59 – 50	**2.0**
F (Fails)	Below 50	**0.0**

F: Failure **I:** Incomplete **DT:** Detained due to Attendance Shortage

- **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 overall performance of a student in each semester is indicated by the Grade Point Average (GPA) which is the weighted average of the grade points earned. 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.

- Sample Calculation of GPA and CGPA:

Subjects	Credits(C_i)	Letter Grade	Grade Value(G_i)	Credit x Grade Value(CiGi)	Grade Points
MATHS	4	C+	2.5	4x2.5	10
PHYSICS-I	3	C	2	3x2	6
CHEMISTRY	3	B+	3.5	3x3.5	10.5
MOS	4	B	3	4x3	12
TOTAL	14				38.5

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 as the respective course credits, then the
CGPA = (3.0x22+2.91x22+2.80×18+3.95×19) / (22+22+18+19) = 3.15

Generally:

$$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \quad \text{and} \quad CGPA = \frac{\sum_{j=1}^{N} GPA_j \times (\Sigma C_{i)j}}{\sum_{j=1}^{N} (\Sigma Ci)_j}$$

where n = number of courses
C_i = course credit
N = number of semesters
G_i = corresponding grade value

5.7 Appeal Process

- A student can apply for a paper seeing immediately after the announcement of end-semester examination results as per the notification.
- Such students may be allowed to see their answer scripts along with the scheme of evaluation, physically on a scheduled date.
- A student may apply for the revaluation of regular end-semester examination courses (for theory subjects of regular semester, one chance only), by submitting an application along with the specified fee, before the notified deadline.
- ICAS will assign a different examiner for revaluation, as far as possible.
- However, the marks scored in the revaluation of such theory subjects will be final and a binding on the student.
- Fees will be refunded in case of grade improvement.
- There will be no paper seeing/revaluation option for the repeat/supplementary exams.

5.8 Make-up Examination

- Make-up examination in Theory subjects will be held during every semester break (after the announcement of revaluation results) to help the regular students to pass those theory subjects, in which they have got F/I grade only, during the same semester.
- Actual or a maximum of B grade only will be awarded in the make-up examination.
- Those who miss regular examinations due to valid reasons (I grade), will be allowed to retain whatever grade they secure in make-up examinations.
- Make-up examination will be conducted on continuous days and there will be no paper seeing/revaluation options.
- Make-up examination provision is only for the regular students of a particular semester, only once after their end-semester theory examinations.

5.9 Handling Malpractice Cases

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

5.10 Re-registration of Courses

- Students with F/I/DT grade are allowed to re-register for subjects of lower semester along with their regular term subjects by paying the prescribed fees.
- The re-registered student has to fulfill the minimum attendance requirement (75%) to be eligible to write the end-semester examination, by attending classes along with the next batch regular students of that particular semester/year (Odd in Odd and Even in Even semesters, respectively). He/she has to re-build in-semester assessment (IA) marks along with the regular students during this period.
- Such a student cannot claim to revert to the old in-semester assessment marks if the new marks are lower than those of the former attempt.
- Students are eligible to get actual grades in re-registered courses.

5.11 Withholding of Results

Examination results will be withheld when a student has not paid his/her outstanding dues or there is a case of disciplinary action pending against him/her.

5.12 Maximum Academic Duration

- The maximum duration for a student for passing/re-registering in any subject offered, is twice the duration of the academic programme at ICAS, 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.
- 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, fee structure, courses of study and syllabi in force, at the time of re-admission.

5.13 Change of Branch

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.

5.14 Improvement of Grades

- A course successfully completed cannot be repeated for grade improvement. However, in special cases, students may be allowed to reject and repeat the entire semester with the consent of the Associate Director/HOI.
- If a student is eligible for but fails to appear in the end sem. examination due to valid reasons, he/she will be awarded as I grade (Incomplete) on the grade sheet. However, it needs the approval of the Assiciate Director/HOI.
- The student who has got F/I grade in any laboratory/practical subject in the regular semester, will be given one more chance to clear the subject along with the next batch regular students of that particular semester/year (Odd in Odd and Even in Even semesters, respectively) by paying the prescribed fees.

5.15 Evaluation of course with practicals

The grading for courses with practicals will be assessed in the following ways. IA with 40% weightage, end sem. examination with 40% weightage and 20% weightage for practicals.

[For example: If a student has IA marks 30/50, end sem. examination marks 40/50 and practical marks 80/100, the final mark of this subject will be (24 + 32 + 16)/100 i.e. 72/100].

6. STUDENT ATTENDANCE REGULATION

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 (both theory & practicals), 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/end-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 re-registered 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, at the end of the semester.

Sl. No.	Nature of Event	Authority for Endorsement
01	Representing Inter-Institute / Inter-University Sports activity	Director of Physical Education, (MIT/MAHE)

02	Representing Inter-Institute / Inter-University Cultural activity / competitions	Faculty Coordinator of Student Activities, ICAS / Director/Deputy Director, Student Affairs, MAHE
03	Presenting papers in Conferences / Tech. Fests / Research Colloquiums etc.	Faculty Coordinator of Student Activities, ICAS
04	Writing Eligibility Exams like SAT/ TOEFL/IELTS etc. and/or attending Passport/Visa related activities (only in exceptional cases, only for the days of exam/meeting, with proof)	Associate Director, ICAS

Students are advised to check their attendance position regularly from the respective teachers and 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 measures.

7. 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/FAs of their wards, to monitor academic progress.

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. (AERONAUTICAL)

FIRST YEAR - I SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 111	Mathematics – I	3–1-0–4
IPH 111	Physics- I	3–0-0–3
ICE 111	Mechanics of Solids	3–1-0–4
ICS 111	Problem Solving Using Computers	3–1-3–5
IHS 111 IHS 113 IHS 114	A course on Psychology for Engineers / Creative Writing / Communication across Cultures	3–0-0–3
IHS 112	Communication skills in English	3–0-0–3
IME 111	Engineering Graphics - I	0–0-3–1
		18–3-6-23

SECOND SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 121	Mathematics – II	3–1–0–4
IPH 121	Physics – II	3–0–3–4
ICH 121	Chemistry	3–0–3–4
IME 121	Engineering graphics – II	0–0–3–1
IME 123	Strength of Materials	3–1–0–4
IAV 121	Introduction to Aerospace Engineering and Avionics	3–1–0-4
		15–3–9–21

SECOND YEAR – THIRD SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 231	Mathematic-III	3–1–0–4
IME 231	Thermal Engineering	3–1–0–4
IME 232	Manufacturing Process Engineering	4–0–0–4
IME 233	Material Science and Metallurgy	3–0–0–3
IME 234	Fluid Mechanics	3–0–0–3
IAE 231	Geometrical Modelling Lab	0–0–6–2
IAE 232	Avionics Lab	0–0–3-1
IAE 233	Introduction to Aircraft Structures	2–1–0-3
		18–3–9–24

FOURTH SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IHS 241	Engineering Economics & Management	3-1-0-4
ICE 241	Linear Control Theory	2-1-0-3
IAE 241	Aircraft Performance	3-1-0-4
IAE 242	Incompressible Aerodynamics	3-1-3-5
IAE 243	Air breathing Propulsion	3-1-0-4
IAE 244	Numerical Computation Lab	0-0-6-2
		14-5-9-22

B.Sc. (CHEMICAL)

FIRST YEAR - I SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 111	Mathematics –I	3–1-0–4
IPH 111	Physics- I	3–0-0–3
ICE 111	Mechanics of solids	3–1-0–4
ICS 111	Problem solving using computers	3–1-3–5
IHS 111 IHS 113 IHS 114	A course on Psychology for Engineers / Creative Writing / Communication across Cultures	3–0-0–3
IHS 112	Communication skills in English	3–0-0–3
IME 111	Engineering Graphics - I	0–0-3–1
		18–3-6-23

SECOND SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 121	Mathematics – II	3–1-0–4
IPH 121	Physics – II	3–0-3–4
ICH 121	Chemistry	3–0-3–4
IME 121	Engineering Graphics - II	0–0-3–1
ICHM 121	Chemical Process Calculations	3–1-0–4
ICHM 122	Chemical Engineering Thermodynamics	3–1-0–4
		15–3–9-21

SECOND YEAR - THIRD SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 231	Mathematics - III	3–1-0–4
ICHM 231	Fluid Flow Operations	3-0-6-5
ICHM 232	Pollution Control and Safety in Chemical Industry	4-0-0-4
ICHM 233	Process Plant Materials	3-0-0-3
ICH 231	Organic Chemistry	4-0-0-4
ICH 232	Applied Chemistry	3-0-0-3
		20-1-6–23

FOURTH SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB. / CREDITS
IHS 241	Engineering Economics & Management	3–1-0–4
ICHM 241	Chemical Reaction Engineering	3-1-0-4
ICHM 242	Heat Transfer Operations	3-0-6-5
ICHM 243	Mass Transfer	3-0-0-3
ICH 241	Instrumental Methods of Chemical Analysis	3-0-0-3
IBT 231	Bio-Chemistry	3-0-3-4
		18-2-9–23

B.Sc. (CIVIL)

FIRST YEAR - I SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 111	Mathematics –I	3–1-0–4
IPH 111	Physics- I	3–0-0–3
ICE 111	Mechanics of Solids	3–1-0–4
ICS 111	Problem Solving Using Computers	3–1-3–5
IHS 111 IHS 113 IHS 114	A Course on Psychology for Engineers / Creative Writing / Communication across Cultures	3–0-0–3
IHS 112	Communication Skills in English	3–0-0–3
IME 111	Engineering Graphics - I	0–0-3–1
		18–3-6-23

SECOND SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 121	Mathematics – II	3–1-0–4
IPH 121	Physics – II	3–0-3–4
ICH 121	Chemistry	3–0-3–4
IME 121	Engineering Graphics - II	0–0-3–1
ICE 121	Building Science and Technology	3–1-0–4
ICE 122	Mechanics of Structures	3–1-0–4
		15–3–9-21

SECOND YEAR - THIRD SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 231	Mathematics – III	3–1-0–4
ICE 231	Basic Reinforced Concrete Design	3-1-0-4
ICE 232	Fluid Mechanics	3-1-0-4
ICE 233	Geotechnical Engineering	3-1-0-4
ICE 234	Surveying	3-1-3-5
ICE 235	Material Testing Laboratory	0-0-6-2
		15-5-9-23

FOURTH SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IHS 241	Engineering Economics & Management	3–1-0–4
ICE 241	Highway Engineering	3-1-0-4
ICE 242	Building Design and Drawing	0-0-3-1
ICE 243	Water Supply Engineering	4-0-0-4
ICE 244	Basic Structural Steel Design	3-1-0-4
ICE 245	Analysis of Indeterminate Structures	3-1-0-4
ICE 246	Fluid Mechanics Laboratory	0-0-6-2
		16-4-9-23

B.Sc. (COMPUTER SCIENCE & ENGINEERING

FIRST YEAR - I SEMESTER

SUBJECT CODE	SUBJECT NAME	THEORY/TUTORIAL/LAB./ CREDITS
IMA 111	Mathematics –I	3–1–0–4
IPH 111	Physics- I	3–0–0–3
ICE 111	Mechanics of Solids	3–1–0–4
ICS 111	Problem Solving Using Computers	3–1–3–5
IHS 111 IHS 113 IHS 114	A Course on Psychology for Engineers / Creative Writing / Communication across Cultures	3–0-0–3
IHS 112	Communication Skills in English	3–0–0–3
IME 111	Engineering Graphics – I	0–0–3–1
		18–3–6–23

SECOND SEMESTER

SUBJECT CODE	SUBJECT NAME	THEORY/TUTORIAL/LAB./ CREDITS
IMA 121	Mathematics – II	3–1-0–4
IPH 121	Physics – II	3–0-3–4
ICH 121	Chemistry	3–0-0–3
ICS 121	Data Structures	3–1-3–5
ICS 122	Digital Systems and Computer Organization	3–0-3–4
ICS 123	Object-Oriented Programming Using Java	3–0-0–3
		18–2–9-23

SECOND YEAR - THIRD SEMESTER

SUBJECT CODE	SUBJECT NAME	THEORY/TUTORIAL/LAB./ CREDITS
IMA 231	Mathematics – III	3–1-0–4
ICS 231	Database Management Systems	3–0-6–5
ICS 232	Software Design Using Object Oriented Paradigm	3–0-3–4
ICS 233	Design and Analysis of Algorithms	2–1-0–3
ICS 234	Data Analytics with Python	2–1–0–3
ICS 235	Machine Learning	3–0–0–3
		17–3–9-22

FOURTH SEMESTER

SUBJECT CODE	SUBJECT NAME	THEORY/TUTORIAL/LAB. / CREDITS
ICS 241	Embedded Systems	3–0-3–4
ICS 242	Operating Systems	2–1-0–3
ICS 243	Computer Networks	3–1-0–4
ICS 244	Web Programming	3–0-0–3
ICS ***	Program Elective – I	3–0-0–3
ICS ***	Program Elective – II	3–0-6–5
		17–2–9-22

PROGRAM ELECTIVE BASED STREAM SPECIALIZATIONS:

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING:

ICS 245: PROGRAM ELECTIVE - I - ARTIFICIAL INTELLIGENCE
ICS 246: PROGRAM ELECTIVE - II - DEEP LEARNING (DEEP LEARNING LAB)

BIG DATA ANALYTICS:

ICS 247: PROGRAM ELECTIVE – I- DATA WAREHOUSING AND DATA MINING
ICS 248: PROGRAM ELECTIVE – II- BIG DATA ANALYTICS (BIG DATA ANALYTICS LAB)

CYBER SECURITY

ICS 249: PROGRAM ELECTIVE – I- SYSTEMS AND NETWORK SECURITY
ICS 250: PROGRAM ELECTIVE – II- PRINCIPLES OF CRYPTOGRAPHY (CYBER SECURITY LAB)

B.Sc. (ELECTRICAL & ELECTRONICS)

FIRST YEAR - I SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 111	Mathematics –I	3–1-0–4
IPH 111	Physics- I	3–0-0–3
ICE 111	Mechanics of Solids	3–1-0–4
ICS 111	Problem Solving Using Computers	3–1-3–5
IHS 111 IHS 113 IHS 114	A Course on Psychology for Engineers / Creative Writing / Communication across Cultures	3–0-0–3
IHS 112	Communication Skills in English	3–0-0–3
IME 111	Engineering Graphics - I	0–0-3–1
		18–3-6-23

SECOND SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 121	Mathematics – II	3–1-0–4
IPH 121	Physics – II	3–0-3–4
ICH 121	Chemistry	3–0-3–4
IME 121	Engineering Graphics - II	0–0-3–1
IEE 121	Elements of Electrical & Electronics Engineering	3–1-0–4
IEC 121	Digital Systems	3–1-0–4
		15–3–9-21

SECOND YEAR - THIRD SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 231	Mathematics -III	3-1-0-4
IEC 231	Analog Electronics Circuits	3-1-0-4
IEE 233	Signals and Signal Processing	3-1-0-4
IEE 231	Network Analysis	3-1-0-4
IEE 234	Microcontrollers	3-1-0-4
IEC 232	Digital Electronics Laboratory	0-0-6-2
IEE 232	System Simulation Laboratory	0-0-3-1
		15-5-9-23

FOURTH SEMESTER

SUBJECT CODE	SUBJECT		THEORY/TUTORIAL/LAB./ CREDITS
IHS 241	Engineering Economics & Management		3–1-0–4
IEC 241	IC Systems		3–1-3–5
IEE 241	Linear Control Theory		3-1-0-4
IEC/IEE 243	Elective-I	VLSI Design	3–1-0–4
		Power System Analysis	
IEC/IEE 244	Elective-II	Digital System Design using Verilog	3–1-0–4
		Electrical Machines	
IEE 242	Microcontroller Laboratory		0–0-6–2
			15–5–9-23

B.Sc. (MECHANICAL)

FIRST YEAR - I SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 111	Mathematics – I	3 – 1 – 0 – 4
IPH 111	Physics- I	3 – 0 – 0 – 3
ICE 111	Mechanics of Solids	3 – 1 – 0 – 4
ICS 111	Problem Solving Using Computers	3 – 1 – 3 – 5
IHS 111 IHS 113 IHS 114	A Course on Psychology For Engineers / Creative Writing / Communication across Cultures	3 – 0 – 0 – 3
IHS 112	Communication Skills in English	3 – 0 – 0 – 3
IME 111	Engineering Graphics – I	0 – 0 – 3 – 1
		18 – 3 – 6 – 23

SECOND SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 121	Mathematics – II	3 – 1 – 0 – 4
IPH 121	Physics – II	3 – 0 – 3 – 4
ICH 121	Chemistry	3 – 0 – 3 – 4
IME 121	Engineering Graphics - II	0 – 0 – 3 – 1
IME 122	Basic Mechanical Engineering	3 – 1 – 0 – 4
IME 123	Strength of Materials	3 – 1 – 0 – 4
		15 – 3 – 9 – 21

SECOND YEAR - THIRD SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 231	Mathematics – III	3 – 1 – 0 – 4
IME 231	Thermal Engineering	3 – 1 – 0 – 4
IME 232	Manufacturing Process Engineering	4 – 0 – 0 – 4
IME 233	Material Science and Metallurgy	3 – 0 – 0 – 3
IME 234	Fluid Mechanics	3 – 0 – 0 – 3
IME 235	Automobile Engineering	3 – 0 – 0 – 3
IME 236	Computer Aided Mechanical Drawing	0 – 0 – 6 – 2
IME 237	Strength of Materials Laboratory	0 – 0 – 3 – 1
		19 – 2 – 9 – 24

FOURTH SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IHS 241	Engineering Economics & Management	3 – 1 – 0 – 4
IME 241	Theory of Machines	3 – 1 – 0 – 4
IME 242	Design of Machine Elements	3 – 1 – 0 – 4
IMET 243	Industrial Robotics	3 – 0 – 0 – 3
IME 243	Metrology and Measurements	3 – 1 – 0 – 4
IME 244	Fluid Mechanics Laboratory	0 – 0 – 3 – 1
IME 245	Manufacturing Process Laboratory	0 – 0 – 3 – 1
IME 246	Thermal Engineering Laboratory	0 – 0 – 3 – 1
		15 – 4 – 9 – 22

B.Sc. (MECHATRONICS)

FIRST YEAR - I SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 111	Mathematics –I	3–1-0–4
IPH 111	Physics- I	3–0-0–3
ICE 111	Mechanics of Solids	3–1-0–4
ICS 111	Problem Solving Using Computers	3–1-3–5
IHS 111 IHS 113 IHS 114	A Course on Psychology For Engineers / Creative Writing / Communication across Cultures	3–0-0–3
IHS 112	Communication Skills in English	3–0-0–3
IME 111	Engineering Graphics - I	0–0-3–1
		18–3-6-23

SECOND SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 121	Mathematics – II	3–1-0–4
IPH 121	Physics – II	3–0-3–4
ICH 121	Chemistry	3–0-3–4
IME 121	Engineering Graphics - II	0–0-3–1
IME 122	Basic Mechanical Engineering	3–1-0–4
IEE 121	Elements of Electrical and Electronics Engineering	3–1-0–4
		15–3–9-21

SECOND YEAR - THIRD SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IMA 231	Mathematics – III	3–1-0–4
IMET 231	Elements of Mechatronics Systems	3–0–0–3
IMET 232	Kinematics of Machines	2–1–0–3
IMET 233	Measurement and Instrumentation	3–0–0–3
IMET 234	Digital System Design	3–0–0–3
IEC 231	Analog Electronics Circuits	3–1–0–4
IMET 235	CAD Laboratory	0–0–3–1
IEC 232	Digital Electronics Laboratory	0–0–6–2
		17–3–9-23

FOURTH SEMESTER

SUBJECT CODE	SUBJECT	THEORY/TUTORIAL/LAB./ CREDITS
IHS 241	Engineering Economics & Management	3–1-0–4
IMET 241	Introduction to Embedded Systems	3–0–0–3
IMET 242	Automated Manufacturing Systems	3–0–0–3
IMET 243	Industrial Robotics	3–0–3–4
IMET 244	Hydraulics and Pneumatics Systems	3–1-0–4
IMET 245	Programmable Logic Controller Laboratory	0–0–3–1
IMET 246	Linear Control Theory	3–0–0–3
IME 245	Manufacturing Process Laboratory	0–0–3–1
		18–2–9–23

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)

Functions with two or more variables, partial differentiation - basic concepts, Euler Theorem of homogeneous functions, total derivatives, composite functions, implicit functions, chain rule, error and approximation. Taylor's and Maclurin's series for two variables, Maxima and minima for functions of two or more variables, and Lagrange's method of undetermined multipliers. (14 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. (8 hours)

Reduction formulae, curve tracing, application of integration to find arc length, area of the plane regions, surface area of revolution, volume of revolution. (8 hours)

TEXT/ REFERENCES:

1. Calculus and Analytical Geometry - IV Edn., George B. Thomas, Jr. Addison Wesley Publications, 1992.
2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney, Addison Wesley Publications, 1998.
3. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.
4. Calculus, by James Stewart, Cengage Publ. 8th Ed.

PHYSICS - I

IPH 111 **3-0-0-3**

Optics: Electromagnetic waves, significance of Maxwell's equations, energy carried by electromagnetic waves, momentum and radiation pressure, the spectrum of electromagnetic waves.

Interference of Light Waves: Conditions for interference, Young's double-slit experiment, Intensity distribution of the double-slit interference pattern, Interference in thin films, The Michelson Interferometer.

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. (10 hours)

Modern Physics: Introduction to Quantum Physics: Blackbody radiation and Planck's hypothesis, The photoelectric effect, The Compton effect, Photons and electromagnetic waves, The wave properties of particles, The quantum particle, The double-slit experiment revisited, The uncertainty principle. (6 hours)

Quantum Mechanics: An interpretation of quantum mechanics, A particle in a box, The particle under boundary conditions, The Schrodinger equation, A particle in a well of finite height, Tunneling through a potential energy barrier, Applications of tunneling, The simple harmonic Oscillator. (6 hours)

Atomic Physics: Overview of the early models of atom, The quantum model of the hydrogen atom, The wave functions for hydrogen, Physical interpretation of the quantum numbers. More on atomic spectra: visible and X-ray, Spontaneous and stimulated transitions, Lasers. (6 hours)

Molecules and Solids: Molecular bonds, Energy states and spectra of molecules, Free-electron theory of metals, Band theory of solids, Electrical conduction in metals, insulators, and semiconductors, Semiconductor Devices, Superconductivity. (8 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning
2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

MECHANICS OF SOLIDS

ICE 111 3-1-0-4

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. (6 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 (9 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:

1. Meriam & Kraige, Engineering Mechanics, John Wiley & Sons. 2004
2. Beer & Johnston, Vector Mechanics for Engineers, Tata McGraw Hill, 2009
3. Singer F.L., Engineering Mechanics, Harper & Row, 2011
4. E. P. Popov, Mechanics of Materials, S.I. Version, PHI, 2015
5. Pytel and Singer, Strength of Materials, Harper & Collins, 2011
6. I.H.Shames – Engineering Mechanics – Statics & Dynamics II Edn. (SI Version) – Prentice Hall, 1996.
7. Bhavikatti & Rajasekharappa, Engineering Mechanics, New Age International, 2008
8. Bhavikatti S.S., Strength of Materials, Vikas Publishers, 2013
9. Basavarajaiah & Mahadevapp, Strength of Materials, CBS Publishers, 2010

PROBLEM SOLVING USING COMPUTERS

ICS 111 **3-1-3–5**

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 Code: Structure of 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.

(2 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. (3 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. (8 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, Introduction to string, built-in string handling functions. (6 hours)

Structured Programming – Functions: Main function, function prototyping, call by reference, return by reference, inline functions, default arguments, 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, Function overloading Objects and array, Dynamic Memory Allocation and Deallocation.

(10 hours)

Inheritance: Introduction to Inheritance, 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.

(5 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

TEXT/ REFERENCES:

1. Bjarne Stroustrup, "The C++ Programming Language",(4e), Addison Wesley Publication, 2013
2. Robert Lafore, "Object Oriented Programming in C++", (4e), Galgotia Publication, 2001
3. Sourav Sahay, "Object oriented programming with C++",(2e), Oxford Higher Education, 2012.
4. E. Balaguruswamy, "Object Oriented Programming with C++", (6e), Tata McGraw Hill Publication, 2014
5. Stephen Prata, "C++ Primer Plus",(6e), Addison Wesley Publication, 2011
6. Herbert Schield, "The Complete Reference C++", (4e), TMH, 2005.

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, Behavioral 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: Behavioral 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:

1. Feldman, R. S., Understanding psychology. New York: McGraw-Hill, 1993.
2. Myers, D. G. Exploring psychology. New York, NY: Worth Publishers, 2005.
3. Morgan and King (Latest edition) Introduction to Psychology. New York: McGraw-Hill.
4. Paul E. Spector "Industrial and Organizational Psychology: Research and Practice", Wiley, 2016.
5. Michael G. Aamodt, "Industrial Psychology", Cengage, 2013.
6. May Smith, "An Introduction to Industrial Psychology", Read Books, 2007
7. Naylor J. C and Blum M. L, "Industrial Psychology: Its Theoretical and Social Foundations", CBS, 2003.

CREATIVE WRITING

IHS 113 3-0-0-3

Unit I: Introduction/Orientation to the course; Various literary/prose forms and their characteristics: Longform Journalism, Travelogue, Short Fiction, Memoir, Autobiography, Novel (12 Hours)

Unit II: Critical Concepts and Terms in Literary Writing: Narrator, Tone, Voice, Style (10 Hours)

Unit III: Literary Movements: Realism, Modernism, Surrealism, Expressionism, Post-Modernism, Magic Realism, Regional writing (8 Hours)

Unit IV: Imagery: Metaphor, Simile, Personification, Narrative Space, Point of View, Time & Space (6 Hours)

TEXT/ REFERENCES:

1. David Lodge, *The Art of Fiction*, Penguin Books, 1992.
2. Milan Kundera, *The Art of the Novel*, Faber and Faber, 1988.
3. Paul Eschholz and Alfred Rosa, Eds., University of Vermont, *Outlooks and Insights: A Reader for Writers,* St. Martin's Press/New York, 1983.
4. James Moffet, Ed., *Points of View,* University of Chicago Press, 2000.
5. M.H. Abrams, *A Glossary of Literary Terms, Seventh Edition,* Macmillan, 2005.

COMMUNICATION ACROSS CULTURES

IHS 114 3-0-0-3

Culture: self, society and identity; Culture and Perception: Beliefs, Values, and Attitudes; Communication across cultures: Underlying Concepts (04 Hours)

Theories on intercultural communication. Cultural Framework – Theories: Hall's High and Low-context Languages; Monochronic and Polychronic Cultures; Kluckhon, and Strobeck's Value Orientation. (06 Hours)

Theories on intercultural communication: Hofstede's Value Dimensions, Fons Trompenaars cultural categories; Cultures and Communication: Significance of cultural dimensions in cross-cultural communication (10 Hours)

Cultures and Communication: Language and Culture; Family/ customs/ society and cultures; Work Space and cultures; Power and cultures; Gender and Cultures. (06 Hours)

Nonverbal Communication and Culture; Perceptions and cultures; Improving Intercultural **Communication:** Skills, Self-Perception and Intercultural Competence. (06 Hours)

Cross-cultural conflicts: assumptions, challenges –multicultural teams (04 Hours)

TEXT/ REFERENCES:

1. Gannon M J and Pillai R**.** Understanding Global Cultures, Sage Publications, California. 2010.
2. Steers, Richard M., Luciara Nardon, and Carlos J. Sanchez-Runde. Management across cultures: Developing global competencies. Cambridge University Press, 2013.
3. Bowe, Heather, Kylie Martin, and Howard Manns. Communication across cultures: Mutual understanding in a global world. Cambridge University Press, 2014.
4. Samovar, Larry A., et al. Communication between cultures. Cengage Learning, 2016.
5. Ting-Toomey, Stella, and Tenzin Dorjee. Communicating across cultures. Guilford Publications, 2018.

COMMUNICATION SKILLS IN ENGLISH

IHS 112 **3-0-0-3**

Reading- selected texts on different themes, genres and styles, discussion on universal human values, and professionalism. Essential features of Reading- skimming, scanning and critical reading. Critical response to a text. (09 Hours)

Writing: Writing - response writing on themes related to human values , academic writing – essay; mechanics of writing–punctuation, functional grammar, and error identification; Coherence, clarity and completeness in Writing. Paragraph, Essay and Critical Response (09 Hours)

Speech: Oral communication –speech, presentation/Impromptu speeches, Group discussion, Interview techniques, formal/informal communication; Feedback- critical and constructive feedback. Sensitivity in response. (09 Hours)

Listening-Audio Texts/speeches, listening skills; Communication- in a group and interpersonal communication. Barriers and challenges to listening. Effective listening techniques. (09Hours)

TEXT/ REFERENCES:

1. Balasubramanian, P., Phonetics for Indian Students. Mc Milan, Mumbai, 2013.
2. Green, David, Contemporary English Grammar Structure and Composition, Laxmi Publications, 2015.
3. Lewis, Norman, Word Power Made Easy. Goyal Publications, 2020.
4. Nagarazan R S., A text book on Professional Ethics and Human values, New age International Publishers, New Delhi, 2007.
5. Raman, M & Sharma S. Technical Communication: Principles and Practice. Oxford University Press, New Delhi, 2015.
6. Swan, Michael, Practical English Usage, Oxford University Press. London, 2016.

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:

1. Gopalkrishna K. R. and Sudhir Gopalkrishna, "A textbook of Computer Aided Engineering Drawing", 37th Edition, Subhas Stores, Bangalore, 2012.
2. Bhat N. D. and V.M. Panchal,"Engineering Drawing", 50th Edition, Charotar Publishing House, Anand, India, 2010.
3. Venugopal K., "Engineering Drawing and Graphics + Auto CAD" Newage International Publishers, Delhi, 2002.
4. Narayana K. L. and Kannaiah P, "Text book on Engineering Drawing" Scitech Publications, Chennai, 2002.
5. Basant Agrawal& Agrawal C M, "Engineering Drawing" Tata McGraw Hill, New Delhi, 2010.

B.Sc. (AERONAUTICAL)

II SEMESTER

MATHEMATICS - II

IMA 121 **3-1-0-4**

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Regula Falsi method, Secant method and Newton Raphson methods. (6 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.

(12 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:

1. Calculus and Analytical Geometry - IV Edn. - George B. Thomas Jr. Addison Wesley Publications, 1992.

2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney, Addison Wesley Publications, 1998.
3. Linear Algebra - G. H. Hadley, Narosa Publishing House, 2002.
4. Theory and problems of vector Analysis and an introduction to tensor analysis, Murray R. Speigel and others, Tata McGraw Hill Publications, 2011.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

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, Kirrchhoff'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)

Alternating Current Circuits: AC sources, Resistors in an AC circuit, Inductors in an AC circuit, Capacitors in an AC circuit, The RLC series circuit, Power in an AC circuit, Resonance in a series RLC circuit, The transformer and power transmission, Rectifiers and filters.

(4 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning

2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

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 **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)

Chemical equilibrium: Introduction to chemical equilibrium, Laws of mass action. Relation between K_c and K_p, Le-Chatelier principle and its application.
Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Theories of acid-Bases, pH and pOH scale, Buffer, 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, Acid and bases indicators, acid-base titration, Common ion effect, solubility product and its applications. Numericals. (7 hours)

Thermodynamics: Terminology of thermodynamics. First law of thermodynamics. Internal energy, Enthalpy, Heat capacity, heat capacity equations at constant volume and pressure. Calculation of ΔU, ΔH and w for reversible isothermal expansion of an ideal gas.

Thermochemistry - Hess's law and its applications. Limitations of first law.
Second law of thermodynamics. Concept of entropy. Helmholtz Free Energy, Gibbs free Energy, Gibbs Helmholtz equation. Numericals. (4 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)

Chemical bonding: Primary bonding: Ionic bond: Ionic bond formation, Factor influencing the formation of ionic bond, Lattice energy & its determination by Born-Haber cycle, Properties of ionic bond.
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.
Metallic bond: Structure of metals, Electron sea model, band theory of solids, conductors, semiconductors & insulators, Properties of metallic 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, 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. (6 hours)

TEXT/ REFERENCES:

1. Atkins P W, Physical chemistry, 8th Edn, Oxford University Press, Oxford, 2006
2. Levine IraN, Physical chemistry, 6th Edn, McGraw Hill, New York , 2009.
3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. P.C. Jain, M. Jain, Engineering Chemistry, 15th Edn., Dhanpat Rai and Sons, Delhi, Revised, 2006.
5. Arun Bahl and B.S.Bahl, A text book of organic chemistry,18th edn., S.Chand& Co.ltd, New Delhi,2019.

CHEMISTRY LABORATORY:

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)

Orthographic Conversions: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/ REFERENCES:

1. Gopalkrishna K. R. and Sudhir Gopalkrishna, "A textbook of Computer Aided Engineering Drawing", 37th Edition, Subhas Stores, Bangalore, 2012.
2. Bhat N. D. and V.M. Panchal, "Engineering Drawing", 50th Edition, Charotar Publishing House, Anand, India, 2010.
3. Venugopal K., "Engineering Drawing and Graphics + Auto CAD" Newage International Publishers, Delhi, 2002.
4. Narayana K. L. and Kannaiah P, "Text book on Engineering Drawing" Scitech Publications, Chennai, 2002.
5. Basant Agrawal& Agrawal C M, "Engineering Drawing" Tata McGraw Hill, New Delhi, 2010.

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)

Beam deflection: Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope : Double integration method, Macaulay Method, and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns. (10 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:

1. Beer F. P. and Johnston R,"Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.
2. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
3. Ryder G.H, "Strength of Materials", Macmillan India Ltd., Third Edition, 2002.
4. Ray Hulse, Keith Sherwin & Jack Cain (2004"Solid Mechanics", Palgrave ANE Books
5. Singh D.K, "Mechanics of Solids" Pearson Education, 2002.
6. Timoshenko S, "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi, 1997.

INTRODUCTION TO AEROSPACE ENGINEERING AND AVIONICS

IAV 121 3-1-0-4

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)

Introduction to Avionics: Need for Avionics in Civil and Military Aircraft and Space Systems, Integrated Avionics and Weapon Systems, Typical Avionics Sub-systems Design & Technology, Defining Avionics Systems Requirements. (2 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)

Aircraft Navigation: Sensors, Inertial Navigation systems, Satellite Navigation System, Automatic Direction Finding (ADF), VHF Omnidirectional Range (VOR), Instrument Landing Systems (ILS), Hyperbolic Navigation Systems (LORAN), Distance Measuring Equipment (DME), Transponders.

(8 hours)

Landing Systems & Control: Mechanics of Landing, Automatic landing systems, Instruments Landing Systems, Microwave landing Systems, Satellites landing systems, Carrier landing systems, Surveillance systems-radio altimeter, Flight Control and FMS.

(3 hours)

TEXT/ REFERENCES:

1. John D. Anderson. Introduction to Flight, 6th edition; ISBN-13: 978-007-126318-4.
2. Myron Kayton & Walter R. Fried, "Avionics Navigation Systems, 2nd Edition", Wiley-interscience, [May 1997].

3. R.P.G. Collinson, "Introduction to Avionics Systems", Springer, [2002].
4. Dava Newman (2001). Interactive Aerospace Engineering and Design; MIT Press
5. Cary R. Spitzer, "Digital Avionics Handbook: 2nd Edition, Avionics Development and Implementation", CRC Press, Taylor & Francis Group, [2007].

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 and inverse differential operator method. Homogeneous and nonhomogeneous differential equations, solution by the method of undermined coefficients, method of variation of parameters. 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:

1. Elementary differential equations, Rainville E. D., Bedient P. E., Macmillan Publishers(Newyork), 1989.
2. Advanced Engineering Mathematics - Erwin Kreyszig, John Wiley & Sons., 2015.
3. Introductory methods of Numerical Analysis, S. S. Sastry, PHI learning Pvt. Ltd., 2012.
4. Complex Variables, Murray R Spiegel and others, Tata McGraw Hill(New Delhi), 2015.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

THERMAL ENGINEERING

IME 231 **3– 1– 0 – 4**

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)

Power cycles: Vapor power cycle: Simple Rankine cycle, effect of boiler pressure, on Rankine cycle, Reheat Rankine cycle, Mollier chart- simple numericals. Gas power cycles: Air standard cycle-Otto, Diesel cycle, Air standard efficiency-numericals.

(10 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:

1. Cenegel Yunus and Bole Michael, Thermodynamics: An Engineering Approach, McGraw Hill, New York, 2010.
2. Estop and McConkey, Applied Thermodynamics for Engineering Technologies, Pearson Education, Delhi, 2002.
3. Mayhew A. and Rogers B., Engineering Thermodynamics, E.L.B.S. Longman, London, 1994.
4. Van Wylen and G. J. and Sonntag R. E., Fundamentals of Classical Thermodynamics, John Wiley, New York, 1985.
5. Cengel, Thermodynamics and Heat Transfer, McGraw Hills, New York, 1997.

MANUFACTURING PROCESS ENGINEERING

IME 232 **4– 0– 0 – 4**

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 ccutting: 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:

1. Chua C K, Leong K F and Lim C S, Rapid Prototyping: Principles and Applications, World Scientific, Singapore, 2003.
2. Paul DeGarmo E, Black J T and Ronald A. Kohser, Materials and Process in Manufacturing, John Wiley & Sons, Delhi, 2004.
3. Rajput R. K., A Text book of Manufacturing Technology, Laxmi Publications Private Limited, 2011.
4. Khanna O. P., A text book of Production Technology, Dhanpat Rai Publications.
5. Rao P. N., Manufacturing Technology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
6. Serope Kalpakejian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education, Delhi, 2006.
7. Lal M. and Khanna O. P., Foundry Technology, Dhanpat Rai and Sons, New Delhi, 1991.

MATERIAL SCIENCE AND METALLURGY

IME 233 **3– 0– 0 – 3**

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:

1. Avner S.H., Introduction to Physical Metallurgy, (3e), McGraw Hill, 2004.
2. William D. Callister, Materials Science and Engineering, John Wiley & Sons, 2007.
3. Lakhtin Yu., Engineering physical metallurgy and heat treatment, MIR Publishers, 1985.
4. Gupta K.M., Material science, Metallurgy and Engineering Materials, Umesh Publication, 2012.
5. Raghavan V, Material Science and Engineering, (4e), Prentice Hall of India, 1989.
6. Arzamasov, Material Science, MIR Publishers, Moscow, 1989.
7. Clark Donald S., Physical metallurgy for engineers, 1962

FLUID MECHANICS

IME 234 **3– 0– 0 – 3**

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.

(3 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.

(3 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.

(3 hours)

Fluid flow measurements: Venturimeter, 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.

(3 hours)

TEXT / REFERENCES:

1. Streeter V. L. and Beinzamin E., Fluid Mechanics, Willy Intl., New York,1998.
2. Bruce R. Munson, Donald F. Young and Teodore H. Okiishi, Fundamentals of Fluid Mechanics, Wiley, 2005.
3. Modi P. N. and Seth S. M., Hydraulics and Fluid Mechnics, Standard Book House, 2011.
4. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House, New Delhi, 2000.
5. Bansal R. K., Fluid Mechanics and Hydraulic Machines, Laxmi Publication, New Delhi, 2006.
6. Yunus A. Cengel and John M. Cimbla, Fluid Mechanics, Tata McGraw-Hill Publications, 2006.

GEOMETRICAL MODELING LABORATORY

IAE 231 **0 -0 -6- 2**

Sketcher Exercises- 2D, Part Modelling tool for 3D Modelling of components and Assembly Exercises, Generative Wireframe and Surface for Surface Modelling.
Mini Project

TEXT / REFERENCES:

1. Sham R Tickoo "CATIA V5:6R2015 for Designers", CADCIM Technologies, 2009.
2. Jaecheol Koh "Catia V5-6r2014 Surface Design: A Step by Step Guide", Ed. 2, Createspace Independent Publishers, 2015.

AVIONICS LABORATORY

IAE 232 **0-0-3-1**

Digital Circuits, Microprocessor: Assembly Programming, ADC/DAC Interface, Embedded Systems and software, Unmanned Aircraft Systems and Instrumentation, Communication, Autopilot and Payloads, PCB design and manufacturing, Circuit design and simulation-Eagle, Proteus or other software, Aircraft Electrical Test Rig and parameter test and analysis EMI/EMC test, Antenna Design, manufacturing and testing, RADAR, Satellite communication, Testing using VNA, RF Source and Spectrum analyser, aircraft databus, ADS-B, Flight Simulator, UAV flying. MATLAB and Simulink- Nonlinear and Linear six degree of freedom aircraft modeling and simulation, HILS, SILS, NGC etc.

TEXT / REFERENCES:

1. K.V. Shibu: Introduction to Embedded Systems, (Second Edition), McGraw Hill Education India Private Limited; Second edition (Revised on 1 July 2017, old edition, 2009.
2. C.A. Balanis: Antenna Theory - Analysis and Design (4th Edition), John Wiley, 2016.
3. Michael Barr, Anthony Massa: Programming Embedded Systems, Second Edition with C and GNU Development Tools (2nd Edition), O'Reilly Media, 2009.
4. Brian L. Stevens, Frank L. Lewis & Eric N. Johnson: Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems (3rd Edition), Wiley-Blackwell, 2015.
5. Roger Hu: PCB Design and Layout Fundamentals for EMC, Independent Publsihed, 2019.
6. Dr. Reinaldo J. Perez: Handbook of Aerospace Electromagnetic Compatibility, IEEE Press, Wiley, 2018.
7. Mike Tooley and David Wyatt: Aircraft Electrical and Electronic Systems: Principles, Operation and Maintenance (1st Edition), Butterworth-Heinemann: Elsevier, 2009.

INTRODUCTION TO AIRCRAFT STRUCTURES

IAE 233 **2– 1– 0 – 3**

Introduction to Aircraft Structural Components and their functions, Loads on Airframe, Stresses: Tensile, Compressive and Shear [6 hours]

Determination of Stresses on Inclined Planes, Principal Stresses, Strain. Analysis of Plane Truss – Method of Joints – 3 D Truss -Plane Frames - Composite Beam. Propped Cantilevers-- Fixed-Fixed Beam- Clapeyron's Three Moment Equation - Moment Distribution Method. [8 hours]

Strain Energy due to Axial, Bending and Torsional Loads - Castigliano's theorem - Maxwell's Reciprocal Theorem, Unit load Method - Application to Beams, Trusses, Frames, Rings, etc. [8 hours]

Euler buckling of columns, Inelastic buckling, Effect of Initial Imperfections, Beam Columns, Stability of Beams under Transverse and Axial Loads. Theory of pure Bending. Torsion of Beams. [6 hours]

Theory of symmetrical and unsymmetrical bending of beams. Ductile and Brittle Materials Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory – Distortion Theory – Maximum Strain energy theory and simple problems of shaft under combined loading. [8 hours]

TEXT / REFERENCES:

1. Ramamurtham, S., Strength of Materials, 18th edition, Dhanpat Rai Publishing Co, New Delhi, 2014.
2. Megson, T.H.G., Aircraft Structures for Engineering Students, 6th edition, Elsevier ltd., 2017.
3. Donaldson B K, Analysis of Aircraft Structures, Cambridge Aerospace Series, McGraw-Hill, 2008.
4. Timoshenko, S., Strength of materials, Vols. I & II, Princeton, D.Von Nostrand Co., 1988.
5. Peery, D.J., Aircraft Structures, McGraw–Hill, N.Y., 2011.
6. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.

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. (5 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. (5 hours)

Staffing: HR planning, recruitment, development and training. (3 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (5 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:

1. Koontz D, "Essentials of Management", 7th edition, McGraw Hill, New York.
2. Peter Drucker, "The Practice of Management", Butterworth Hein Mann, 2003.
3. Thuesen G. J, "Engineering Economics", Prentice Hall of India, New Delhi, 2005.
4. Blank Leland T. and Tarquin Anthony J., "Engineering Economy", McGraw Hill, Delhi, 2002.
5. Prasanna Chandra, "Fundamentals of Financial Management", Tata Mc-Graw Hill Companies, New Delhi, 2005.

LINEAR CONTROL THEORY

ICE 241 2-1-0-3

Introduction to control systems and mathematical modeling: Terminologies, Classifications and need for control systems. Mathematical modelling, State space representation of electrical, mechanical, electromechanical systems, Transfer function, block diagram representation and reduction, signal flow graph, Masons gain formula. (10 hours)

Time domain analysis: Time response of first and second order systems, Time domain specifications. Steady state error and error coefficients, Definition of Stability: Routh- Hurwitz criteria. (6 hours)

Frequency Domain Specifications: Frequency domain specifications for second order systems. Correlation between frequency domain and time domain specifications.

(2 hours)

Stability analysis: Root-Locus plots, Bode diagrams, Polar plots, Nyquist stability criterion.

(10 hours)

Compensator design: lead, lag and lag-lead compensator, Compensator design using Root-locus and Bode plot.

(8 hours)

TEXT / REFERENCES:

1. K. Ogata, *Modern control engineering*, PHI, (5e), 2011.
2. Norman S. Nise, *Control Systems Engineering*, Wiley India, (5e), 2009.
3. R.C Dorf and R.H Bishop, *Modern Control Systems*, Pearson, (11e), 2013.

AIRCRAFT PERFORMANCE

IAE 241 3-1-0-4

Atmosphere and Flight Speeds: International Standard Atmosphere; Flight Speeds – IAS, CAS, EAS and TAS.

[6 hours]

Review of Aerodynamics and Propulsion: Aircraft Lift and Drag Aerodynamics. Aerodynamic Efficiency. Aircraft Propulsion - Piston Engine - Propeller Aircraft, Turboprop and Turbojet/Turbofan Aircraft, Power and Thrust variation – Altitude and Speed. Specific Fuel Consumption. [10 hours]

Aircraft Performance: Performance Analysis -Steady Level Flight, Stall Speed. Flight Envelope. Climbing and Gliding Performance. Landing and Takeoff Performance. Balanced Field Length. Manoeuvre Load Factor. Level and climb Turn. Loop. Manoeuvre. V-n Diagram. Range and Endurance. Range and Pay Load Trade Off.

[10hours]

.

Mission Performance: Transport and Fighter Aircraft. Mission Analysis

[4 hours]

Energy Heights and Unsteady Flights: Energy Climb Performance. Unsteady Flights – Constant Energy Zoom Climb and Transonic Dive.

[6 hours]

TEXT / REFERENCES:

1. Anderson, Jr, J, D, Aircraft performance and design, McGraw Hill, 1999.
2. Anderson, Jr, J, D: Introduction to flight, Fifth edition, McGraw Hill, 2005.
3. Yechout, T. R: Introduction to aircraft flight mechanics. AIAA, 2003.
4. Pamadi, B: Performance, stability, dynamics and control of an airplane, AIAA,2004.
5. Ruijgrok G,J,J,: Elements of airplane performance, VSSD, 2009.
6. Phillips, W,F,: Mechanics of flight (2e), John Wiley,2010.

INCOMPRESSIBLE AERODYNAMICS

IAE 242 3-1-3-5

Fluid motion Basics:- Streamline, pathline, types of flows, [6 hours]
basic aerodynamics forces, boundary layer, Potential flows: stream function, velocity potential, their properties, Inviscid incompressible flows: [6 hours]
governing equations, Blasius theorem, [6 hours]
boundary layer equations, application of momentum theory [6 hours]
Low speed aerodynamics: airfoils: elementary flows, [2 hours]
Kutta Joukowsky theorems, Kutta condition, circulation theorem , [8 hours]
Flow over a wing: vortex element, downwash , induced drag, effect of aspect ratio, Conformal transformations, Zhokowsky transformation and its application, [6 hours]
Wind Tunnel Techniques. [8 hours]

TEXT / REFERENCES:

1. Anderson, J. D., Fundamentals of Aerodynamics, (5e), McGraw-Hill International, (2011)
2. Houghton, E. L. and Carruthers N.B., Aerodynamics for Engineering Students, (5e), Edward Arnold Publishers Ltd., London, (2003)
3. Clancy L. J., Aerodynamics, Sterling Book House, (2006)
4. L M Milne Thomson, Theoretical Aerodynamics, Courier Corporation, (2011)
5. Ethirajan Radhakrishnan, theoretical aerodynamics, John Willey and Sons, Singapore Pte Ltd, (2013)

AERODYNAMICS & PROPULSION LAB

Introduction to Wind tunnel and Propulsion labs and familiarizing the apparatus, Introduction to wind tunnel and its calibration, flow over a cylinder, Pressure distribution and flow over symmetric and cambered airfoils,Boundary layer calculations, Calculation of zero lift angle and hot wire anemometer, Calculation of drag of a cylinder and airfoil by using wake survey method, Demonstration of 6 component balance and water tunnel visualization, Performance of mini gas turbine, Axial flow fan performance, Free jet and wall jet experiment, Calculation of burning velocity, forced & natural convection, Performance of convergent nozzle, Bomb calorimeter, propeller test rig experiment.

TEXT / REFERENCES:

1. Jewel B Barlow, William H Rae, Alan Pope Low speed wind tunnel testing, Wiley-Interscience, 3rd edition (1999)
2. J.D. Anderson, Fundamental of Aerodynamics, McGraw-Hill Education; 6th edition (2016).
3. George P. Sutton, Rocket Propulsion Elements, Wiley India Pvt Ltd, (2010).
4. National Aeronautics and Space Administration. 1985. Aeronautical Facilities Catalogue. 1: Wind Tunnels (NASA RP-1132). Washington, D.C. National Academies of Sciences, Engineering, and Medicine. 1992. Aeronautical Technologies for the Twenty-First Century. Washington, DC: The National Academies Press. https://doi.org/10.17226/2035.
5. Lab Manuals of Aerodynamics & Propulsion Lab.

AIR BREATHING PROPULSION

IAE 243 **3-1-0-4**

Classification of propulsion systems, difference between airbreathing and non-airbreathing systems; [6 hours]
types of nozzles, isentropic flow in nozzles, Area-Mach number relationship; performance parameters of jet engines, factors affecting thrust, engine performance parameters,
[6 hours]
Ideal and Real Brayton cycles with intercooling, reheating and regeneration, Brayton cycle efficiency, ideal and real Brayton cycles for jet engines, such as, turbojet, turbofan, turboprop and turboshaft engines, [6 hours]
Thrust produced by jet engine, specific thrust, TSFC, specific impulse, performance of a turbojet engine, advantages & disadvantages of jet engines,
[6 hours]
Ramjet engine, classification, construction and working, efficiency of ramjet, advantages & disadvantages, ideal and real cycles, thrust estimation from Ramjet, Pulse jet engines, construction and working, advantages and disadvantages, valved type and valveless pulse jet engines, jet engine components [6 hours]
axial compressors, turbines and combusti on chamber, enthalpy-entropy diagram, velocity triangle, performance estimation of turbomachines, different types of combustion chambers, combustion mechanism and important combustion parameters.
[6 hours]

TEXT / REFERENCES:

1. Kroes Michael J; Wild Thomas W; Aircraft Powerplants, 7th Edition, Tata-Mcgraw-Hill, (2010)
2. Hill Philip, Peterson Carl, Mechanics and Thermodynamics of Propulsion, Addison Wesly. (1992)
3. Roy Bhaskar, Aircraft Propulsion, Elsevier, India, (2008)
4. Mattingly J D, Elements of Propulsion - Gas Turbines and Rockets, AIAA Education series, (2006)
5. El-Sayed Ahmed, Aircraft Propulsion and gas Turbine Engines, Taylor and Francis, CRC press, (2008)
6. Saravanamuttoo, H.I.H., Rogers G.F.C., Cohen H. Gas Turbine Theory, Pearson, (2001)
7. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, (1999)

NUMERICAL COMPUTATION LAB

IAE 244 **0-0-6-2**

Introduction to MATLAB Programming: Basics of MATLAB programming – Array operations in MATLAB – Loops and execution control – Working with files: Scripts and Functions – Plotting and program output; Approximations and Errors; Numerical Differentiation and Integration; Linear equations; Non-linear equations; Regression and Interpolation; Ordinary differential equation (ODE solvers).
Mini Project

TEXT / REFERENCES:

1. Robert J. Schilling and Sandra L. Harries, Applied Numerical Methods for Engineers using MATLAB and C, Thomson Learning Inc., (2000)
2. Brian R Hunt, et al, Guide To MATLAB: For Beginners and Experienced Users, 2 Ed., Cambridge University Press, (2011)
3. Fausett L.V., Applied Numerical Analysis Using MATLAB, 2 Ed., Pearson Education, (2007)
4. Chapra S.C. and Canale R.P., Numerical Methods for Engineers, 5th Ed., McGraw Hill, (2006)
5. william palm, Introduction to MATLAB for Engineers , 3rd edition, 2010

B.Sc. (CHEMICAL)

II SEMESTER

MATHEMATICS - II

IMA 121 **3-1-0-4**

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Regula Falsi method, Secant method and Newton Raphson methods. (6 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.

(12 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:

1. Calculus and Analytical Geometry - IV Edn. - George B. Thomas Jr., Addison Wesley Publications, 1992.
2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney Addison Wesley Publications, 1998.
3. Linear Algebra - G. H. Hadley, Narosa Publishing House, 2002.

4. Theory and problems of vector Analysis and an introduction to tensor analysis, Murray R. Speigel and others, Tata McGraw Hill Publications, 2011.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

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, Kirrchhoff'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)

Alternating Current Circuits: AC sources, Resistors in an AC circuit, Inductors in an AC circuit, Capacitors in an AC circuit, The RLC series circuit, Power in an AC circuit, Resonance in a series RLC circuit, The transformer and power transmission, Rectifiers and filters.

(4 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning
2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

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 **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)

Chemical equilibrium: Introduction to chemical equilibrium, Laws of mass action. Relation between K_c and K_p, Le-Chatelier principle and its application.
Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Theories of acid-Bases, pH and pOH scale, Buffer, 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, Acid and bases indicators, acid-base titration, Common ion effect, solubility product and its applications. Numericals. (7 hours)

Thermodynamics: Terminology of thermodynamics. First law of thermodynamics. Internal energy, Enthalpy, Heat capacity, heat capacity equations at constant volume and pressure. Calculation of ΔU, ΔH and w for reversible isothermal expansion of an ideal gas.

Thermochemistry - Hess's law and its applications. Limitations of first law.
Second law of thermodynamics. Concept of entropy. Helmholtz Free Energy, Gibbs free Energy, Gibbs Helmholtz equation. Numericals. (4 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)

Chemical bonding: Primary bonding: Ionic bond: Ionic bond formation, Factor influencing the formation of ionic bond, Lattice energy & its determination by Born-Haber cycle, Properties of ionic bond.
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.
Metallic bond: Structure of metals, Electron sea model, band theory of solids, conductors, semiconductors & insulators, Properties of metallic 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, 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. (6 hours)

TEXT/ REFERENCES:

1. Atkins P W, Physical chemistry, 8th Edn, Oxford University Press, Oxford, 2006
2. Levine IraN, Physical chemistry, 6th Edn, McGraw Hill, New York , 2009.
3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. P.C. Jain, M. Jain, Engineering Chemistry, 15th Edn., Dhanpat Rai and Sons, Delhi, Revised, 2006.
5. Arun Bahl and B.S.Bahl, A text book of organic chemistry,18th edn., S.Chand& Co.ltd, New Delhi,2019.

CHEMISTRY LABORATORY:

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)

Orthographic Conversions: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/ REFERENCES:

1. Gopalkrishna K. R. and Sudhir Gopalkrishna, "A textbook of Computer Aided Engineering Drawing", 37th Edition, Subhas Stores, Bangalore, 2012.
2. Bhat N. D. and V.M. Panchal, "Engineering Drawing", 50th Edition, Charotar Publishing House, Anand, India, 2010.
3. Venugopal K., "Engineering Drawing and Graphics + Auto CAD" Newage International Publishers, Delhi, 2002.
4. Narayana K. L. and Kannaiah P, "Text book on Engineering Drawing" Scitech Publications, Chennai, 2002.
5. Basant Agrawal& Agrawal C M, "Engineering Drawing" Tata McGraw Hill, New Delhi, 2010.

CHEMICAL PROCESS CALCULATIONS

ICHM 121 3-1-0-4

Introduction to chemical engineering, unit operations, unit processes, importance of chemical engineering. Chemical engineering as profession. (3 hours)

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. (8 hours)

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. (10 hours)

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. (19 hours)

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. (8 hours)

TEXT/ REFERENCES:

1. A. Hougen, K.M. Watson and R. A. Ragatz, Chemical Process Principles, Part – I, CBS publishers and distributors, 2nd edition, 2004.
2. David M. Himmelblau, Basic Principles and Calculations in Chemical Engineering, Eastern Economy ed., Prentice Hall of India (P) Ltd , 7th edition, 2009
3. Richard Felder and Ronald W. Rausseau, Elementary principles of Chemical Processis, 3rd edition, John Wiley and Sons, 2008.

CHEMICAL ENGINEERING THERMODYNAMICS

ICHM 122

3-1-0-4

Basic concepts and definition: internal energy, work, heat, equilibrium, reversible process, intensive and extensive function. First law of thermodynamics for non-flow and flow process, State and path function, Enthalpy, Heat capacity.

(8 hours)

Volumetric properties of pure fluids: PVT behaviour of pure substances, ideal gas law, isobaric, isothermal, adiabatic and polytropic process. equation of state for real gases, the principles of corresponding states, compressibility factors. (8 hours)

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.

(8 hours)

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. (8 hours)

Phase equilibria: Thermodynamic properties of pure substances: fugacity, fugacity coefficient, compressibility factor, activity, partial molar properties, chemical potential, Gibbs-Duhem equation, Property changes of mixing, Duhem theorem. Vapour liquid equilibrium, Phase diagrams for binary solution, Azeotropes and its types. Activity coefficient, Margules van Laar equations, bubble point, dew point calculations. (8 hours)

Chemical reaction equilibria: 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 equilibrium constants. Relation of equilibrium constants to composition: gas-phase reactions, liquid-phase reactions, equilibrium conversions for single reactions: single- phase reactions (8 hours)

TEXT / REFERENCES:

1. K.V. Narayanan, A Text Book of Chemical Engineering Thermodynamics, Prentice Hall of India, 2006.
2. J.M Smith, H.C.VanNess and M.M.Abbot, Introduction to Chemical Engineering Thermodynamics,(7e), McGraw Hill, 2004.
3. 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)

Higher order linear differential equations with constant coefficients and inverse differential operator method. Homogeneous and nonhomogeneous differential equations, solution by the method of undermined coefficients, method of variation of parameters. 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:

1. Elementary differential equations, Rainville E. D., Bedient P. E., Macmillan Publishers (Newyork), 1989.
2. Advanced Engineering Mathematics - Erwin Kreyszig, John Wiley & Sons, 2015.
3. Introductory methods of Numerical Analysis, S. S. Sastry, PHI learning Pvt. Ltd., 2012.
4. Complex Variables, Murray R Spiegel and others, Tata McGraw Hill (New Delhi), 2015.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

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. (3 hours)

Basic equations of fluid flow: Principle of continuity, one – dimensional Euler's equation and Bernoulli's equation and their applications, Impulse momentum equation. (4 hours)

Laminar flow: steady incompressible viscous flow through round pipes, Hagen – Poiseuilli's theory, Flow between parallel plates, Flow through concentric circular annulus, coutte flow. (5 hours)

Turbulence: Semi empirical theories of turbulence, Turbulent flow in smooth pipes, Power law, universal velocity distribution laws, Darcy's equation, losses in pipe flow, pipe flow problems. (5 hours)

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. (5 hours)

Motion of particles through fluids, Stoke's equation, Flow of fluids through beds of solids, Fluidization principles. (4 hours)

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. (4 hours)

Flow measurement : pilot tube, venture and Orifice meters, flow nozzle, variable area meters, compressors and pumps. (6 hours)

TEXT / REFERENCES:

1. McCabe and Smith, Unit operations in Chemical Engineering, McGraw – Hill 7th Edition. 2005
2. Coulson and Richardson, Chemical Engineering Volume I, Elsevier India private limited, 5th Edition. 2006
3. Frank M. White, Fluid Mechanics, McGraw – Hill, 6th edition, 2009

FLUID FLOW OPERATIONS LABORATORY:

The experiments and mini projects are 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.

POLLUTION CONTROL AND SAFETY IN CHEMICAL INDUSTRY

ICHM 232 4-0-0-4

Man and Environment
Concept of ecosystem and Biosphere - Nutrient and hydrologic cycles -Types of pollution- Legislation to environmental pollution- Aspects of pollution control. 10 hours

Pollution analysis and control methods
Evaluation and characterization of wastewater - Treatment methods - advanced wastewater treatment- Sludge and disposal Solid waste management
Ambient air and stack gas sampling analysis for air pollutants - Principles of air pollution Plume behaviour- Meteorological factors affecting air pollution- Equipment for control and abatement of air pollution. 20 hours

Pollution control in chemical process industries
Pollution control of effluent in chemical industries such as Fertiliser, Petroleum refinery, Pulp and paper and Tannery industries. 08 hours

Safety in chemical process industries

Scientific and engineering aspects of safety in industry- Considerations- Hazards of industrial chemicals – Fire and explosion Prevention and control -Ventilation and lighting- Personal protective devices -Legal aspects and labour relations in safety- Cost considerations.

10 hours

TEXT / REFERENCES:

1. S.P. Mahajan, Pollution Control in Process Industries, Tata McGraw Hill, 1990.
2. C.S. Rao Environmental Pollution Control Engineering, Wiley Eastern, 1992.
3. V. Cavaseno Industrial Air Pollution Engineering., McGraw Hill 1980.

PROCESS PLANT MATERIALS

ICHM 233 3–0-0–3

Structure of solids, Iron Carbon diagram, Introduction of nanomaterials and their application in Chemical Engg. (5 hours)

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. (8 hours)

Properties and uses of ferrous metals: Cast iron, plain carbon steels, classification of steel, alloy steels, thermal and electrical insulating materials. (6 hours)

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.

(6 hours)

Plastics as material of construction for chemical plant; PVC, PTFE, glass fiber reinforced plastics – glass, rubber and metal lining of process vessels. (5 hours)

Corrosion resistance: Uniform, galvanic, pitting, crevice, intergranular, erosion, selective leaching and stress corrosion, high temperature oxidation, hydrogen embrittlement, selection of corrosion resistance. Methods of Corrosion measurement. (6 hours)

TEXT / REFERENCES:

1. Fontana M.G. – Corrosion Engineering,3rd edition, McGraw Hill, 2009.
2. Vanvlack – Elements of Material Science, Pearson Education limited, 6th Ed. 2009.
3. T.Pradeep – Nano: The essentials, McGraw Hill, 2011.
4. S.K. Hajra Choudhury – Materials science and processes, Indian Book Distributing Co., 2nd edition, 2008.

ORGANIC CHEMISTRY

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)

Aromatic & Heterocyclic Compounds: Structures of benzene, Theories of aromaticity, Electrophilic substitution reactions of benzene, Effect of substituents in electrophilic substitution, Structure, Preparation and electrophilic substitution reactions of Furan ,Thiophene and Pyrrole, Structure, Preparation, elctrophiic and nucleophilic substitutions of Pyridine, Preparation & Properties of quinoline and Indole. (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, Fluoroscent brightening agents. (8 hours)

TEXT / REFERENCES:

1. M.K. Jain, Modern Organic Chemistry, S.Chand & Co., Delhi, 2020.
2. L. Finar, Organic Chemistry, Vol I, 6th Edn, Longman, Delhi, 2002.
3. R.T. Morrson, R.N, Boyd, Organic Chemistry, 7th Edn., Prentice Hall, Delhi, 2010.
4. Arun Bahl, B.S.Bahl, Organic Chemistry, 22nd Edn, S. Chand & Co., Delhi, 2019.
5. Raj K.Bansal, Synthetic Approaches in Organic Chemistry, Jones & Bartlett Publishers**.**1996.

APPLIED CHEMISTRY

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. (12 hours)

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. (10 hours)

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. (5 hours)

Pharmaceutical and Petroleum Chemistry: Structure and chemistry of antibiotics, Penicillin, Streptomycin, Tetracycline, Chlorampenicol, Sulphadrugs, 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. (9 hours)

TEXT / REFERENCES:

1. Anil Kumar, R.K. Gupta, Fundamentals of Polymer Engineering, Tata McGraw Hill, New Delhi, 2019.
2. M. G. Rao M. Sittig, Dryden's Outlines of Chemical Technology, 3rd edn, East West Press, New Delhi, 2010
3. P. W. Kuchel, G. B. Ralston, Theory and Problems of Biochemistry, Mc Graw Hill, New York, 1998
4. G.T. Austin, Shreve's chemical process industries, McGraw Hill, 5th ed, 2016.
5. G.E. Dryden, Outlines of Chemical Technology, East west press, 3rd edition, New Delhi, 1997.

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. (5 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. (5 hours)

Staffing: HR planning, recruitment, development and training. (3 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (5 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:

1. Koontz D, "Essentials of Management", 7th edition, McGraw Hill, New York.
2. Peter Drucker, "The Practice of Management", Butterworth Hein Mann, 2003.
3. Thuesen G. J, "Engineering Economics", Prentice Hall of India, New Delhi, 2005.
4. Blank Leland T. and Tarquin Anthony J., "Engineering Economy", McGraw Hill, Delhi, 2002.
5. Prasanna Chandra, "Fundamentals of Financial Management", Tata Mc-Graw Hill Companies, New Delhi, 2005.

CHEMICAL REACTION ENGINEERING

ICHM 241 **3- 1 -0 –4**

Kinetics of homogeneous chemical reactions – Rate expressions – Temperature dependence of rate –Differential, integral, half-life and total pressure method –theories, Elementary and Non elementary reaction kinetics - Pseudo, steady state hypothesis – mechanism. (10 hours)

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. (14 hours)

Multiple reaction system – Series and parallel reactions in flow reactors - Product distribution – Yield and selectivity – Maximizing the desired product. (8 hours)

Non-ideal reactor- types of non-idealities, determination of non-idealities by RTD studies. Introduction to non-isothermal and heterogenous reactions. (16 hours)

TEXT / REFERENCES:

1. Scott Fogler H, Elements of Chemical Reaction Engineering, (4e), PHI, 2005.
2. Octave Levenspiel, Chemical Reaction Engineering, (3e), Wiley & Sons, 2003.
3. Rawlings J.B, Ekerd, J.G., Chemical Reactor Analysis and Design Fundamentals Nole Hill 2002.
4. Smith J.M, Chemical Engineering Kinetics, (3e), McGrawl-Hill, International student edition.

HEAT TRANSFER OPERATIONS

ICHM 242 3- 0 -6 –5

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. (11 hours)

Heat Transfer by convection – Types - Natural and Forced convection – Factors influencing heat transfer coefficients – Analogies – Enthalpy balances in an exchanger - Heat Transfer with packed and fluidized bed - Heat transfer in extended surfaces – Fin efficiency, Fin effectiveness. (9 hours)

Heat Exchangers – concept of logarithmic mean temperature difference and overall heat transfer coefficient – dirt factor. Heat exchanger effectiveness. Heat transfer with phase change – Heat transfer to boiling liquids – Types of condensation – Nusselt equation derivation. (10 hours)

Radiation heat transfer – Kirchoff's law – view factor – calculations – radiation exchange between gray bodies – Radiation shield – Net radiation between two parallel planes – Temperature measurement of gases and radiation errors. (6 hours)

TEXT / REFERENCES:

1. J.M. Coulson and J.F. Richardson – Chemical Engineering, Vol.1, 6th ed., Elsevier India private limited , 2006.
2. Kreith- Principles of Heat Transfer, Delmer learning India private limited, 6th Edition, 2007
3. McCabe and Smith- Unit Operations in Chemical Engg., McGraw Hill Co., 7th edition, 2005.
4. Kern D.Q., Process Heat Transfer, McGraw Hill Co., 1st edition, 2009.

HEAT TRANSFER OPERATIONS LABORATORY:

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

Transient Heat Conduction, Combined Convection And Radiation Heat Transfer, Heat Transfer In A Double Pipe Heat Exchanger, Heat Transfer In A Vertical Shell And Tube Condensor, Heat Transfer In A Horizontal Shell And Tube Condensor, Condensation In Finned Tube Heat

Exchanger, Heat Transfer In Bare Tube Heat Exchanger, Forced Convection Heat Transfer In Jacketed Vessel, Pool Boiling, Boiling Point Regime – Determination of Heat Transfer Coefficient, Thermal conductivity of the copper rod, Packed Bed Heat Exchanger.

MASS TRASFER

ICHM 243 **3- 0 -0 –3**

Diffusion: Introduction to mass transfer operations- molecular diffusion in gases and liquids-steady state diffusion under stagnant and laminar flow conditions−diffusion in multi component mixtures−Diffusion in solids−molecular and Knudsen diffusion in porous solids−unsteady state diffusion in solids. (8 hours)

Interphase Mass Transfer and Mass Transfer coefficient: Theories of interphase mass transfer-estimation of mass transfer coefficient - Individual and overall mass transfer coefficients for gas-liquid and liquid-liquid operations−Material balance approach for steady state mass transfer processes−concept of equilibrium curve and operating line−stages and Murphree stage efficiency. (8 hours)

Absorption: Gas Absorption−calculation of number of theoretical stages for Absorption and stripping column (Graphical)−estimation of number of plates by Kremser equation−Packed tower absorber – HETP−HTU and NTU calculations – Design of absorption column−Equipment for gas-liquid operations. (10 hours)

Adsorption: Adsorption−adsorption isotherm−batch and continuous stage wise adsorption operation−unsteady state fixed bed adsorbers−break through curves - process design of adsorption column- Adsorption equipment. (7 hours)

Humidification and Dehumidification: Vapor gas mixtures terminology – Psychometric chart – Water cooling operations–Gas-Liquid contact operations–Adiabatic operations–Types of Equipment – Design calculations – Cooling towers –design of cooling towers–Recirculating Liquid-gas humidification cooling. (3 hours)

TEXT / REFERENCES:

1. R.E. Treybol, “Mass Transfer Operations”, McGraw Hill, 3rd Edition, 1991.
2. W.L.Mc.Cabe, J.C.Smith and P.Harriot, “Unit operations of chemical engineers”, McGraw Hill, 7th edition, 2005.
3. C.J.Geankoplis, “Transport Processes and Unit Operations”, Prentice Hall, 4th Edition, 2003.
4. Coulson J.M and Richerdson J.F, “Chemical Engineering - Volume 2” Elsevier Press, 5th Edition, 2006.

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

ICH 241 **3- 0 -0 –3**

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. (12 hours)

Spectroanalytical Methods: Rotational Spectroscopy, Theory: Rigid diatomic molecules, Non-rigid diatomic molecules, Instrumentation, Applications. IR Spectroscopy: Theory-Molecule as a simple Harmonic Oscillator and anharmonic oscillator, Rotational- Vibrational Spectra of a diatomic molecules, Modes of vibrations of atoms in polytomic molecules, Instrumentation (double beam IR Spectrophotometer), Applications, Raman Spectroscopy: Mechanism of Raman effects, Classical and quantum theories, Applications. UV-Visible spectroscopy: Theory- Types of transitions in organic molecules, Instrumentation (Double beam spectrophotometer), Application-qualitative and quantitative, Spectrophotometry, Beer-Lamberts Law and its deviations. Thermal methods: Theory, Instrumentation (double beam spectrophotometer) Interference, applications. (12 hours)

Thermal Analysis: Thermal methods of Analysis, Thermogravimetry Thermogram. Factors affecting Instrumentation, Application, Derivative Thermal Gravimetry{DTG}, Differential Thermal Analysis. (DTA) Factors affecting DTA, Instrumentation and Applications. (4 hours)

Chromatography: Introduction, Classification, Thin layer chromatography, Experimental Techniques. Gas chromatography, Instrumentation, Carrier gas, Sample injection system, Columns, Detectors-Important properties, Thermal conductivity detector, Flame ionization detector, Electron Capture detectors. Temperature control, Evaluation, Retention volume. Resolution, Qualitative and quantitative Applications, Liquid Chromatography, Column efficiency of liquid Chromatography, High performance liquid chromatography, Instrumentation and applications. (8 hours)

TEXT / REFERENCES:

1. Vogel's Text Book of Quantitative Analysis 5th edn. ELBS, Longman, 1991
2. G. Chatwal, S. Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, New Delhi, 2000
3. H.H. Willard, L.L. Merrit, J.A. Dean, Instrumental Methods of Analysis, 6th edn, CBS Publishers, Delhi, 1986
4. C.N. Banwell, Fundamentals of Molecular Spectra, TMH, 3rd edn. Tata McGraw Hill, New Delhi, 1994
5. D.A. Skoog, J.J. Leary,"Principles of Instrumental Analysis", Sounders College Publishing, 4th Edn, 1992.

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, sucrose. Invert sugars, biomedical importance of disaccharides, oligosaccharides, polysaccharides- starch, glycogen, inulin, cellulose, dextrins, dextrans. Heteropolysaccharides classification. Acidic sulphate free MPS- Hyaluronic acid, chondroitin. Sulphate containing acid MPS-keratan sulphate, chondroitin, heparin, heparin sulphate. Neutral MPS, proteoglycans(O-glycosidic linkage, N-glycosylamine linkage).

(5 hours)

Lipids:Definition, classification of lipids, simple lipids, compound lipids, derived lipids, miscellaneous- with examples. Types of fatty acids- saturated FA, unsaturated FA, branched chain FA, substituted fatty acids, cyclic fatty acids, eicosanoids. Isomerism, essential fatty acids- Biomedical importance, Alcohols, Glycerol, unsaturated alcohols, steroids and sterols. Cholesterol – forms, esterification, colour reactions. Sterols of biological importance – 1,7-dehydrocholesterol, ergosterol, coprosterol. Neutral fats –properties(chemical & physical). Lipases. Lipases. Identification of fats and oils. Phospholipids- definition , classification-phosphatidyl choline. Phospholipases, phosphatidyl ethanolamine,phosphatidyl inositol, phosphatidyl serine, plasmologens, sphingomyelins. Functions of phospholipids. Glycolipids-types of cerebrosides. Gangliosides. (6 hours)

Amino Acids and proteins:Classification of aminoacids[Non-polar amino acids, Aromatic amino acids ,Polar amino acids ,Polar uncharged amino acids, Polar amino acids with positively charged side chains , Polar amino acids with negatively charged side chains. Functions of aminoacids. Essential amino acids, selenocysteine and pyrrolysine. Properties- isomerism, amphoteric nature and isoelectric pH. Proteins- classification of proteins(on the basis of shape & size , functional properties, solubility and physical properties) Simple proteins, conjugated proteins, Derived proteins. General properties of proteins- taste, odour, molecular weight, viscosity, hydration of proteins, heat coagulation, amphoteric nature. Precipitation of proteins. Characteristics of peptide bond, Biologically important peptides. Primary structure of proteins, secondary structure [alpha helix, beta pleated sheet, reverse turn and bends], Tertiary structure, quaternary structure, prions, denaturation, purity of proteins. Structure of haemoglobin.

(6 hours)

Enzymes: Catalytic activity of enzymes, coenzymes, metalloenzymes, classification of enzymes, specificity of enzymes, Mechanism of enzyme action. Lock and key model, induced fit model Michaelis menton constant, Lineweaver burk plot. Factors affecting enzyme action. Enzyme inhibition- competitive , noncompetitive, uncompetitve, allosteric enzymes. Diagnostic applications- lipase, amylase, trypsin, cholinesterase, alkaline phosphatase, acid phosphatase,, transaminases, lactate dehydrogenase, isocitrate dehydrogenase, creatinine phosphokinase. Immobilized enzyme technology. (4 hours)

Blood:Composition, haemoglobin structure and properties, plasma proteins, Normal serum levels, clinical significance Estimations of glucose, urea, creatinine, protein, cholesterol and bilirubin. (3 hours)

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. (3 hours)

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 it 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:

1. Albert L. Lehninger, David L. Nelson.,Textbook of Biochemistry, 2000.
2. Textbook of Medical Biochemistry – MN Chatterjee, Rana Shinde, 7th edition Jaypee Brothers.2008.

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)

B.Sc. (CIVIL)

II SEMESTER

MATHEMATICS - II

IMA 121 **3-1-0-4**

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Regula Falsi method, Secant method and Newton Raphson methods. (6 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.

(12 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:

1. Calculus and Analytical Geometry - IV Edn. - George B. Thomas Jr., Addison Wesley Publications, 1992.
2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney, Addison Wesley Publications, 1998.
3. Linear Algebra - G. H. Hadley,Narosa Publishing House, 2002.
4. Theory and problems of vector Analysis and an introduction to tensor analysis, Murray R. Speigel and others,Tata McGraw Hill Publications, 2011.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

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, Kirrchhoff'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)

Alternating Current Circuits: AC sources, Resistors in an AC circuit, Inductors in an AC circuit, Capacitors in an AC circuit, The RLC series circuit, Power in an AC circuit, Resonance in a series RLC circuit, The transformer and power transmission, Rectifiers and filters.

(4 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning
2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

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 **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)

Chemical equilibrium: Introduction to chemical equilibrium, Laws of mass action. Relation between K_c and K_p, Le-Chatelier principle and its application.
Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Theories of acid-Bases, pH and pOH scale, Buffer, 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, Acid and bases indicators, acid-base titration, Common ion effect, solubility product and its applications. Numericals. (7 hours)

Thermodynamics: Terminology of thermodynamics. First law of thermodynamics. Internal energy, Enthalpy, Heat capacity, heat capacity equations at constant volume and pressure. Calculation of ΔU, ΔH and w for reversible isothermal expansion of an ideal gas.

Thermochemistry - Hess's law and its applications. Limitations of first law.
Second law of thermodynamics. Concept of entropy. Helmholtz Free Energy, Gibbs free Energy, Gibbs Helmholtz equation. Numericals. (4 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)

Chemical bonding: Primary bonding: Ionic bond: Ionic bond formation, Factor influencing the formation of ionic bond, Lattice energy & its determination by Born-Haber cycle, Properties of ionic bond.
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.
Metallic bond: Structure of metals, Electron sea model, band theory of solids, conductors, semiconductors & insulators, Properties of metallic 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, 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. (6 hours)

TEXT/ REFERENCES:

1. Atkins P W, Physical chemistry, 8th Edn, Oxford University Press, Oxford, 2006
2. Levine IraN, Physical chemistry, 6th Edn, McGraw Hill, New York , 2009.
3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. P.C. Jain, M. Jain, Engineering Chemistry, 15th Edn., Dhanpat Rai and Sons, Delhi, Revised, 2006.
5. Arun Bahl and B.S.Bahl, A text book of organic chemistry,18th edn., S.Chand& Co.ltd, New Delhi,2019.

CHEMISTRY LABORATORY:

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)

Orthographic Conversions: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/ REFERENCES:

1. Gopalkrishna K. R. and Sudhir Gopalkrishna, "A textbook of Computer Aided Engineering Drawing", 37th Edition, Subhas Stores, Bangalore, 2012.
2. Bhat N. D. and V.M. Panchal,"Engineering Drawing", 50th Edition, Charotar Publishing House, Anand, India, 2010.
3. Venugopal K., "Engineering Drawing and Graphics + Auto CAD" Newage International Publishers, Delhi, 2002.
4. Narayana K. L. and Kannaiah P,"Text book on Engineering Drawing" Scitech Publications, Chennai, 2002.
5. Basant Agrawal& Agrawal C M,"Engineering Drawing" Tata McGraw Hill, New Delhi, 2010.

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:

1. Neville A. M, "Properties of Concrete", McGraw Hill- Singapore, 1989.
2. SP 20-1991 Handbook on Masonry design and construction
3. SP10-1975 Nomograms for thickness of masonry walls (First reprint September 1991)
4. SP:62 (S&T) :1997 Handbook on Building Construction Practices.
5. “National Building Code”, BIS, New Delhi, 2005.
6. Punmia B.C, "Building Construction", Lakshmi Publications, New Delhi, 2003.

7. Mohan Rai and Jai Singh M.P, "Advances in Building Material and Construction" CBRI Publications, Roorkee, 1986.
8. Shetty M.S., "Concrete Technology", S. Chand and Co., New Delhi, 2006.
9. ITTI, “Engineering Materials”, Tata McGraw – Hill Publishing Co., Ltd., New Delhi, 2003.

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. (4 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 (9 hours)

TEXT/ REFERENCES:

1. Timoshenko, Strength of Materials Vol. I & Vol. II , CBS Publishers & Distributers, New Delhi, 2002
2. James M Gere & Stephen P Timoshenko , Mechanics of Materials , CBS Publishers &Distributers, New Delhi, 2018
3. Basavarajaiah & Mahadevappa, Strength of Materials, CBS Publishers, 2010
4. Reddy C.S., Basic structural analysis, Tata McGraw Hill, New Delhi, 2017
5. Ramamrutham & Narayanan, Strength of Materials, Dhanpat Rai Publishers, 2020

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 and inverse differential operator method. Homogeneous and nonhomogeneous differential equations, solution by the method of undermined coefficients, method of variation of parameters. 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:

1. Elementary differential equations, Rainville E. D., Bedient P. E., Macmillan Publishers(Newyork), 1989.
2. Advanced Engineering Mathematics - Erwin Kreyszig, John Wiley & Sons, 2015.
3. Introductory methods of Numerical Analysis, S. S. Sastry, PHI learning Pvt. Ltd., 2012.
4. Complex Variables, Murray R Spiegel and others, Tata McGraw Hill(New Delhi), 2015.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

BASIC REINFORCED CONCRETE DESIGN

ICE 231 **3 - 1 - 0- 4**

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)

Limit State of Collapse in compression, Design of axially loaded short R.C. columns, uniaxial and Biaxial bending – use of interaction diagram. Design of slender columns, effective length of columns – using SP16 hand book (8 hours)

Design of footing – loads on foundation – Design basis (limit state method).
Introduction to pre-cast, pre-stressed concrete (4 hours)

TEXT / REFERENCES:

1. Shah H.J. " Reinforced Concrete" Vol I, Charotar Publishing house, 2014
2. Sinha N.C. and Roy S.K " Fundamental of Reinforced Concrete" S. Chand and company, 2007
3. Jain A.K. " Reinforced Concrete- limit state design", Nemchand & Brothers, Roorkee, 2012
4. Karve S.R, and Shah V.L., "Limit State Theory and Design of Reinforced Concrete", Structures Publishers, Pune, 1996
5. Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, New Delhi, 2004
6. Unnikrishna Pillai,Devdas Menon, "Reinforced Concrete Design" Tata McGraw Hill Publishing Company Limited, New Delhi, 2017
7. SP-16-1980 Design Aids for Reinforced Concrete IS 456-1978
8. IS 456-2000 code of practice for plain and reinforced concrete.
9. SP 24 : 1983, Explanatory hand book on I S code of practice for plain and reinforced concrete.

FLUID MECHANICS

ICE 232 **3 - 1 - 0- 4**

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. (2 hours)

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. (5 hours)

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) (4 hours)

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. (4 hours)

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). (4 hours)

Dynamics of Fluid Motion: Euler's Equation of motion; Bernoulli's Equation, limitations, modification, applications of Bernoulli's Equation, Venturimeter, Orifice meter, Pitot tube. (4 hours)

Ideal Fluid Flow: Requirements for ideal fluid flow, Rotational and Irrotational flows – Velocity Potential Functions, Stream Function, Flow nets. (4 hours)

Laminar Flow Through Pipes: Reynold's Experiment, steady laminar flow through a circular pipe, Relation between pipe friction factor and Reynold's Number. (3 hours)

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. (5 hours)

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:

1. Streeter V.L. and Wiley E.B., "Fluid Mechanics", McGraw Hill book Co., New York, 1998.
2. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2005.
3. Bansal R. K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publishers, New Delhi, 2010.
4. Jain A.K., "Fluid Mechanics", Khanna Publishers, New Delhi, 2002.
5. Garde R.J., "Fluid Mechanics through problems", New age international Pvt. Ltd., Publishing, New Delhi, 2003.

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:

1. Terzaghi K., and Peck R.B., "Soil Mechanics in Engineering Practice", A Wiley International Edition, 3rd Edition, New York, 1996
2. Taylor D.W., "Fundamentals of Soil mechanics", Asia Publishing house Bombay, 3rd Edition, 2013
3. Ramiah B.K. and Chickanagappa L.S., "Hand Book of Soil Mechanics and Foundation Engg.", Oxford and IBH, 2nd Edition 2006
4. Lambe T.W. and Whitman R.V., "Soil Mechanics", SI Version, John Wiley and Sons, 2012
5. Punmia B.C, "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., 16th edition, 2017.
6. Arora K.R, "Soil Mechanics and Foundation Engineering", Standard, Publishers and Distributors, 7th Edition, 2008
7. Murthy V.N.S., "A Text Book of Soil Mechanics and Foundation, 2006
8. Engineering", SaiKripa, Technical Consultant, Bangalore, 3rd Edition.
9. GopalRanjan and. Rao A.S.R, "Basic and Applied Soil Mechanics", New Age International Pvt. Limited, Publishers, 2nd Edition, 2000

SURVEYING

ICE 234 **3- 1-3-5**

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 description of EDM instruments. (3 hours)

TEXT / REFERENCES:

1. David Clark, "Plane and Geodetic Surveying for Engineers", Vol I and II, 6th Edition, CBS Publication and Distributors, New Delhi, 2004.
2. Norman Thomas, "Surveying", Edward Arnold Publishers (ELBS) London, 2010.
3. Kanetkar T.P. and Kulkarni S.V., "Surveying and levelling", Part I and II, Pune Vidyarthi Griha Prakashana, Pune, 2006.
4. Arora K.R., "Surveying", Vol. I and II, Standard Book House, New Delhi, 2019.
5. Punmia B.C, "Surveying", Vol. I and II, Lakshmi Publications, New Delhi, 2005.

SURVEYING LABORATORY

Leveling: Differential leveling, cross sectioning and reciprocal leveling, sensitiveness of bubble tube. Theodolite: Measurement of horizontal angles by repetition and reiteration methods. Trigonometrical leveling - single plane and double plane methods.

Tachometer: Determination of tacheometer constants. Measurement of distances and elevations.

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.s

Total stations –Demo

TEXT / REFERENCES:

1. Surveying and field work – Vol.1 & 2 by B.C. Punmia, 2005.
2. Plane and geodetic surveying - Vol 1 by David Clark, 2004.
3. Surveying and leveling - Vol 1 by T.P. Kanetkar and Kulkarni, 2006.
4. Higher Surveying by Norman Thomas, 2010.
5. Surveying by Higgins, 2008.

MATERIAL TESTING LABORATORY

ICE 235 **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 hard ness 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).

Cement- Specific gravity, Fineness, consistency, setting times, soundness and strength.

Concrete- workability, Compressive strength

TEXT / REFERENCES:

1. A.J.Fanner - Mechanical testing of materials – Georgenewnes Ltd - London, 2002.
2. H.E. Davis, G.E.Troxell and C.T. Wiskocil, The testing and inspection of Engineering materials, McGraw Hill Book company, 2006 .
3. K.H. Holes - Experimental Strength of materials - The English University Press Ltd., London, 2008.
4. I.S. specification of cement, fine and coarse aggregates and concrete.
5. Laboratory manual of concrete testing (Parts I & II) by V.V. Sastry & M.L. Gambhir, 2006.
6. Properties of concrete by Neville, Pearson Education, India, 2012.
7. Shetty M.S., "Concrete Technology", S. Chand and Co., 2006.
8. Neville and Brooks, "Concrete Technology", Pearson Education, 2003.
9. Singh Gurucharan, "Materials of Construction", Std. Publishers, 1988.

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. (5 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. (5 hours)

Staffing: HR planning, recruitment, development and training. (3 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (5 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:

1. Koontz D, "Essentials of Management", 7th edition, McGraw Hill, New York.
2. Peter Drucker, "The Practice of Management", Butterworth Hein Mann, 2003.
3. Thuesen G. J, "Engineering Economics", Prentice Hall of India, New Delhi, 2005.
4. Blank Leland T. and Tarquin Anthony J., "Engineering Economy", McGraw Hill, Delhi, 2002.
5. Prasanna Chandra, "Fundamentals of Financial Management", Tata Mc-Graw Hill Companies, New Delhi, 2005.

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. (14 hours)

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. (10 hours)

Highway Economics and Finance: -Methods of Economic Analysis- Motor vehicle operation cost, Highway finance. (6 hours)

Highway Drainage System: -Types of highway drainage and its design. (4 hours)

TEXT / REFERENCES:

1. E.J. Yoder, Principles of Pavement Design, 2nd Edition, John Wiley & Sons, Inc. New York, 2011.
2. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, 2003.
3. Khanna S.K and Justo C.E.G., (2001), "Highway Engineering", 8th Edition, Nemchand and Bros., Roorkee, 2001.
4. Kadiyali L.R., "Traffic Engineering and Transportation Planning", 6th Edition, Khanna Publisher, New Delhi, 2000.

BUILDING DESIGN AND DRAWING

ICE 242 0- 0 -3 –1

Introduction to Auto cad: Introduction to Auto CAD for drafting Civil Engineering Drawings

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

(6 hours)

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

(6 hours)

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

a) Wooden and Aluminium doors, with
   i) Fully panelled
b) Fully glazed,
c) PVC doors and Steel doors

d) Collapsible Door, (6 hours)

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

f) Aluminium windows with
   i) Fully glazed Fixed and open able shutters
   ii) Fully glazed Sliding (2 leaves and 3 leaves) (6 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. (6 hours)

Designing and Drawing of Public Buildings: Plan, Elevation and Sectional views of School Building, Bank, and Health Centre for the given Line Diagram. (6 hours)

Plan and elevation of single bed room RCC building with flat roof. (6 hours)

TEXT / REFERENCES:

1. Balagopal Pabhu T.S., Vincent Paul K. and Vijayan C., "Building Design of Civil Engg. Drawing", Spades Publishers, Calicut, 1999.
2. Shah and Kale, "Principle of Building Drawing", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Sharma and Kaul, "Text book of Building Construction", S. Chand, New Delhi, 2008.
4. Rangawala S.C., "Elementary and advanced building Construction", 2008.
5. IS National Building Code – 1970.Limited, 2009.
6. IS National Building Code, 2005.

WATER SUPPLY ENGINEERING

ICE 243 **4- 0 -0 –4**

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:

1. Manual on water supply and treatment CPHEEO, Ministry of Urban development, New Delhi, 2008.
2. Garg S.K., "Environmental Engg. -I", Khanna Publishers, New Delhi, 1999.
3. Birdie G.S., "Water Supply and Sanitary Engg.", Dhanpath Rai and Sons, New Delhi, 1987.
4. B.C. Punmia, "Water Supply and Sanitary Engg.", Dhanpath Rai and Sons, New Delhi, 2016.
5. Fair and Gayer, "Water Supply and Sanitary Engg.", Dhanpath Rai and Sons, New Delhi, 2012.

BASIC STRUCTURAL STEEL DESIGN

ICE 244 **3- 1-0 –4**

Introduction: scope and use of structural steel, Importance of steel construction. Corrosion, Fire protection and fatigue consideration in steel structures. (2 hours)

Limit state method of design: Allowable stress design, Limit state method of design, partial safety factors, and load combinations. (2 hours)

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. (12 hours)

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. (6 hours)

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. (11 hours)

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. (7 hours)

Welded Plate Girders : Elements of plate girder, proportioning of web, proportioning of flanges, self weight of plate girders, stiffeners - Detailed Design. (6 hours)

Design concepts for roof trusses (2 hours)

TEXT / REFERENCES:

1. Martin L.H and Purkiss J.A., "Structural Design of Steelworks to BS 5950", Edward Arnold, London, 1992.

2. Subramanian N., "Design of Steel Structures", Oxford University press, New Delhi, 2010.
3. Duggal S.K., "Limit State method of design of steel structures", Tata McGraw-Hill, Bhavikatti S. S., (2010), "Design of Steel structures", I.K. International Publishing House, New Delhi, 2010.
4. IS 800-2007: General construction in steel-Code of practice (third revision), Bureau of Indian Standards, New Delhi.
5. IS 875-1987 (Part III): Code of practice for design loads (other than earthquake) for building structures, Bureau of Indian Standards, New Delhi.
6. BS 5950 (part I) - 1985: Structural us of steelwork in buildings, British Standards Institution, London.
7. SP: (6)-1964: Hand book for Structural Engineers, Bureau of Indian Standards, New Delhi.

ANALYSIS OF INDETERMINATE STRCUTURES

ICE 245 **3- 1 -0 –4**

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:

1. Hibbeler, RC, Structural analysis, Pearson Education, 10th Edition, 2017.
2. Daniel L Schodak, Structures, Pearson Education, 7th Edition, 2013.
3. Reddy C.S., Basic structural Analysis, Tata McGraw Hill, New Delhi, 2004.
4. Ramamrutham, Theory of Structures, Dhanpath Rai & Sons, 10th Edition, New Delhi, 2018.
5. Rao Prakash D.S., Structural Analysis, Universities Press, India, 2008.

FLUID MECHANICS LABORATORY

ICE 246 **0- 0 -6 –2**

The experiments and mini projects are based on following topics:
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:

1. Streeter V.L and Wiley E.B., Fluid Mechanics, McGraw Hill Co. New York, 1998.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics Standard Book House, New Delhi, 2005.
3. Jain A.K., Fluid Mechanics, Khanna Publishers, New Delhi, 2002.
4. Bansal R. K. Fluid Mechanics and Hydraulic Machines, Laxmi Publishers, New Delhi, 2010.

B.Sc. (COMPUTER SCIENCE & ENGINEERING)

II SEMESTER

MATHEMATICS - II

IMA 121 **3-1-0-4**

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. Curvilinear coordinates systems- Spherical and cylindrical coordinate systems. (14 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. (10 hours)

Linear algebra: n-dimensional vectors, vector spaces, linear combination, linear dependence, linear independence, spanning set, basis, Norms, Inner Products, Lengths and Distances Gram-Schmidt orthogonalization process. Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations.

(14 hours)

Linear system of equations: Rank of a matrix, Elementary row operations, Gauss elimination process, consistency, Inverse of invertible matrices by row operations. Matrix Decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization. (10 hours)

TEXT/ REFERENCES:

1. Calculus and Analytical Geometry - IV Edn. - George B. Thomas Jr., Addison Wesley Publications, . 1992.
2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney, Addison Wesley Publications, 1998.
3. Stephen H. Friedberg Lawrence E Spence, Arnold J Insel, Elementary Linear Algebra: A Matrix Approach Introduction to Linear Algebra, Second Edition, 2019.
4. David Lay, Steven Lay, Judi McDonald, Linear Algebra and Its Applications, Pearson, 2019.
5. Gilbert Strang, Introduction to Linear Algebra, Fifth Edition (2016), Wellesley-Cambridge Press.

6. Theory and problems of vector Analysis and an introduction to tensor analysis, Murray R. Speigel and others,Tata McGraw Hill Publications, 2011.
7. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

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, Kirrchhoff'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)

Alternating Current Circuits: AC sources, Resistors in an AC circuit, Inductors in an AC circuit, Capacitors in an AC circuit, The RLC series circuit, Power in an AC circuit, Resonance in a series RLC circuit, The transformer and power transmission, Rectifiers and filters.

(4 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning
2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

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 **3–0-0-3**

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)

Chemical equilibrium: Introduction to chemical equilibrium, Laws of mass action. Relation between K_c and K_p, Le-Chatelier principle and its application.
Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Theories of acid-Bases, pH and pOH scale, Buffer, 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, Acid and bases indicators, acid-base titration, Common ion effect, solubility product and its applications. Numericals. (7 hours)

Thermodynamics: Terminology of thermodynamics. First law of thermodynamics. Internal energy, Enthalpy, Heat capacity, heat capacity equations at constant volume and pressure. Calculation of ΔU, ΔH and w for reversible isothermal expansion of an ideal gas.

Thermochemistry - Hess's law and its applications. Limitations of first law.
Second law of thermodynamics. Concept of entropy. Helmholtz Free Energy, Gibbs free Energy, Gibbs Helmholtz equation. Numericals. (4 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)

Chemical bonding: Primary bonding: Ionic bond: Ionic bond formation, Factor influencing the formation of ionic bond, Lattice energy & its determination by Born-Haber cycle, Properties of ionic bond.
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.
Metallic bond: Structure of metals, Electron sea model, band theory of solids, conductors, semiconductors & insulators, Properties of metallic 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, 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.
(6 hours)

TEXT/ REFERENCES:

1. Atkins P W, Physical chemistry, 8th Edn, Oxford University Press, Oxford, 2006.
2. Levine IraN, Physical chemistry, 6th Edn, McGraw Hill, New York , 2009.
3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. P.C. Jain, M. Jain, Engineering Chemistry, 15th Edn., Dhanpat Rai and Sons, Delhi, Revised, 2006.
5. Arun Bahl and B.S.Bahl, A text book of organic chemistry,18th edn., S.Chand& Co.ltd, New Delhi,2019.

DATA STRUCTURES

ICS 121 **3-1-3-5**

Template: Concept of Function & Class Template. (2 hours)

Algorithm Analysis: Space Complexity, Time Complexity, Big-oh notation (2 hours)

Recursion: Definition & Examples, Complexity analysis of Recursive algorithms
(5 hours)

STACKS, QUEUES: Stacks: Definitions & implementation, Representation, Operations on Stacks, Applications of Stacks. Definition, Representation, Operations on Queues, Priority Queues, Circular Queues. (8 hours)

LINKED LISTS: Singly Linked List and Doubly Linked Lists, Linked Stacks and Queues, Circular Linked Lists, Applications using linked lists. (12 hours)

TREES AND THEIR APPLICATIONS: Terminology, Representation of Trees, Binary Trees, Binary Tree Traversals, Additional Binary Tree Operations, Threaded Binary Trees, Binary Search Trees- Definition, Searching a Binary Search Tree, Inserting into and Deletion from Binary Search Tree, Introduction to the concepts of Optimal Binary Search Trees, Height Balanced Trees - AVL Trees. (12 hours)

Graphs: Types of Graphs, Representation - Adjacency Matrix, Adjacency Lists, Traversals- Depth-First Search and Breadth-First Search, (7 hours)

DATA STRUCTURES LABORATORY

Examples of Template, 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, Graph.

TEXT/ REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, Dinesh P. Mehta "Fundamentals of Data Structures in C ++" , Universities Press, 2nd Edition, 2008.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", (5e),Careermonk Publications, 2016.
3. Tenenbaum Aaron M., LangsamYedidyah, Augenstein Moshe J., "Data Structures using C and C++", (2e), Prentice Hall of India Ltd., 2012.
4. Mark Allen Weiss, "Algorithms, Data Structures and Problem solving with C++",(3e), Addison Wesley , 2006.

DIGITAL SYSTEMS AND COMPUTER ORGANIZATION

ICS 122 **3-0-3-4**

Logic gates and Karnaugh maps, Combinational logic design, Decoding, Encoding, Selecting, Binary Adders, Subtractors, Sequential Circuit, Latches, Flip-Flops, Sequential Circuit Design, Registers and Register transfers, Microoperations Multiplexer and Bus-Based Transfers for Multiple Registers, Counters and Bus structure, Microprogrammed Control, Instruction set architecture, Addressing Modes, Floating-Point Computations, Computer Design basics, Arithmetic/Logic Unit, Hardwired Control, Memory systems, SRAM ICs, DRAM ICs, Cache Memory, Virtual M:emory, I/O Interfaces, Interrupts, Direct Memory Access

TEXT/ REFERENCES:

1. M. Morris R. Mano, Charles R. Kime, Tom Martin, *Logic and Computer Design Fundamentals* (5e), Prentice Hall, 2015.
2. John F. Wakerly, *Digital design - Principles and practice* (4e), Pearson Education, 2013.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, *Computer Organization and Embedded Systems*, (6e), Mc Graw-Hill, 2012.

OBJECT-ORIENTED PROGRAMMING USING JAVA

ICS 123 **3-0-0-3**

Introduction : The Java Language, The Key Attributes of Object Oriented Programming, The Java Development Kit, A First Simple Program, Programming Basics, The Java Keywords, Identifiers in Java, The Java Class Libraries. (1 hours)

Language Basics: Java's Primitive Types, Literals, Variables, Scope and Lifetime of Variables, Operators and Operator Precedence, Expressions, Input, Control Structures, Arrays and Strings. (2 hours)

Inroduction 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. (6 hours)

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 (2 hours)

Exception Handling: Exception Hierarchy, Exception Handling Fundaments, Consequences of an Uncaught Exception, Handling Errors through Exceptions, Using Multiple catch Clauses, Nesting try blocks, Throwing an Exception, Closer look at Throwable, Using finally, Using throws, Built-in Exceptions, Creating Exception Subclasses. (5 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)

Event Handling: Understanding the event model, handling the basic events. (4 hours)

* Note: Weekly one hour tutorial is suggested to get hands-on experience [Extra hour to be incorporated in Time Table].

TEXT/ REFERENCES:

1. Herbert Schildt and Dale Skrien, "Java Fundamentals – A Comprehensive Introduction", McGrawHill, First Edition, 2013.
2. Herbert Schildt, "The Complete Reference JAVA 2", Tata McGrawHill, 8th Edition 2011.
3. Dietel and Dietel, "Java How to Program", 9th Edition, Prentice Hall India, 2012.
4. Steven Holzner, "Java 2 programming BlackBook",DreamTech,India 2005.

III SEMESTER

MATHEMATICS - III

IMA 231 **3-1-0-4**

Two Basic Counting Principles, Simple Arrangements and Selections Arrangements and Selections with Repetitions, Distributions, Binomial Identities, Generating Function Models, Calculating Coefficients of Generating Functions, Partitions, Exponential Generating Functions. (14 hours)

Basic Set theory, Axioms of probability, Sample space, conditional probability, total probability theorem, Baye's theorem. One dimensional and Two-dimensional random variables, mean and variance, properties, Chebyschev's inequality, correlation coefficient.
(10 hours)

Distributions: Binomial, Poisson, Exponential, Normal and Chi-square. (8 hours)

Functions of random variables: One dimensional and Two-dimensional, Moment generating functions. (10 hours)

Optimization: Basic solution, Convex sets and function, Simplex Method, Constrained Optimization. (6 hours)

TEXT / REFERENCES:

1. P.L. Meyer "Introduction to probability and Statistical Applications",2nd edition, Oxford and IBH publishing, Delhi, 1980.
2. Miller, Freund and Johnson, "Probability and Statistics for Engineers", 8th Edn., PHI, 2011.
3. Ross Sheldon M, "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, 2010.
4. Alan tucker, Applied Combinatorics, Wiley Publishers, 2012.
5. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
6. Hamdy A. Taha, "Operations Research: An Introduction", 8th Edn., Pearson Education 2008.
7. E. S. Page, L. B. Wilson, An Introduction to Computational Combinatorics, Cambridge University Press.

DATABASE MANAGEMENT SYSTEMS

ICS 231 **3-0-6–5**

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, NoSQL, Sharding.

Relational Model: Structure of Relational Databases, Database Schemas, Keys, Schema Diagrams, Relational Query Languages, Relational Operations, Relational Algebra – Fundamental Operations, Formal Definition of Relational Algebra, Extended Relational Algebra Operations. (07 hours)

Structured Query Language: 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. (08 hours)

Database Design Using E-R Model: Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity- Relationship Diagrams, Entity-Relationship Design Issues, Extended E-R Features, Reduction to Relational Schemas.

Normalization: Features of Good Relational Design, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies. (10 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. Bitmap Indices.

Transaction Management: Transaction Concept, A simple Transaction model, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity, Transaction Isolation Levels, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm. (11 hours)

TEXT / REFERENCES:

1. Silberschatz, Korth, Sudarshan, Database System Concepts, (6e), McGrawHill, New York, 2011.
2. Pramod J Sadalage, Martin Fowler, NoSQL Distilled, Addison-Wesley, 2013.
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, Fundamentals of Database Systems, (6e), Pearson Education, United States of America, 2011.
4. Thomas Connolly, Carolyn Begg, Database Systems – A Practical Approach to Design, Implementation and Management, (4e), Pearson Education, England, 2005.
5. Peter Rob, Carlos Coronel, Database Systems–Design, Implementation and Management, (10e), Course Technology, Boston, 2013.

DATABASE MANAGEMENT SYSTEMS LABORATORY

MS Access, Introduction to SQL, Intermediate SQL, Integrity Constraints in SQL, Additional Exercises on SQL, PL/SQL Basics, Exception Handling and Cursors, Additional Cursors constructs and Transactions, Procedures, Functions and Packages, Triggers,
Mini Project

TEXT / REFERENCES:

1. Silberschatz, Korth, Sudarshan, Database System Concepts, (6e) McGrawHill, 2011.
2. Ivan Bayross, SQL, PL/SQL, (3e), BPB Publications
3. G, Reese, Database Programming with JDBC And Java, (2e), O'REILLY, 2000.

SOFTWARE DESIGN USING OBJECT ORIENTED PARADIGM

ICS 232 **3–0-3–4**

Introduction: Procedure and Objected oriented systems, Need for Object Oriented systems, OO Development, OO themes, Modeling, Abstraction, Three Models, Object and Class concepts. (03 hours)

Object Oriented Paradigms in Java: Introduction to Java language, Introduction to Classes and Objects in Java, Methods in Java, Inheritance in Java, Interfaces in Java, Packages in Java (6 hours)

Structural Modeling: Class and Object Concepts – Enumerations, Multiplicity, Scope, Visibility, Link and Association – Association ends, N-ary association, Aggregation versus Association, Aggregation versus Composition, Operations, Abstract Classes, Generalization - Nested Generalization, Metadata, Inheritance - Types, Multiple Inheritance, Reification, Constraints, Derived Data, Packages, Sample model and navigation (07 hours)

Interaction Modeling: Use case models – Actors, Use Cases, Use Case Diagrams, Use Case Relationships – Include, Extend, Generalization, Combination and Guidelines of Use case relationships.
Sequence Models – Scenario, Sequence diagrams, Diagrams with passive and transient objects, Guidelines.
Activity Models – Activities, Branches, Initiation, Termination, Concurrent activities, Executable, Signals - send and receive, Swimlanes, Flows, Guidelines. (12 hours)

Domain Analysis: Domain Class model, Domain State Model, Domain Interaction Model, Application Interaction Model, Class Model, Operations (03 hours)

State Modeling: Events, States, Transitions and Conditions, State Diagrams and behavior, Nested State diagrams, Nested States, Signal Generalization, Concurrency, Sample State Model, Relation of Class and State Model (03 hours)

Grasp Patterns: Introduction to Patterns, why are they required, Types - Structural, Behavioral, Creational, Designing objects with responsibilities – Creator, Information expert, Low Coupling, High Cohesion, Controller (02 hours)

TEXT / REFERENCES:

1. Object-Oriented Modeling and Design with UML, Second Edition, Michael R Blaha, James R Rumbaugh, Pearson, 2013.
2. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Third Edition, Pearson Education, 2005. Reprint 2015.
3. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Third edition, AddisonWesley, 2003.
4. Herbert Schildt and Dale Skrien, Java Fundamentals – A Comprehensive Introduction, (1e), McGrawHill, 2015.

SOFTWARE DESIGN USING OBJECT ORIENTED PARADIGM LABORATORY

Classes in Java – control access to members, this reference, default and no-argument constructors, set and get methods, static class members, static members, final instance variable, package access. Inheritance – Superclasses and Subclasses, Constructors in subclasses, Class object, Composition vs. Inheritance. Polymorphism and Interfaces – Polymorphism examples, Abstract classes and methods, final Methods and Classes, creating and using interfaces, private Constructors. 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, 2 full case studies – POS and ATM.

TEXT / REFERENCES:

1. Herbert Schildt and Dale Skrien, Java Fundamentals – A Comprehensive Introduction, (1e), McGrawHill, 2015.
2. Dietel and Dietel, Java How to Program, (9e), Prentice Hall India, 2012.
3. Herbert Schildt, The Complete Reference JAVA 2, (10e), Tata McGrawHill, 2017.
4. Steven Holzner, Java 2 Programming Black Book, DreamTech, India, 2005.
5. Bruce Eckel, Thinking in Java, (5e), Prentice Hall, 2013.

DESIGN AND ANALYSIS OF ALGORITHMS

ICS 233 **2-1-0-3**

Introduction: Introduction, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental Data Structures.
Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes,
Mathematical Analysis of Non-recursive and Recursive Algorithms. (8 hours)

Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search Method, Depth First Search, Breadth First Search.

Decrease and Conquer: Insertion Sort, Topological Sorting, Binary Search. (10 hours)

Divide and Conquer: Mergesort, Quicksort, Binary tree traversals and related properties, Multiplication of large integers and Strassen's Matrix Multiplication.
Transform and Conquer: Presorting, Balanced Search Trees, Heaps and Heapsort, Problem Reduction. (10 hours)

Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching, Hashing.
Dynamic Programming: The Knapsack Problem and Memory Functions. (8 hours)

TEXT / REFERENCES:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, India, 2011.
2. Ellis Horowitz and Sartaj Sahni, "Computer Algorithms/C++", 2nd Edition, University Press, India, 2007.
3. Thomas H. Cormen, Charles E. Leiserson, Ronal L, Rivest, Clifford Stein, "Introduction to Algorithms", 2nd Edition, PHI, India, 2006.

DATA ANALYTICS WITH PYTHON

ICS 234 **2–1-0–3**

Basics of Data Analysis With Python: Introduction to Data Science with Python: The Stages of Data Science, Why Python? Python Environment and EditorsThe Basics of Python Programming, Fundamental Python Programming Techniques, Data Cleaning and Manipulation

Techniques, Abstraction of the Series and Data Frame, Running Basic Inferen-tial Analyses. The Importance of Data Visualization in Business Intelli-gence: Shifting from Input to Output, Why Is Data Visualization Important?, Why Do Modern Businesses Need Data Visualization?, The Future of Data Visualiza-tion, How Data Visualization Is Used for Business Decision-Making, Introducing Data Visualization Techniques. Data Collection Struc-tures: Lists, Dictionaries, Tuples, Series, Data Frames, Panels. File I/O Processing and Regular Expressions: File I/O Processing, Regular Expressions. Data Gathering and Cleaning: Cleaning Data, Reading and Cleaning CSV Data, Merging and Inte-grating Data, Reading Data from the JSON, HTML, XML Format. Data Exploring and Analysis: Series Data Structures, Data Frame Data Structures, Data Analysis. (16 Hours)

Data Visualization: Direct plotting: Line Plot, Bar Plot, Pie Chart, Box Plot, Histogram Plot, Scatter Plot Seaborn Plotting System: Strip Plot, Swarm Plot, Box plot, Joint Plot

Matplotlib Plot: Line Plot, Bar Plot, Pie Chart, Stack Plot, Histogram Plot, Scatter Plot Case studies (6 hours)

Data Exploration: Scalars, Vectors, and Spaces, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Log Transform in Action, Power Transforms: Gen-eralization of the Log Transform, Feature Scaling or Normalization, Min-Max Scal-ing, Standardization (Variance Scaling), ℓ2 Normalization, Interaction Features
Feature Selection, Encoding Categorical Variables, One-Hot Encoding, Dummy Coding, Effect Coding, Pros and Cons of Categorical Variable Encodings, Deal-ing with Large Categorical Variables, Feature Hashing, Bin Counting (8 hours)

Regression Clustering and Classification: Relationships between variables: Regression Multivariate Linear Regression Ordinary Least Squares Brain and Body: Regression with one variable Logarithmic transformation Making the Task Easier: Standardisation and Scaling Polynomial Regression Variance-Bias Trade-Off Shrinkage: LASSO and Ridge, Clustering, Clustering with K-Means, Classification, Classification with KNN (6 hours)

TEXT / REFERENCES:

1. Dr. Ossama Embarak, Data Analysis and Visualization Using Python, Apress, 2018.
2. Alice Zheng and Amanda Casari The Feature Engineering for Machine Learning O' Reil-ley publishers 2018.
3. Jesus Rogel-Salazar Data Science and analytics with python, CRC Press 2018
4. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Explor-atory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
5. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publica-tion, 2009.

MACHINE LEARNING

ICS 235 **3-0-0-3**

Introduction To Machine Learning: Different Paradigms Of ML; Perspectives and Issues; Hypothesis Evaluation; VC-Dimensions and Distributions; Bias-Variance Trade-Off; Applications of machine learning, Machine Learning Types. 3 Hours

Data Cleaning and Preprocessing: Identifying missing values in datasets, Techniques for handling missing values: Deletion of missing values, Mean/median imputation, Outlier

detection methods: Z-score method, Data Transformation and Scaling-Standardization Min-max scaling, Identifying, and removing duplicate records, Handling Categorical Data, One-hot encoding. 4 Hours

Feature Engineering: Dataset Understanding, Exploratory Data Analysis – Univariate, Bivariate, Multivariate, Feature Selection-Correlation matrix, Chi-square test, Information gain, Wrapper methods: Forward selection, Backward elimination, Recursive feature elimination (RFE), Irrelevant Feature Effects 4 Hours

Supervised Machine Learning Techniques: Introduction, Example of a Classification Decision Tree, Measure of Impurity for Evaluating Splits in Decision Trees, Logistic Regression, KNN, Naive Bayes, Linear Regression, Support Vector Machines. 7 Hours

Unsupervised Machine Learning Techniques: Unsupervised Learning, Engineering the Data, Overview of Basic Clustering Methods, K-Means Clustering, Expectation-Maximization Algorithm and Gaussian Mixtures Clustering, Hierarchical Clustering 6 Hours

Model Assessment and Ensembles: Approaches Batch Assessment, Rank-Ordered, Assessing Regression Models, Model Ensembles, Bagging, Boosting, Random Forests, Heterogeneous Ensembles. 6 Hours

Neural Network: Neural Networks: Single Laye

r Neural Network; Multilayer Perceptron, Back Propagation Learning, Recurrent Neural Networks; Deep Learning; Convolutional Neural Networks.
6 Hours

TEXT / REFERENCES:

1. Gopinath Rebala, Ajay Ravi, Sanjay Churiwala, An Introduction to Machine Learning, Springer 2019.
2. Miroslav Kubat, An Introduction to Machine Learning, (2e), Springer 2017.
3. Ethem Alpaydin, Introduction to Machine Learning, (2e), MIT Press. 2010.
4. MehryarMohri, AfshinRostamizadeh, and AmeetTalwalkar, Foundations of Machine Learning, MIT Press, 2012.

IV SEMESTER

EMBEDDED SYSTEMS

ICS 241 **3-0-3-4**

Introduction to Embedded Systems and ARM Cortex-M Microcontroller: Introduction to Embedded Systems, Microprocessors and Microcontrollers, An overview of ARM-Cortex- M Architecture: General purpose registers, ARM memory map, Load store instructions in ARM, ARM CPSR, ARM Data format, Pseudo instructions and Directives, Introduction to ARM Assembly Programming, The Program Counter and Program Memory space in the ARM, Some ARM Addressing modes, RISC Architecture in ARM. (05 Hours)

Arithmetic and Logical Instructions, Branch, Call And Looping In ARM: Arithmetic Instructions, Logic Instructions, Rotate and Barrel Shifter, Shift and Rotate Instructions, BCD and ASCII Conversion, Looping and Branch Instructions, Calling Subroutine and Return, Conditional execution, Recursion, Conditional Execution. (10 Hours)

ARM Memory Map, Memory Access and Stack: ARM Memory Map and Memory Access, Advanced Indexed Addressing Mode, Stack and Stack usage in ARM, ADR, LDR and PC Relative addressing. (4 Hours)

Input/Output (IO) Programming: Pin connect block, Pin function select registers, General Purpose Input and Output (GPIO) registers, GPIO configuration, GPIO programming using ARM C language, Interfacing: LEDs, Seven segment, LCD, keyboard. (8 Hours)

Timer Programming: Timer versus counter, timer registers, timer architecture and operation, PWM timer and architecture, PWM programming. (5 Hours)

Interrupt Programming: Hardware and software synchronization, multithreading, Nested Vectored Interrupt Controller (NVIC), external hardware interrupts, IO interrupts.
(4 Hours)

TEXT / REFERENCES:

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Shujen Chen, ARM Assembly Language Programming & Architecture (2e), MicroDigitalEd, 2016.
2. Jonathan W. Valvano., Embedded systems: Introduction to ARM(R) Cortex-M Microcontrollers (5e), Createspace Independent Publishing Platform, June 2014.
3. Jonathan W. Valvano., Embedded systems: Real-time interfacing to ARM Cortex-M Microcontrollers (4e), Createspace Independent Publishing Platform, 2017.
4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 4.1, 2016.
5. Toulson and Tim Wilmshurst., Fast and Effective Embedded System Design applying the ARM mbed, Elsevier, 2017.
6. Joseph V., A definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors (3e), Elsevier, 2014

EMBEDDED SYSTEMS LABORATORY

Assembly Language Programming in ARM using Keil Software: Data transfer instructions, Arithmetic, Logical and Branch instructions, Code conversion, Packing and unpacking of BCD and ASCII data, Sorting, Searching and Recursion

Interfacing Exercises using LPC1768 ARM kit: Interfacing of LEDs, LCD, Keyboard, 7 Segment Display and Interrupt programming.

TEXT / REFERENCES:

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Shujen Chen, ARM Assembly Language Programming & Architecture (2e), MicroDigitalEd, 2016.
2. Jonathan W. Valvano., Embedded systems: Introduction to ARM(R) Cortex-M Microcontrollers (5e), Createspace Independent Publishing Platform, June 2014.
3. Jonathan W. Valvano., Embedded systems: Real-time interfacing to ARM Cortex-M Microcontrollers (4e), Createspace Independent Publishing Platform, 2017.
4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 4.1, 2016.
5. Toulson and Tim Wilmshurst., Fast and Effective Embedded System Design applying the ARM mbed, Elsevier, 2017.
6. Joseph V., A definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors (3e), Elsevier, 2014.

OPERATING SYSTEMS

ICS 242 **2-1-0-3**

Introduction: What Operating Systems Do, Operating System Structure, Operating System Operations, Process Management, Memory Management, Storage Management. OPERATING SYSTEM STRUCTURE: Operating System Services, User and Operating System Interface, System Calls, Types of System Calls, System Programs, Operating System Structure, Virtual Machines, System Boot.

Processes: Overview, Process Scheduling, Operations on Processes, Inter-process Communication.
THREADS: Overview, Multithreaded Models, Thread Libraries. (10 hours)

Process Synchronization: Background, The Critical Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores.
CPU SCHEDULING: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Linux scheduling.

Deadlocks: System Model, Deadlock, Characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock Avoidance. (10 hours)

Main Memory: Logical Versus Physical Address Space, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table.
Virtual Memory: Background, Demand Paging, Copy-On-Write, Page Replacement, Allocation of Frames, Thrashing.

Mass Storage Structure: Disk Structure, Disk Scheduling, Directory and Disk Structure, Disk Management, Swap-Space Management (10 hours)

File-System Interface: File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

Protection: Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix Implementation of Access Matrix. (06 hours)

TEXT / REFERENCES:

1. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts, (9e), Wiley and Sons (Asia) Pte. Ltd, 2013.
2. Milan Milenkovic, Operating systems: Concepts and Design, McGraw Hill, New York, 1987.
3. H. M. Dietel, An Introduction to Operating Systems, Addison Wesley, 1990.
4. Andrew S. Tannebaum, Operating System: Design and Implementation, (3e), Prentice Hall of India, 2008.
5. Maurice J Bach, Design of Unix Operating System, Prentice Hall of India, 1988.

COMPUTER NETWORKS

ICS 243 **3–1-0–4**

Introduction: What is internet?-A Nuts and Bolts Description, A service description, What is protocol?, The Network Edge-Access Networks,Physical Media. The Network Core-Packet Switching, Circuit Switching, A network of Networks. Delay, Loss, and Throughput in Packet Switched Networks-Overview of Delay in Packet-Switched Networks, Queuing delay and Packet Loss, End-to-End Delay, throughput in Computer Networks. Protocol Layers and their Service Models-Layered Architecture, Encapsulation. Principles of Network Applications- Network Application Architecture, Process Communication, Transport Service Available to Applications,Transport services provided by the internet

6 Hours

The Web and HTTP: Overview of HTTP, Non-Persistent and Persistent Connections, HTTP Message Format, User-Service Interaction:Cookies,Web Caching. DNS- Services provided by DNS, Overview of how DNS works,DNS Records and Messages, Peer-to-Peer Applications-P2P File Distribution, Video streaming and Content Distribution Networks-Internet Video,HTTP streaming and DASH,Content Distribution Networks, Socket Programming-Socket programming with UDP, Socket Programming with TCP.

6 Hours

Introduction and Transport: Layer Services-Relationship between Transport and Network Layers,Overview of transport layers in the Internet,Multiplexing and De-multiplexing, Connection-less Transport: UDP-UDP segment structure,UDP Checksum, Principles of Reliable Data Transfer-Building a reliable Data transfer protocol, pipelined Reliable Data transfer protocol,Go=Back-N(GBN), Selective Repeat(SR). Connection Oriented Transport- The TCP Connection, TCP Segment Structure, Round Trip Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management. Principles of Congestion Control-The Causes and costs of Congestion, Approaches to congestion control .TCP Congestion control- Fairness, Explicit Congestion Notification(ECN):Network assisted Congestion control.

6 Hours

Overview of Network layer: Forwarding and Routing, Network Service model, The Internet Protocol (IP)-IPv4 Datagram Format, IPv4 Datagram Fragmentation, IPv4 addressing, Network Address Translation(NAT), IPV6. Generalized Forwarding and SDN.

Routing Algorithms: The Link-State(LS) routing algorithm., The Distance-Vector (DV) Routing Algorithm. Intra-AS Routing in the Internet, Routing Among the ISPs:BGP. ICMP: Internet Control Message Protocol. 6 Hours

Introduction to the Link Layer: Services provided by the link layer,where the link layer is implemented?. Error-Detection and -Correction Techniques-Parity Checks,Checksumming methods, Cyclic Redundancy check(CRC), Multiple Access Links and Protocols-Channel Partitioning Protocols,Random Access Protocols, Taking-Turns Protocols, Switched Local Area Networks and ARP-link Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks(VLANs) 6 Hours

Wireless Links and Network Characteristics: CDMA, WiFi:802.11 Wireless LANs-The 802.11 Architecture, The 802.11 MAC Protocol, IEEE 802.11 Frame. Cellular Internet Access-An overview of Cellular Network Architecture,, 3G Cellular Data Networks: Extending the Internet to Cellular Subscribers,Mobility Management:Principles,Mobile IP.

6 Hours

TEXT / REFERENCES:

1. James F. Kurose & Keith W. Ross, Computer Networking A Top-Down Approach, (7e), Pearson Education, 2013.
2. Larry L. Peterson and Bruce S. Davie, Computer Networks- A Systems approach, (5e), Elsevier, 2016.
3. Behrouz A. Forouzan, Firouz Mosharraf , Computer Networks A top Down Approach, Mc-Graw Hill, 2012.
4. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks, (5e), Pearson Education, 2013.

WEB PROGRAMMING

ICS 244 **3–0-0–3**

Introduction to HTML5 And Css3, Markup, HTML5 Style:

Introducing The HTML5 Herald, A Basic HTML5 Template, HTML5 FAQ, Defining the Page's Structure, Structuring The HTML5 Herald, More HTML5 Semantics, A New Perspective on Types of Content, The Document Outline, Breaking News, More New Elements, Changes to Existing Features, Other New Elements and Features, Validating HTML5 Documents HTML5 Forms Dependable Tools in Our Toolbox, HTML5 Form Attributes, HTML5 New Form Input Types, Other New Form Controls in HTML5, Changes to Existing Form Controls and Attributes HTML5 Audio and Video The Current State of Play, The Markup, Encoding Video Files for Use on the Web, Creating custom controls.

8 Hours

Introducing CSS3 :

Getting Older Browsers on Board, CSS3 Selectors, CSS3 Colors, Putting it into Practice, Rounded Corners: border-radius, Drop Shadows, Text Shadow, More Shadows CSS3 Gradients and Multiple Linear Gradients, Radial Gradients, Repeating Gradients, Multiple Background Images, Background Size CSS3 Transforms and Transitions Transforms, Transitions, Animations. Embedded Fonts and Multi-column Layouts Web Fonts with @font-face, CSS3 Multi-column Layouts, Media Queries, What are Media Queries?

8 Hours

Introduction to Javascript:

Writing your first JavaScript program The Grammar of JavaScript Statements, Built-In Functions, Types of Data, Variables, Working with Data Types and Variables, Tutorial: Using Variables to Create Messages, Tutorial: Asking for Information, Arrays, Tutorial: Writing to a Web Page Using Arrays, A Quick Object Lesson, Comments Adding Logic and Control to Your Programs Making Programs React Intelligently, Tutorial: Using Conditional Statements, Handling Repetitive Tasks with Loops, Functions: Turn Useful Code Into Reusable Commands, Tutorial: A Simple Quiz.

8 Hours

Introduction to jQuery:

About JavaScript Libraries, Getting jQuery, Adding jQuery to a Page, Modifying Web Pages: An Overview, Understanding the Document Object Model, Selecting Page Elements: The jQuery Way, Adding Content to a Page, Setting and Reading Tag Attributes, Reading, Setting, and Removing HTML Attributes, Acting on Each Element in a Selection, Automatic Pull Quotes Action/Reaction: Making Pages Come Alive with Events What Are Events? Using Events the jQuery Way, Tutorial: Introducing Events, More jQuery Event Concepts, Advanced Event Management, Tutorial: A One-Page FAQ Animations and Effects jQuery Effects, Tutorial: Login Slider, Animations, Performing an Action After an Effect Is Completed, Tutorial: Animated Dashboard, jQuery and CSS3 Transitions and Animations Common jQuery Tasks Swapping Images, Tutorial: Adding Rollover Images, Tutorial: Photo Gallery with Effects Controlling How Links Behave, Opening External Links in a New Window, Creating New Windows, Introducing jQuery Plug-ins, Build a Responsive Navigation Bar Enhancing Web Forms Understanding Forms, Adding Smarts to Your Forms, Tutorial: Basic Form Enhancements, Form Validation, Validation Tutorial. **12 Hours**

TEXT / REFERENCES:

1 Alexis Goldstein, Louis Lazaris, Estelle Weyl, HTML5 and CSS3 for The Real World, (2e), SitePoint, 2015.

2 David Sawyer McFarland, JavaScript and jQuery The Missing Manual, (3e), O'Reilly Media, Inc., 2014.

3 Matthew MacDonald, HTML5: The Missing Manual, (2e), O'Reilly Media, 2013.

4 Jon Duckett, Gilles Ruppert, Jack Moore, JavaScript and JQuery: Interactive Front-End Web Development, John Wiley & Sons, 2014.

5 Ed Tittel, Chris Minnick, Beginning HTML5 & CSS3 for Dummies, A Wiley Brand, 2013.

PROGRAM ELECTIVES:

STREAM I: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

ARTIFICIAL INTELLIGENCE

ICS 245 **3–0-0–3**

Introduction: What is AI? Definitions of AI and its's four categories , Turing test, Foundations of Artificial Intelligence, History of Artificial Intelligence, The state of the Art

(4 hours)

Intelligent Agents: Introduction, Agents action, mapping from percept sequences to actions, Agents and Environments, Rationality logic, The Nature of Environments, Rational Agent, Structure of intelligent agents: Agent programs Simple reflex agents, model-based, goal-based agents, utility-based agents and learning agents, behavior and environment in which a particular agent operates, properties of agents. (3 Hours)

Solving Problems by Searching: Problem Solving and Search Techniques: Defining the problem as a state space Search State space representation, production systems, problem characteristics, production system characteristics, Uninformed Search: Breadth First Search, Depth First Search, Depth-limited search and Iterative deepening DFS, Uniform cost search.
Heuristic Search Techniques: Best First Search, A* algorithm, Constraint Satisfaction Problem, Means-End Analysis, Adversarial search: Min-Max search procedure, Alpha – Beta pruning.

(10 hours)

Logical Agents: Knowledge based agents, The Wumpus World environment, specifying the environment, acting and reasoning in Wumpus world, representing reasoning and logic: Logic, Propositional logic, Propositional Theorem Proving, Agents based on propositional logic

(4 hours)

Using Predicate Logic: Representing simple facts in logic, Representing instances and ISA relationship, Compatible functions and predicates. (4 hours)

Knowledge Representation: Ontological Engineering, knowledge representation using predicate calculus, Knowledge engineering process. Representing knowledge using rules: Procedural versus Declarative knowledge, Forward versus Backward reasoning.

(6 hours)

Quantifying Uncertainity And Probabilistic Reasoning: Acting under uncertainty, Basic probability notation, Inference using full joint distribution, Probability and Bayes' theorem, knowledge engineering for uncertain domain, Semantics and inference of Bayesian belief networks, Semantic nets and Frames, Forward and backward chaining algorithms.

(5 hours)

TEXT / REFERENCES:

1. Stuart Russell and Peter Norvig – Artificial Intelligence A Modern Approach, Pearson Education, Third Edition, 2016.
2. Elaine Rich, Kevin Knight,Shivashankar B. Nair, Artificial Intelligence, Third Edition, Tata McGraw Hill Edition, 2010.
3. Saroj Kaushik– Artificial Intelligence, Cengage Learning Publications, First Edition, 2011.
4. Don W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI Publication, 2006.

DEEP LEARNING

ICS 246 **3–0-6–5**

Introduction and Preliminaries:
Why deep learning? Trends in Deep Learning
Mathematical Preliminaries: Linear Algebra, Probability and Information Theory, Numerical computation

Machine Learning Basics: Learning Algorithms, Capacity, Under and Overfitting, Hyperparameter and Validation Set, Estimators, Bias and Variance, MLE, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms 07 Hours
Deep Feedforward Networks:
Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation Algorithm 05 Hours

Regularization for Deep Learning:
Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise-Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training 06 Hours

Optimization for Training Deep Models:
Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms 05 Hours

Convolutional Networks:
Convolution Operation, Pooling, Convolution and Pooling, Variants of Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features 05 Hours

Recurrent and Recursive Networks: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architecture, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, LSTM
Practical Methodology: Performance Metrics, Default Baseline Models, Selecting Hyperparameters, Debugging Strategies 08 Hours

TEXT/REFERENCES

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press 2016.
2. Simon Haykin, Neural Networks and Learning Machines, PHI, 2008.
3. Andrew Ng's Notes on Machine Learning from CS229.
4. François Chollet, Deep Learning with Python, Manning Publications, 2017.

DEEP LEARNING LAB

Implementing the neuron using activation functions, Implement using error correction and memory based learning algorithm, Implement the gate operations using single layer perceptron, Implement the XOR using multi-layer perceptron, basics of TensorFlow, Implementation of YOLO model convolutional neural network, implementation of recurrent network model, Implementing the Long Short-Term Memory for Time Series Prediction, understanding ImageNet, GoogleNet, ResNet convolutional Neural Networks, GAN, reinforcement learning.

Mini Project

TEXT/REFERENCES

1. Leonardo De Marchi and Laura Mitchell, Hands-On Neural Networks: Learn how to build and train your first neural network model using Python, 1st ed, Packt Publishing, 2019.

2. Goodfellow, Ian, et al. Deep learning. Vol. 1. No. 2. Cambridge: MIT press, 2016.

3. Rosebrock, Adrian. Deep Learning for Computer Vision with Python: Starter Bundle. Vol.1, PyImageSearch, 2017.

STREAM II: BIG DATA ANALYTICS

DATAWAREHOUSING AND DATA MINING

ICS 247 **3-0-0-3**

Data Warehouse and Online Analytical Processing: Basic concepts, Data warehouse modeling: Data cube and OLAP, Data ware-house design, usage and implementation, Data generalization, Data cube compu-tation: preliminary concepts and computation methods, Prediction mining in cu-be space, Multifeature cubes: complex aggregation at multiple granularities, Case Study (13 Hours)

Mining Frequent Patterns, Associations and Corre-Lations: Basic concepts and a road map, Candidate generation algo-rithms: Apriori algorithm, Improving the efficiency of Apriori, Mining Frequent Itemsets: Using Pattern-Growth approach and vertical data format, Mining closed and maximal patterns, Pattern Evaluation Methods, Pattern mining: a road map, Mining associations: Multilevel and Multidimensional, Mining Rare Patterns and Negative Patterns, Constraint based frequent pattern mining, Mining high-dimensional data and colossal patterns, Case Study. (9 Hours)

Classification: Basic concepts, Decision tree induc-tion, Attribute selection measures, Tree pruning, Scalability and decision tree induction, Rule based classification: using IF-THEN rules for classification, Rule extraction from a decision tree, Rule induction using a sequential covering algorithm, Model evaluation and selection: Metrics for evaluating classifier performance, Holdout method and random subsampling, Cross-validation, Bootstrap, Model selection using statistical tests of signifi-cance, Techniques to improve classification accuracy: Introducing ensemble methods, Bagging, Boosting and AdaBoost, Random forests, Case Study. (5 Hours)

Cluster Analysis: Cluster Analysis and requirements for Cluster Analysis, Basic Clustering Meth-ods, Partitioning Method: k-Medoids, Hierarchical Methods: Agglomerative ver-sus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, BIRCH, Chameleon, Density-Based Methods: DBSCAN, OPTICS, DENCLUE, Grid-Based Methods: STING, CLIQUE, Evaluation of Clustering: Assessing Clustering Tendency, Determining the Number of Clusters, Measuring Clustering Quality, Case Study. (5 Hours)

Mining Stream Data: Mining Data Streams: Methodologies for Stream Data Processing and Stream Data Systems, Stream OLAP and Stream Data Cubes, Frequent-Pattern Mining in Data Streams, Classification of Dynamic Data Streams, Clustering Evolving Data Streams, Mining Sequence Patterns in Transactional Databases: Sequential Pattern Mining Concepts and Primitives, Scalable Methods for Mining Sequen-tial Patterns, Case Study. (4 hours)

TEXT / REFERENCES:

1. Jiawei Han and Micheline Kamber, Data Mining- Concepts and Techniques,(3e), Morgan Kaufmann Publishers, 2012.
2. Jiawei Han and Micheline Kamber, Data Mining- Concepts and Techniques,(2e), Morgan Kaufmann Publishers, 2010.
3. G. K. Gupta, Introduction to Data Mining with Case Studies, (3e), PHI Learning Pvt. Ltd., 2014.
4. Mohammed J. Zaki, Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, 2017.
5. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Introduction to Data Mining, (2e), Pearson Addison Wesley, 2020.
6. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, (3e), Elsevier Science, 2011.

BIG DATA ANALYTICS

ICS 248 **3-0-6-5**

Introduction To Big Data, Hadoop and Spark: Introduction to big data, Distributed computing, and Hadoop, Hadoop ecosystem, Hadoop Distributed File System (HDFS), MapReduce framework, MapReduce applications, Understanding YARN architecture, Exploring Hive, Apache Spark background, Uses for Spark, Programming interfaces to Spark, Submission types for Spark programs, Input/Output types for Spark applications

(6 Hours)

Spark Programming Basics : Anatomy of Spark application, Spark driver, Spark workers and executors, The Spark manager and Cluster manager, Spark applications using the standalone scheduler, Spark applications running on YARN, Deployment modes for Spark applications running on YARN, Introduction to RDDs, Loading data into RDDs, Operations on RDDs.

(5 Hours)

Recommendation System: The alternating least squares recommender algorithm, Spot checking recommendation, Evaluating recommendation quality, Computing AUC, Hyperparameter selection, Making recommendation (4 Hours)

Prediction with Decision Trees: Fast forward to regression, Vectors and features, Training examples, Decision trees and forests, Preparing the data, Decision tree hyperparameters, Tuning decision trees, Categorical features revisited, Random decision forests, Making predictions.

(4 Hours)

Anomaly Detection With K-Means Clustering: Anomaly detection, K-means clustering, Network intrusion, Choosing K, visualization, Feature normalization, Categorical variables, Using labels with entropy, Clustering in Action (4 hours)

Analyzing Co-Occurrence Network With Graphx: Parsing KML documents, Analyzing the Mesh major topics and their co-occurrences, Constructing a co-occurrence network with GraphX, Understanding the structure of networks, Filtering out noisy edges, Small world networks. (4 hours)

Estimating Risk Through Monte-Carlo Simulation: Methods for calculating VaR: Variance-Co-variance, Historical simulation, Mon-te-Carlo simulation, Pre-processing, Determining the

factor weights, Sampling: The multivariate normal distribution, Visualizing the distribution of returns, Evaluating the results (4 Hours)

Stream Processing and Messaging Using Spark: Spark streaming architecture, DStreams, State operations, Sliding window operations, Structured streaming, Apache Kafka.

(5 Hours)

TEXT / REFERENCES:

1. Vignesh Prajapathi, Big Data Analytics with R and Hadoop, Packt Publishing, 2013.
2. Jeffery Aven, Data Analytics with Spark using Python, Pearson, 2018
3. Sandya Ryza, Uri Laserson, Sean Owen and Josh Wills, Advanced Analytics with Spark (2e), O'Reilly Media Inc, 2017.
4. Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia, Learning Spark: Lightning-Fast Big Data Analysis (2e), O'Reilly Media Inc, 2020.
5. Tom White, Hadoop: The definitive guide (4e), O'Reilly, 2015.

BIG DATA ANALYTICS LAB

Hadoop Installation and HDFS Commands, Hadoop Map Reduce and Hive, Introduction to PySpark: Basic Commands, PySpark: RDD, Loading Data and Operations on RDD, Recommendation System, Prediction with Decision Trees, Anomaly detection with K-means Clustering, Analyzing graph data with GraphX, Estimating Risk Through Monte Carlo Simulation.
Mini Project

TEXT / REFERENCES:

1. Tom White, Hadoop: The definitive guide (4e), O'Reilly, 2015.
2. Vignesh Prajapathi, Big Data Analytics with R and Hadoop, Packt Publishing, 2013.
3. Jeffery Aven, Data Analytics with Spark using Python, Pearson, 2018
4. Sandya Ryza, Uri Laserson, Sean Owen and Josh Wills, Advanced Analytics with Spark (2e), O'Reilly Media Inc, 2017.
5. Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia, Learning Spark: Lightning-Fast Big Data Analysis (2e), O'Reilly Media Inc, 2020.

STREAM III: CYBER SECURITY

SYSTEM AND NETWORK SECURITY

ICS 249 **3-0-0-3**

Introduction: CIA Triad, Defence Models, Computer Viruses: Genesis, Classification.
Risk analysis: Threats, types of attacks, worms, trojans, buffer overflow, poisoning, risk analysis. (6 Hours)
Intrusion detection systems, types, changing nature of IDS tools, challenges, implementation, intrusion prevention systems, intrusion detection tools. (6 Hours)
Operating system security: OS models, classic security models, reference monitor, international standards for operating system security. (5Hours)

Firewalls: Types, implementation, Demilitarized Zone, Firewall forensics, Firewall Services and Limitations. (5 Hours)

IPSec: IPv4 and Ipv6, SKIP, IKE phases, Session Keys, Message IDs, Phase 2/Quick Mode, Traffic selectors, IPSec SA. (5 Hours)

PGP: Overview, Key distribution, Efficient encoding, Signature Types, Key rings, Anomalies and Object formats. (4 Hours)

Kerberos: Version 4, Realms, Interrealm authentication, Message formats. Kerberos V5 ASN.1, KDC Database, Kerberos V5 Messages. (5 Hours)

TEXT / REFERENCES:

1. Mark Rhodes Ousley, "*The Complete* Reference*: Information Security*", (2e), Mc Graw Hill Publication, 2013.
2. Peter Szor, "The art of Computer Virus Research and Defense", Addison Wesley Professional, 2005.
3. Joseph Migga Kizza, "Guide to Computer Security", (3e), Springer,2015.
4. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security: PRIVATE Communication in a PUBLIC World", (2e), Pearson Education, 2005.
5. William Stallings, "Cryptography and Network Security Principles and Practice", (6e), Prentice Hall, 2014.

PRINCIPLES OF CRYPTOGRAPHY

ICS 250 **3-0-6-5**

Introduction: Security Goals, Cryptographic Attacks, Services and Mechanisms, Techniques. 2 Hours

Symmetric Ciphers: Classical Encryption Techniques- Symmetric Cipher Model, Substitution Techniques, Transposition Techniques. Block Ciphers and Data Encryption Standard (DES), the Strength of DES, Block Cipher Design Principles. Advanced Encryption Standard (AES), Finite field arithmetic, AES structure, Transformation functions, Key expansion, Equivalent Inverse Cipher. 10 Hours

Block Cipher Operation: Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode, XTS-AES Mode for Block-Oriented Storage Devices, Format-Preserving Encryption. 04 Hours

Introduction To Number Theory: The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat theorem, Euler theorem, Testing for Primality, The Chinese Remainder theorem, Discrete Logarithms. 03 Hours

Random Bit Generation: Random Bit Generation and Stream Ciphers: Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation Using a Block Cipher, Stream Ciphers, RC4. 04 Hours

Asymmetric Ciphers: Public Key Cryptography and RSA-Principles of Public Key Cryptosystems, the RSA Algorithm. Other Public Key Cryptosystems- Diffie Hellman Key Exchange, El-Gamal Cryptographic System. 05 Hours

Cryptographic Data Integrity Algorithms: 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 Codes- Message Authentication Requirements, Message Authentication Functions, Security of MACs, HMAC. 08 Hours

TEXT / REFERENCES:

1.William Stallings, Cryptography and Network Security: Principles and Practice, (7e), Prentice Hall, 2017.
2.Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, (2e), McGraw Hill, 2008.
3.Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill Publishing, 2008
4.Bruce Schneier, Applied Cryptography-Protocols, Algorithms, and source code in C, (2e), John Wiley & Sons, Inc., 2013.

CYBER SECURITY LABORATORY

Perform encryption, decryption using Substitution techniques: Caesar cipher, Playfair cipher, Hill Cipher, Vigenere cipher and Transposition techniques: Rail fence, Row & Column Transformation. Applications of DES & AES algorithms. Implementation of RSA, Diffie-Hellman Key Exchange, SHA-1 algorithms. Demonstration of intrusion detection system, N-Stalker, a Vulnerability Assessment Tool. Defeating Malware using Building Trojans and Rootkit Hunter.
Mini project

B.Sc. (ELECTRICAL & ELECTRONICS)

II SEMESTER

MATHEMATICS - II

IMA 121 **3-1-0-4**

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Regula Falsi method, Secant method and Newton Raphson methods. (6 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.

(12 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:

1. Calculus and Analytical Geometry - IV Edn. - George B. Thomas Jr., Addison Wesley Publications, 1992.
2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney, Addison Wesley Publications, 1998.
3. Linear Algebra - G. H. Hadley,Narosa Publishing House, 2002.
4. Theory and problems of vector Analysis and an introduction to tensor analysis, Murray R. Speigel and others,Tata McGraw Hill Publications, 2011.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

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, Kirrchhoff'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)

Alternating Current Circuits: AC sources, Resistors in an AC circuit, Inductors in an AC circuit, Capacitors in an AC circuit, The RLC series circuit, Power in an AC circuit, Resonance in a series RLC circuit, The transformer and power transmission, Rectifiers and filters.

(4 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning
2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

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 **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)

Chemical equilibrium: Introduction to chemical equilibrium, Laws of mass action. Relation between K_c and K_p, Le-Chatelier principle and its application.
Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Theories of acid-Bases, pH and pOH scale, Buffer, 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, Acid and bases indicators, acid-base titration, Common ion effect, solubility product and its applications. Numericals. (7 hours)

Thermodynamics: Terminology of thermodynamics. First law of thermodynamics. Internal energy, Enthalpy, Heat capacity, heat capacity equations at constant volume and pressure. Calculation of ΔU, ΔH and w for reversible isothermal expansion of an ideal gas.

Thermochemistry - Hess's law and its applications. Limitations of first law.
Second law of thermodynamics. Concept of entropy. Helmholtz Free Energy, Gibbs free Energy, Gibbs Helmholtz equation. Numericals.

(4 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)

Chemical bonding: Primary bonding: Ionic bond: Ionic bond formation, Factor influencing the formation of ionic bond, Lattice energy & its determination by Born-Haber cycle, Properties of ionic bond.
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.
Metallic bond: Structure of metals, Electron sea model, band theory of solids, conductors, semiconductors & insulators, Properties of metallic 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, 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.

(6 hours)

TEXT/ REFERENCES:

1. Atkins P W, Physical chemistry, 8th Edn, Oxford University Press, Oxford, 2006
2. Levine IraN, Physical chemistry, 6th Edn, McGraw Hill, New York , 2009.

3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. P.C. Jain, M. Jain, Engineering Chemistry, 15th Edn., Dhanpat Rai and Sons, Delhi, Revised, 2006.
5. Arun Bahl and B.S.Bahl, A text book of organic chemistry,18th edn., S.Chand& Co.ltd, New Delhi,2019.

CHEMISTRY LABORATORY:

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

Orthographic Conversions: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. 9 hours

TEXT/ REFERENCES:

1. Gopalkrishna K. R. and Sudhir Gopalkrishna, "A textbook of Computer Aided Engineering Drawing", 37th Edition, Subhas Stores, Bangalore, 2012.
2. Bhat N. D. and V.M. Panchal, "Engineering Drawing", 50th Edition, Charotar Publishing House, Anand, India, 2010.
3. Venugopal K., "Engineering Drawing and Graphics + Auto CAD" Newage International Publishers, Delhi, 2002.
4. Narayana K. L. and Kannaiah P, "Text book on Engineering Drawing" Scitech Publications, Chennai, 2002.
5. Basant Agrawal& Agrawal C M, "Engineering Drawing" Tata McGraw Hill, New Delhi, 2010.

ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

IEE 121 3-1-0-4

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)

Principles of Electronic Communication: Fundamentals of Analog communication, Amplitude and Frequency modulation systems, Pulse modulation. Introduction to digital communication, Basic digital modulation schemes, Introduction to Mobile Communication and Communication networks. (6 hours)

TEXT / REFERENCES:

1. Kothari D. P. & Nagarath I. J,, Basic Electrical Engineering, TMH 2013.
2. Nagasarkar T. K. & Sukhija M. S., Basic Electrical Engineering, OUP 2012.
3. Hughes E., Electrical and Electronic Technology (9e), Pearson Education, 2008.
4. Robert L. Boylestad, Louis Nashelsky, Electronic Devices & Circuit Theory, 11th Edition, PHI, 2012.
5. Albert P Malvino, David J Bates – Electronic Principles,7th edition, TMH,2007.
6. George Kennedy, Bernad Davis, Electronic Communication Systems, 5thedition,TMH, 2011.
7. Garcia and Widjaja, "Communication Networks", McGraw Hill, 2006.
8. Raj Pandya, "Mobile and Personal Communication Services And Systems", Wiley-IEEE Press, 2000.

DIGITAL SYSTEMS

IEC 121 3-1-0-4

Logic Families: Performance metrics of logic gates, basic transistor-transistor logic (TTL) and CMOS logic. [2]

Boolean Algebra: Review of number systems, BCD code and arithmetic, Gray code, self-complimenting codes, error detection and correction principles, simplification of Boolean expressions, De Morgan's Theorem, implementations of Boolean expressions using logic gates, universal gates, tutorials. [5]

Combinational Logic Design: Combinational circuit analysis and synthesis, techniques for minimization of Boolean functions: Karnaugh map, VEM and Quine-Mc Cluskey methods, tautology, heuristic optimization methods**.** Design of arithmetic circuits, code convertors, multiplexers, de-multiplexers, encoders, decoders, comparators, parity generator/checker, tutorials. [11]

Synchronous Sequential Logic Design: Need for sequential circuits, binary cell, latches, flip-flops: SR, JK, master-slave JK, D and T flip flops. Fundamentals of synchronous sequential circuits, classification of synchronous sequential machines, analysis and design of synchronous sequential circuits: counters, shift registers, ring counters, examples. Timing issues in synchronous sequential circuits, tutorials. [11]

Asynchronous Sequential Logic Design: Fundamentals of asynchronous sequential circuits. Analysis and design of asynchronous sequential circuits, asynchronous counters, cycles, races and hazards in asynchronous circuits, tutorials. [6]

System architecture: Microprogrammed Control, Instruction set architecture, Addressing Modes, Floating-Point Computations, Computer Design basics, Arithmetic/Logic Unit, Hardwired Control, Memory systems, SRAM ICs, DRAM ICs, Cache Memory, Virtual Memory, I/O Interfaces, Interrupts, Direct Memory Access, tutorials. [13]

TEXT/ REFERENCES:

1. M. Morris R. Mano, Charles R. Kime, Tom Martin, *Logic and Computer Design Fundamentals* (5e), Prentice Hall, 2015.
2. John F. Wakerly, *Digital design - Principles and practice* (4e), Pearson Education, 2013.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, *Computer Organization and Embedded Systems*, (6e), Mc Graw-Hill, 2012.

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 and inverse differential operator method. Homogeneous and nonhomogeneous differential equations, solution by the method of undermined coefficients, method of variation of parameters. 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:

1. Elementary differential equations, Rainville E. D., Bedient P. E., Macmillan Publishers(Newyork), 1989.
2. Advanced Engineering Mathematics - Erwin Kreyszig, John Wiley & Sons, 2015,.

3. Introductory methods of Numerical Analysis, S. S. Sastry, PHI learning Pvt. Ltd, 2012.
4. Complex Variables, Murray R Spiegel and others, Tata McGraw Hill(New Delhi), 2015.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S., Khanna Publishers, 2015.

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 (6 hours)

BJT Amplifiers: Input and Output Impedances, Biasing: DC and Small-Signal Analysis, Simple Biasing, Resistive Divider Biasing, Biasing with Emitter Degeneration, Self-Biased Stage, Amplifier Topologies: Common-Emitter, Common-Base, Emitter Follower.

(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. (6 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.

(10 hours)

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)

Feedback: Loop Gain, Properties of Negative Feedback: Gain Desensitization, Bandwidth Extension, Modification of I/O Impedances, Linearity Improvement, Types of Amplifiers: Simple Amplifier Models, Examples of Amplifier Types, Sense and Return Techniques, Polarity of Feedback, Feedback Topologies: Voltage-Voltage, Voltage-Current, Current-Voltage, Current-Current Feedback. (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 amplifer, Power efficiency of all Classes.

(4 hours)

TEXT / REFERENCES:

1. Behzad Razavi, "Fundamental of Microelectronics", Wiley, 2013.

2. A. S. Sedra, K. C. Smith, “Microelectronic circuits”, Oxford University Press, 2011.
3. R. L. Boylestad, L. Nashelsky, “Electronic Devices and Circuit Theory”, 2009.
4. J. Millman, C. C. Halkias, Chetan. D. Parekh, “Integrated Electronics”, McGraw Hill. 2010.

SIGNALS AND SIGNAL PROCESSING

IEC 233 **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)

Fourier representations for signals: Introduction, Discrete-time periodic signals: The discrete-time Fourier series, continuous-time periodic signals: The Fourier series, Discrete-time non-periodic signals: The discrete-time Fourier transform, continuous-time non-periodic signals: The Fourier transform, properties of Fourier representations (Including Parseval’s relations). (12 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:

1. Simon Haykin & Barry Van Veen, “Signals and Systems”, John Wiley &Sons, New Delhi, 2005.
2. Proakis J.G and Manolakis D.G.Mimitris D., “Introduction to Digital Signal Processing” Prentice Hall, India, 2003.
3. H.Hsu, R. Ranjan, “Signals and Systems”, Schaums’s outline, Tata McGraw – Hill, New Delhi, 2006.
4. B.P.Lathi., “Linear systems and Signals”, Oxford University Press, 2005.

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. (8 hours)

First order and Second order differential equations: General and particular solutions of RL, RC and RLC circuits for DC and AC excitation. (8 hours)

Laplace transformation and its application: Solution of RL, RC, RLC networks using Laplace transformation method. (5 hours)

Linear wave shaping: Response of RC circuits to step, pulse, square wave and ramp input. (6 hours)

Network Functions for one port and two port network: Driving point functions, transfer functions. (3 hours)

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. (7 hours)

TEXT / REFERENCES:

1. M. E. Van Valkenberg, "Network analysis", Prentice Hall of India, 2000.
2. Franklin F. Kuo, "Network analysis and Synthesis", 2nd Edition, Wiley International.
3. R C Dorf, J A Svoboda, "Introduction to Electric Circuits", Wiley, 6th edition
4. Millman, H. Taub, "Pulse, digital and switching waveforms", 2nd Edition, McGraw Hill.

MICROCONTROLLERS

IEE 234 **3– 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. (3 hours)

The 8051 architecture, On chip features, Registers, Assembly language programming, 8051 instruction set, addressing modes, Programming using 8051 instruction set. (12 hours)

Pin diagram of 8051 microcontroller, signal description, oscillator and Reset circuit, I/O ports. (2 hours)

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. (6 hours)

Interrupts: 8051 interrupts, programming timer interrupts, programming external hardware interrupts, programming the serial communication, interrupt priority. (4 hours)

System design using 8051: Interfacing keyboards, seven segment LED display, LCD display, ADC, DAC and stepper motor to 8051. (8 hours)
Programming 8051 in 'C', programming examples (including interfacing exercises). (5 hours)
Interfacing external memory to 8051,I/O expansion using PPI, 8255, Interfacing 8255 to 8051 and programming. (6 hours)
Development tools: Simulators, debuggers, assembler and compilers, linkers, in circuit emulators for microcontrollers. (2 hours)

TEXT / REFERENCES:

1. Muhammad Ali Mazidi and Gillispie Mazidi, The 8051 Microcontroller and embedded systems, using assembly and 'C' , Pearson education, 2013.
2. Kenneth. J. Ayala, The 8051 Microcontroller and embedded systems, using assembly and 'C', Cengage Learning, 2013.
3. Ajay. V. Deshmukh, Microcontrollers theory and applications, TMH, 2007

DIGITAL ELECTRONICS LABORATORY

IEC 232 **0–0-6–2**

The experiments and mini projects are based on the following topics:

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:

1. Morris M. Mano, Digital Design, Prentice-Hall, 2nd edition.
2. William I. Fletcher, an Engineering Approach to Digital Design, Prentice Hall of India, 2009.
3. Anand Kumar, Fundamentals of Digital Circuits, Prentice Hall of India 2nd edition, 2012.

4. K. A. Krishnamurthy, Digital Lab Primer, Pearson Education.
5. J Bhaskar, VHDL Primer, Prentice Hall, 3rd edition.

SYSTEM SIMULATION LABORATORY

IEE 232 **0–0-3–1**

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:

1. Rudra Pratap, Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers, Oxford University Press, 2010.
2. Shampine I.F, Solving ODEs with MATLAB, Cambridge University Press, 2003.
3. www.mathworks.com
4. Rashid M.H, Spice for Circuits and Electronics using PSPICE, PHI, 2004
5. Conant Roger., Engineering Circuit Analysis with Pspice and Probe, MGH, 1993

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. (5 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. (5 hours)

Staffing: HR planning, recruitment, development and training. (3 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (5 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:

1. Koontz D, "Essentials of Management", 7th edition, McGraw Hill, New York.
2. Peter Drucker, "The Practice of Management", Butterworth Hein Mann, 2003.
3. Thuesen G. J, "Engineering Economics", Prentice Hall of India, New Delhi, 2005.
4. Blank Leland T. and Tarquin Anthony J., "Engineering Economy", McGraw Hill, Delhi, 2002.
5. Prasanna Chandra, "Fundamentals of Financial Management", Tata Mc-Graw Hill Companies, New Delhi, 2005.

IC SYSTEMS

IEC 241 3-1-3 –5

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. (5 hours)

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. (10 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. (5 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:

1. Franco Sergio "Design with Op amps &Analog integrated electronics" McGraw Hill, 4th edition,2016.
2. David L. Terrell, Butterworth-Heinemann(1996) "Op amp Design, Application, and Troubleshooting,1997.
3. Ramakant A. Gayakwad, "Op.Amps and linear integrated circuit"s, PHI.,2011.
4. Roy and Choudhary, (1991)"Linear Integrated circuits", Wiley Eastern, 5th edition, 2018.
5. R.L.Boylestead and L.Nashelsky, Electronic devices and circuit theory, PHI edition, 2009.

LINEAR IC LABORATORY

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:

1. Franco Sergio "Design with Op amps &Analog integrated electronics" McGraw Hill,2002.
2. Ramakant A. Gayakwad, "Op.Amps and linear integrated circuit"s, PHI.,2000.
3. Roy and Choudhary, (1991)"Linear Integrated circuits", Wiley Eastern,2003.

LINEAR CONTROL THEORY

IEE 241 **3-1-0-4**

Classification of control systems, Mathematical modelling of electrical circuits/mechanical systems (translational & rotary)/electro-mechanical systems/geared systems, reduction of sub-systems, signal flow graphs.

(9hrs)

Time domain response of 1st and 2nd order systems, RH criteria, Root Locus technique

(8hrs)

Bode plots, Nyquist Plots

(8hrs)

Frequency domain based compensator design and their realization through OPAMPS, Design/realization of active P, PI, PID controllers for LTI systems

(14hrs)

State equation, state space modelling, Physical variable form of electrical/mechanical/ electromechanical systems, Phase variable form of electrical/ mechanical/ electromechanical systems, State space models from transfer function, Solution of state equation for continuous time system, State transition matrix, Controllability criteria, Observability criteria.

(9hrs)

TEXT / REFERENCES:

1. Norman S. Nise, Control Systems Engineering, John Wiley & Sons Inc, 2010.
2. Ogata K, Modern Control Engineering, Englewood Cliffs, NJ: Prentice Hall, 2010.
3. Gopal M., Control Systems: Principles and Design, McGraw Hill, 2008.
4. S.D. Agashe, Control Engineering, NPTEL, December 2009. http://nptel.ac.in/courses/108101037/
5. Dynamic Systems and Control, 241J,MIT Open CourseWare, Spring 2011. http://ocw.mit.edu/courses/electricalengineering-and-computerscience/6-241j-dynamic-systems-and-control-spring 2011

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. (14 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:

1. Pucknell D. A. and Eshraghian K.,"Basic VLSI Design", PHI publication, 2009.
2. Weste. N and Eshraghian K, "Principles of CMOS VLSI Design", 2nd Edition, Addison Wesley Publication.
3. Sung Mo Kang and Yusuf leblebici, "CMOS digital Integrated circuits design and analysis", 3rd edition, Tata Mcgraw Hill.
4. Saraju P. Mohanty and Ashok Srivastava,"Nano-CMOS and Post-CMOS Electronics: Devices and Modelling", Vol. 1.

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)

Symmetrical three-phase faults: Short circuit current and reactances of synchronous machines short-circuit current calculations, selection of circuit breakers, current limiting reactors. (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:

1. Nagrath I.J. & D.P.Kothari, Modern Power System Analysis (3e), TMH, 2003.
2. Grainger & Stevenson, Power System Analysis, TMH 2003
3. Hadi Saadat, Power System Analysis, MGH, 1999.
4. Khan B. H., Non-conventional Energy Resources, TMH, 2006

ELECTIVE – II - DIGITAL SYSTEM DESIGN USING VERILOG

IEC 244 **3- 1 -0 –4**

Digital Implementation Options and Design Flow: Design styles: Full-custom, Semi-custom, Programmable ASICs: CPLDs, MPGAs and FPGAs, Y-chart, Design flow, Logic synthesis. (6 hours)

FPGA Architectures and Applications: Architecture of ACTEL, XILINX and ALTERA logic families, Logic module, Switching technology. Implementation of combinational and sequential circuits using FPGAs: Shannon's decomposition. (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)

Introduction to Verilog: Introduction to HDL, VHDL versus Verilog, Verilog description of combinational circuits. Verilog modules. Verilog assignments. Procedural assignments. Modeling flip-flops using always block. Always blocks using event control statements. Delays in Verilog. Compilation, simulation, and synthesis of Verilog code. Verilog data types and operators. Simple synthesis examples. Verilog models for multiplexers. Modeling registers and counters using Verilog always statements. Behavioral, switch level, data flow and structural models. Constants. Arrays. Loops in Verilog. Testing Verilog model. Verilog functions. Verilog tasks, Named association. Generate statements. (18 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:

1. Charles Roth, Lizy Kurian John, Byeong Kil Lee, Digital System Design Using Verilog, 1st Edition, 2016.
2. Michael D. Ciletti, Advanced Digital Design with the Verilog HDL, Prentice Hall Publishing, Second edition, 2010.
3. Stephen. Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, TMH, 2013.
4. Parag K. Lala, Fault tolerant and Fault testable hardware design, BS Publication, 1990.
5. 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:

1. P. S. Bimbhra, Electrical Machinery (7e), Khanna publishers, 2012
2. D. P. Kothari & I. J. Nagrath, Electric Machines (4e), TMH, 2013
3. Langsdorf E.H., Theory of Alternating Current Machinery (2e), TMH, 2004
4. Say M. G., Alternating Current Machines (5e), ELBS, 1994
5. Mukherjee P. K. & Chakravarti C, Electrical Machines (2e), Dhanpat Rai & Sons, 2005

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:

1. Muhammad Ali Mazidi and Gillispie Mazidi, The 8051 Microcontroller and embedded systems, using assembly and ‘C’ , Pearson education, 2013.
2. Kenneth. J. Ayala, The 8051 Microcontroller and embedded systems, using assembly and ‘C’, Cengage Learning, 2013.
3. Ajay. V. Deshmukh, Microcontrollers theory and applications, TMH, 2007

B.Sc. (MECHANICAL)

II SEMESTER

MATHEMATICS - II

IMA 121 **3-1-0-4**

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Regula Falsi method, Secant method and Newton Raphson methods. (6 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.

(12 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:

1. Calculus and Analytical Geometry - IV Edn. - George B. Thomas Jr. (1992) Addison Wesley Publications.
2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney (1998), Addison Wesley Publications.
3. Linear Algebra - G. H. Hadley(2002), Narosa Publishing House.
4. Theory and problems of vector Analysis and an introduction to tensor analysis, Murray R. Speigel and others (2011), Tata McGraw Hill Publications.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S. (2015), Khanna Publishers.

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, Kirrchhoff'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)

Alternating Current Circuits: AC sources, Resistors in an AC circuit, Inductors in an AC circuit, Capacitors in an AC circuit, The RLC series circuit, Power in an AC circuit, Resonance in a series RLC circuit, The transformer and power transmission, Rectifiers and filters.

(4 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning
2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

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 **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)

Chemical equilibrium: Introduction to chemical equilibrium, Laws of mass action. Relation between K_c and K_p, Le-Chatelier principle and its application.
Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Theories of acid-Bases, pH and pOH scale, Buffer, 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, Acid and bases indicators, acid-base titration, Common ion effect, solubility product and its applications. Numericals. (7 hours)

Thermodynamics: Terminology of thermodynamics. First law of thermodynamics. Internal energy, Enthalpy, Heat capacity, heat capacity equations at constant volume and pressure. Calculation of ΔU, ΔH and w for reversible isothermal expansion of an ideal gas.

Thermochemistry - Hess's law and its applications. Limitations of first law.
Second law of thermodynamics. Concept of entropy. Helmholtz Free Energy, Gibbs free Energy, Gibbs Helmholtz equation. Numericals.
(4 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)

Chemical bonding: Primary bonding: Ionic bond: Ionic bond formation, Factor influencing the formation of ionic bond, Lattice energy & its determination by Born-Haber cycle, Properties of ionic bond.
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.
Metallic bond: Structure of metals, Electron sea model, band theory of solids, conductors, semiconductors & insulators, Properties of metallic 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, 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.

(6 hours)

TEXT/ REFERENCES:

1. Atkins P W, Physical chemistry, 8th Edn, Oxford University Press, Oxford, 2006
2. Levine IraN, Physical chemistry, 6th Edn, McGraw Hill, New York , 2009.
3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. P.C. Jain, M. Jain, Engineering Chemistry, 15th Edn., Dhanpat Rai and Sons, Delhi, Revised, 2006.
5. Arun Bahl and B.S.Bahl, A text book of organic chemistry,18th edn., S.Chand& Co.ltd, New Delhi,2019.

CHEMISTRY LABORATORY:

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)

Orthographic Conversions: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/ REFERENCES:

1. Gopalkrishna K. R. and Sudhir Gopalkrishna (2012) "A textbook of Computer Aided Engineering Drawing", 37th Edition, Subhas Stores, Bangalore.
2. Bhat N. D. and V.M. Panchal (2010) "Engineering Drawing", 50th Edition, Charotar Publishing House, Anand, India.
3. Venugopal K. (2002) "Engineering Drawing and Graphics + Auto CAD" Newage International Publishers, Delhi.
4. Narayana K. L. and Kannaiah P (2002) "Text book on Engineering Drawing" Scitech Publications, Chennai.
5. Basant Agrawal& Agrawal C M (2010) "Engineering Drawing" Tata McGraw Hill, New Delhi.

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:

1. K. R. Gopalakrishna, "Text book of elements of Mechanical Engineering", Subhash Publications, Bangalore, 2005.
2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, Mumbai, 2000.
3. Mishra B.K., "Mechanical Engineering Sciences", Kumar & Kumar Publishers Pvt. Ltd., Bangalore, 1999.
4. Trymbaka Murthy S., "A text book of elements of Mechanical Engineering", I. K. International Publishing House Pvt. Ltd, 2010.
5. Rajput R. K., "Elements of Mechanical Engineering", Fire Wall Media, 2005.
6. B. S. Raghuwanshi, “A Course in Workshop Technology”, Vol 1, Dhanpat Rai & Sons, New Delhi, 2005.

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)

Beam deflection: Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope : Double integration method, Macaulay Method, and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns. (10 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:

1. Beer F. P. and Johnston R (2002) "Mechanics of Materials", McGraw-Hill Book Co, Third Edition.
2. Nash W.A (1995) "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York
3. Ryder G.H (2002) "Strength of Materials", Macmillan India Ltd., Third Edition
4. Ray Hulse, Keith Sherwin & Jack Cain (2004) "Solid Mechanics", Palgrave ANE Books
5. Singh D.K (2002) "Mechanics of Solids" Pearson Education
6. Timoshenko S (1997) "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi

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 and inverse differential operator method. Homogeneous and nonhomogeneous differential equations, solution by the method of undermined coefficients, method of variation of parameters. 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:

1. Elementary differential equations, Rainville E. D., Bedient P. E. (1989) Macmillan Publishers(Newyork).
2. Advanced Engineering Mathematics - Erwin Kreyszig (2015), John Wiley & Sons.
3. Introductory methods of Numerical Analysis, S. S. Sastry(2012), PHI learning Pvt. Ltd.
4. Complex Variables, Murray R Spiegel and others(2015), Tata McGraw Hill(New Delhi).
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S. (2015), Khanna Publishers.

THERMAL ENGINEERING

IME 231 **3– 1– 0 – 4**

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)

Power cycles: Vapor power cycle: Simple Rankine cycle, effect of boiler pressure, on Rankine cycle, Reheat Rankine cycle, Mollier chart- simple numericals. Gas power cycles: Air standard cycle-Otto, Diesel cycle, Air standard efficiency-numericals. (10 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:

1. Cenegel Yunus and Bole Michael, Thermodynamics: An Engineering Approach, McGraw Hill, New York, 2010.

2. Estop and McConkey, Applied Thermodynamics for Engineering Technologies, Pearson Education, Delhi, 2002.
3. Mayhew A. and Rogers B., Engineering Thermodynamics, E.L.B.S. Longman, London, 1994.
4. Van Wylen and G. J. and Sonntag R. E., Fundamentals of Classical Thermodynamics, John Wiley, New York, 1985.
5. Cengel, Thermodynamics and Heat Transfer, McGraw Hills, New York, 1997.

MANUFACTURING PROCESS ENGINEERING

IME 232 **4– 0– 0 – 4**

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:

1. Chua C K, Leong K F and Lim C S, Rapid Prototyping: Principles and Applications, World Scientific, Singapore, 2003.
2. Paul DeGarmo E, Black J T and Ronald A. Kohser, Materials and Process in Manufacturing, John Wiley & Sons, Delhi, 2004.
3. Rajput R. K., A Text book of Manufacturing Technology, Laxmi Publications Private Limited, 2011.
4. Khanna O. P., A text book of Production Technology, Dhanpat Rai Publications.
5. Rao P. N., Manufacturing Technology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
6. Serope Kalpakejian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education, Delhi, 2006.
7. Lal M. and Khanna O. P., Foundry Technology, Dhanpat Rai and Sons, New Delhi, 1991.

MATERIAL SCIENCE AND METALLURGY

IME 233 **3– 0– 0 – 3**

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:

1. Avner S.H., Introduction to Physical Metallurgy, (3e), McGraw Hill, 2004.
2. William D. Callister, Materials Science and Engineering, John Wiley & Sons, 2007.
3. Lakhtin Yu., Engineering physical metallurgy and heat treatment, MIR Publishers, 1985.
4. Gupta K.M., Material science, Metallurgy and Engineering Materials, Umesh Publication, 2012.

5. Raghavan V, Material Science and Engineering, (4e), Prentice Hall of India, 1989.
6. Arzamasov, Material Science, MIR Publishers, Moscow, 1989.
7. Clark Donald S., Physical metallurgy for engineers, 1962

FLUID MECHANICS

IME 234 **3– 0– 0 – 3**

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. (3 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. (3 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. (3 hours)

Fluid flow measurements: Venturimeter, 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. (3 hours)

TEXT / REFERENCES:

1. Streeter V. L. and Beinzamin E., Fluid Mechanics, Willy Intl., New York,1998.
2. Bruce R. Munson, Donald F. Young and Teodore H. Okiishi, Fundamentals of Fluid Mechanics, Wiley, 2005.
3. Modi P. N. and Seth S. M., Hydraulics and Fluid Mechnics, Standard Book House, 2011.
4. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House, New Delhi, 2000.
5. Bansal R. K., Fluid Mechanics and Hydraulic Machines, Laxmi Publication, New Delhi, 2006.
6. Yunus A. Cengel and John M. Cimbla, Fluid Mechanics, Tata McGraw-Hill Publications, 2006.

AUTOMOBILE ENGINEERING

IME 235 **3– 0– 0 – 3**

Automotive engine parts: Automotive engine classification, Multi cylinder arrangements. Cylinder block, Cylinder head, Crankcase, Oil pan, Cylinder liners, Piston, Arrangements to 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, Synchromesh 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:

1. Heinz Heisler, Vehicle and Engine Technology (2e), Butterworth-Heinemann Publication, Second Edition, 1998.
2. Kirpal Singh, Automobile Engineering Vol. I & II (12e), Standard Publishers Distributors, New Delhi, 2011.
3. R.K. Rajput, Automobile Engineering (1e), LaxmiPublication (P) Ltd, 2010.
4. Narang G. B. S., Automobile Engineering, Khanna Publishers, 1990.
5. Giri N. K., Automotive Technology, Khanna Publication, 2006.
6. Gupta K. M., Automotive Technology Vol. I & II, Umesh Publication, 2007.

COMPUTER AIDED MECHANICAL DRAWING

IME 236 **0– 0– 6 – 2**

AutoCAD 2D drafting: Intersection of solids - prisms, cylinders, pyramids and cones. Threaded fasteners - thread forms, hexagonal, square bolts & nuts, foundation bolt. Bearings - Bush bearing, Footstep bearing, Plummer block. Couplings - Muff, Flanged, Oldham's and Universal. Joints - Knuckle, Socket & Spigot, Sleeve & Cotter, Strap joints with jib & cotter.

3D part modeling, assembly and sectional/exploded 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/exploded views in mechanical engineering applications.

TEXT / REFERENCES:

1. Gopalkrishna K. R., Machine Drawing, Subhas Publications, Bangalore, 2002.
2. Bhat N. D., Machine Drawing, Charotar Publishing House, Anands, 2002.
3. Venugopal K., Engineering Drawing and Graphics + Auto CAD, Newage International Publishers, Delhi, 2002.
4. Narayana K. L. and Kannaiah P, Text book on Engineering Drawing, Scitech Publications, Chennai, 2002.
5. Ibrahim K Zeid, CAD/CAM Theory and Practice, Tata McGraw Hill, New Delhi, 1998.

STRENGTH OF MATERIALS LABORATORY

IME 237

0– 0– 3– 1

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:

1. Suryanarayana A.V.K., Testing of Metallic Materials, PHI, 1990.
2. Khanna and Justo, Highway Materials Testing, Nemchand, 1989.
3. Technical Teacher's Training Institute, Laboratory Manual of Strength of Materials, Oxford University Press, 1983.
4. Davis H.E., Troxell G.E., Wiscocil C.T., The Testing and Inspection of Engineering Materials, McGraw Hill Book Company.

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. (5 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. (5 hours)

Staffing: HR planning, recruitment, development and training. (3 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (5 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:

1. Koontz D, "Essentials of Management", 7th edition, McGraw Hill, New York.
2. Peter Drucker, "The Practice of Management", Butterworth Hein Mann, 2003.
3. Thuesen G. J, "Engineering Economics", Prentice Hall of India, New Delhi, 2005.
4. Blank Leland T. and Tarquin Anthony J., "Engineering Economy", McGraw Hill, Delhi, 2002.
5. Prasanna Chandra, "Fundamentals of Financial Management", Tata Mc-Graw Hill Companies, New Delhi, 2005.

THEORY OF MACHINES

IME 241 **3- 1 -0 –4**

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:

1. Ballaney P. L., Theory of Machines, Khanna Publishers, New Delhi, 1998.
2. Rattan S. S, Theory of Machines, Tata Mc-Graw Hill Publishers Pvt. Ltd, New-Delhi, 2009.
3. Singh, V. P., Theory of Machines, Khanna Publishers, New Delhi, 1998.
4. Rao J. S. and Dukkipati R. V., Mechanism and Machine Theory, Wiley Eastern Ltd. Delhi, 1992.
5. Gosh A., and Mallick A. K., Theory of Machines and Mechanisms, Affiliated East West Press, Delhi, 1989.

6. Shigley, J. E. and Uicker J. J., Theory of Machines and Mechanisms, McGraw Hill, Delhi, 1980.

DESIGN OF MACHINE ELEMENTS

IME 242 **3- 1 -0 –4**

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:

1. Hamrock B. J., Jacobson B.O. and Schmid S. R., “Fundamentals of Machine Elements”, Mc Graw Hill Inc., New York, 1999.
2. Shigley J. E. and Mischke C. R., “Mechanical Engineering Design” , 5/e, McGraw Hill Inc, New York, 2004.
3. Bhandari V. B., Design of Machine Elements, 2/e, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
4. Norton R. L., “Machine Design - An Integrated Approach”, 2/e, Prentice Hall Inc. New Jersy, 2004.
5. Juvenile R. C. and Marshek K. M., “Fundamentals of Machine Component Design”, 3/e, John Wiley and Sons, Inc, New York, 2000.
6. Maleev and Hartman, “Machine Design” 5/e (Revised and edited by Drop Grover), CBS Publishers, New Delhi, 1999.
7. Mahadevan K. and Balaveera Reddy K., “Machine Design Data Hand Book”, 4/e, CBS Publishers and distributors’ New Delhi, 1987.

INDUSTRIAL ROBOTICS

IMET 243 **3–0–0–3**

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:

1. K.R. Guruprasad, Robotics: Mechanics and Control (1st ed.). PHI, Delhi, 2019.
2. J. J. Craig: Introduction to robotics: Mechanics and Control, (3rd edition), Pearson Ed, 2004.
3. Asitava Ghosal, Robotics: Fundamental concepts and Analysis, oxford University Press, 2013.

METROLOGY AND MEASUREMENTS

IME 243 **3-1-0-4**

Measurements and measurement systems: Methods of Measurement, Generalized Measurement System & its elements, Static Characteristics of Instruments & measurement systems: Accuracy, Precision, Sensitivity, Reproducibility, Repeatability, Linearity, Hysteresis. Threshold, Dead zone, Resolution. Errors in Measurement.

(3 hours)

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)

Measurement of force, torque and shaft power: Measurement of Force - Hydraulic & Pneumatic load cells, Proving ring, Strain gauge load cell & related problems. Methods of Torque & Shaft power - Cradled dynamometer, Torque Meter, Band Brake dynamometer, Water Brake dynamometer. (3 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.

TEXT / REFERENCES:

1. Beckwith Thomas G., Mechanical Measurements, Pearson Education, Delhi, 2003.
2. Jain R.K., Engineering Metrology, Khanna Publishers, New Delhi, 1997.
3. Sawhney A.K., Mechanical Measurement & Instrumentation, Dhanpat Rai & Co, New Delhi, 2002.
4. Nakra B.C. and Chaudry K.K., Instrumentation, Measurement & Analysis, Tata McGraw Hill, New Delhi, 2002.
5. Gupta I. C., Engineering Metrology, Dhanpat Rai Publications, New Delhi, 1997.
6. ASTME, Handbook of Engineering Metrology, Prentice Hall of India, New Delhi, 1972
7. Raghavendra N.V. and Krishnamurthy L., Engineering Metrology and Measurements, Oxford University Press, 2013.

FLUID MECHANICS LABORATORY

IME 244 **0- 0 -3 –1**

List of Experiments:

1. Measurement of flow using Venturimeter
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:

1. Jagadishlal, Fluid Mechanics & Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd New Delhi,1995.
2. Bansal R K., Fluid Mechanics and Hydraulic Machines, Laxmi Publication, New Delhi, 2006.

MANUFACTURING PROCESS LABORATORY

IME 245 **0- 0 -3–1**

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:

1. Hajra Choudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy, Elements of Workshop Technology Vol.1, Media Promoters & Publishers Pvt. Ltd., Mumbai, 2004.
2. Raghuvanshi B. S., A Course in Workshop Technology Vol.1, Dhanpat Rai & Sons, Delhi, 1989.
3. Peter Smid, CNC Programming Hand book, Industrial Press, New York, 2000.

THERMAL ENGINEERING LABORATORY

IME 246 **0- 0 -3–1**

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:

1. Ganeshan V., Internal Combustion Engines (3e), Tata McGraw Hill, Education Private Limited New Delhi, 2007.
2. Mathur M. L. and Sharma R. P., Course in Internal Combustion Engines, Dhanpath Raj Publishers, New Delhi, 2001.

B.Sc. (MECHATRONICS)

II SEMESTER

MATHEMATICS - II

IMA 121 **3-1-0-4**

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Regula Falsi method, Secant method and Newton Raphson methods. (6 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.

(12 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:

1. Calculus and Analytical Geometry - IV Edn. - George B. Thomas Jr. (1992) Addison Wesley Publications.
2. Calculus & Analytical Geometry - George B. Thomas Jr & Ross L. Finney (1998), Addison Wesley Publications.
3. Linear Algebra - G. H. Hadley(2002), Narosa Publishing House.
4. Theory and problems of vector Analysis and an introduction to tensor analysis, Murray R. Speigel and others (2011), Tata McGraw Hill Publications.
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S. (2015), Khanna Publishers.

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, Kirrchhoff'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)

Alternating Current Circuits: AC sources, Resistors in an AC circuit, Inductors in an AC circuit, Capacitors in an AC circuit, The RLC series circuit, Power in an AC circuit, Resonance in a series RLC circuit, The transformer and power transmission, Rectifiers and filters.

(4 hours)

TEXT/ REFERENCES:

1. Physics for Scientists and Engineers with Modern Physics, Raymond A. Serway, John W. Jewett Jr, 8th Ed. 2010, CENGAGE Learning
2. Fundamentals of Physics, Halliday, Resnick and Walker, 8th Ed, 2008, John Wiley and Sons.

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 **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)

Chemical equilibrium: Introduction to chemical equilibrium, Laws of mass action. Relation between K_c and K_p, Le-Chatelier principle and its application.

Ionic equilibria: Arrhenius theory of electrolyte dissociation, The Ostwald dilution law, Theories of acid-Bases, pH and pOH scale, Buffer, 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, Acid and bases indicators, acid-base titration, Common ion effect, solubility product and its applications. Numericals. (7 hours)

Thermodynamics: Terminology of thermodynamics. First law of thermodynamics. Internal energy, Enthalpy, Heat capacity, heat capacity equations at constant volume and pressure. Calculation of ΔU, ΔH and w for reversible isothermal expansion of an ideal gas.

Thermochemistry - Hess's law and its applications. Limitations of first law.
Second law of thermodynamics. Concept of entropy. Helmholtz Free Energy, Gibbs free Energy, Gibbs Helmholtz equation. Numericals.

(4 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)

Chemical bonding: Primary bonding: Ionic bond: Ionic bond formation, Factor influencing the formation of ionic bond, Lattice energy & its determination by Born-Haber cycle, Properties of ionic bond.
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.
Metallic bond: Structure of metals, Electron sea model, band theory of solids, conductors, semiconductors & insulators, Properties of metallic 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, 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.

(6 hours)

TEXT/ REFERENCES:

1. Atkins P W, Physical chemistry, 8th Edn, Oxford University Press, Oxford, 2006
2. Levine IraN, Physical chemistry, 6th Edn, McGraw Hill, New York , 2009.
3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. P.C. Jain, M. Jain, Engineering Chemistry, 15th Edn., Dhanpat Rai and Sons, Delhi, Revised, 2006.
5. Arun Bahl and B.S.Bahl, A text book of organic chemistry,18th edn., S.Chand& Co.ltd, New Delhi,2019.

CHEMISTRY LABORATORY:

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)

Orthographic Conversions: Simple & cut solids (Prisms, Pyramids, Cones, Cylinders), Combined solids, Simple machine components. (9 hours)

TEXT/ REFERENCES:

1. Gopalkrishna K. R. and Sudhir Gopalkrishna (2012) "A textbook of Computer Aided Engineering Drawing", 37th Edition, Subhas Stores, Bangalore.
2. Bhat N. D. and V.M. Panchal (2010) "Engineering Drawing", 50th Edition, Charotar Publishing House, Anand, India.
3. Venugopal K. (2002) "Engineering Drawing and Graphics + Auto CAD" Newage International Publishers, Delhi.
4. Narayana K. L. and Kannaiah P (2002) "Text book on Engineering Drawing" Scitech Publications, Chennai.
5. Basant Agrawal& Agrawal C M (2010) "Engineering Drawing" Tata McGraw Hill, New Delhi.

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:

1. K. R. Gopalakrishna, "Text book of elements of Mechanical Engineering", Subhash Publications, Bangalore, 2005.
2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, Mumbai, 2000.
3. Mishra B.K., "Mechanical Engineering Sciences", Kumar & Kumar Publishers Pvt. Ltd., Bangalore, 1999.
4. Trymbaka Murthy S., "A text book of elements of Mechanical Engineering", I. K. International Publishing House Pvt. Ltd, 2010.
5. Rajput R. K., "Elements of Mechanical Engineering", Fire Wall Media, 2005.
6. B. S. Raghuwanshi, “A Course in Workshop Technology”, Vol 1, Dhanpat Rai & Sons, New Delhi, 2005.

ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

IEE 121 **3-1-0-4**

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)

Principles of Electronic Communication: Fundamentals of Analog communication, Amplitude and Frequency modulation systems, Pulse modulation. Introduction to digital communication, Basic digital modulation schemes, Introduction to Mobile Communication and Communication networks. (6 hours)

TEXT / REFERENCES:

1. Kothari D. P. & Nagarath I. J,, Basic Electrical Engineering, TMH 2013
2. Nagasarkar T. K. & Sukhija M. S., Basic Electrical Engineering, OUP 2012
3. Hughes E., Electrical and Electronic Technology (9e), Pearson Education, 2008
4. Robert L. Boylestad, Louis Nashelsky, Electronic Devices & Circuit Theory, 11th Edition, PHI, 2012.
5. Albert P Malvino, David J Bates – Electronic Principles,7th edition, TMH,2007.
6. George Kennedy, Bernad Davis, Electronic Communication Systems, 5thedition,TMH, 2011
7. Garcia and Widjaja, “Communication Networks”, McGraw Hill, 2006

8. Raj Pandya, “Mobile and Personal Communication Services And Systems”, Wiley-IEEE Press, 2000.

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 and inverse differential operator method. Homogeneous and nonhomogeneous differential equations, solution by the method of undermined coefficients, method of variation of parameters. 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:

1. Elementary differential equations, Rainville E. D., Bedient P. E. (1989) Macmillan Publishers(Newyork).
2. Advanced Engineering Mathematics - Erwin Kreyszig (2015), John Wiley & Sons.
3. Introductory methods of Numerical Analysis, S. S. Sastry(2012), PHI learning Pvt. Ltd.
4. Complex Variables, Murray R Spiegel and others(2015), Tata McGraw Hill(New Delhi).
5. Higher Engineering Mathematics, Grewal B. S., Grewal J. S. (2015), Khanna Publishers.

ELEMENTS OF MECHATRONIC SYSTEMS

IMET 231 **3– 0– 0 – 3**

Introduction: Definition, basic concepts and elements of mechatronic systems, needs and benefits of mechatronics in manufacturing. (1 hour)

Sensors and Transducers: Displacement Sensor - Linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders. Strain - Strain gauges. Force/Torque - Load cells. Temperature – Thermocouple, Bimetallic Strips, Thermistor, RTD, Motion – Accelerometers, Velocity sensors – Tachometers, Proximity and Range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch. Light sensors – Photodiodes, phototransistors, Flow sensors – Ultrasonic sensor, laser Doppler anemometer, tactile sensors – PVDF tactile sensor, micro-switch and reed switch. Piezoelectric sensors, vision sensor. (9 hours)

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:

1. A.K. Sawhney, "A course in Electrical and Electronic Measurements and Instrumentation", 19/e, Dhanpat Rai & Co. Publishers, 2012
2. A. K. Sawhney, "A course in Mechanical Measurement and Instrumentation", 9/e, Dhanpat Rai & Co. Publishers, 2012
3. R.K. Rajput, "Electrical & Electronic Measurements & Instrumentation", 2/e, S.Chand Publishers, 2010

KINEMATICS OF MACHINES

IMET 232 2– 1– 0 – 3

IMET 232 KINEMATICS OF MACHINES:

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. (8 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. (6 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. (4 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. Friction: Flat pivot and collar friction, power loss due to friction, problems on single plate and multiplate clutches (6 hours)

TEXT / REFERENCES:

1. Norton, Robert L. Design of machinery: an introduction to the synthesis and analysis of mechanisms and machines. 5/ed, McGraw-Hill, 2011.
2. Uicker, John Joseph, Gordon R. Pennock, and Joseph Edward Shigley. Theory of machines and mechanisms. Vol. 1. New York, NY: Oxford University Press, 2011.
3. Myszka, David H. Machines and mechanisms. Applied Kinematic Analysis. 4/e, Pearson Higher education, 2012.
4. Rattan, S. S. Theory of machines. Tata McGraw-Hill Education. 5th edition, 2019.

MEASUREMENT AND INSTRUMENTATION

IMET 233 **3– 0– 0 – 3**

Basic Measurement Concepts: Units and standards, calibration, static and dynamic characteristics of an instrument, error analysis, electromechanical indicating instruments. 8 hours

Sensors and Transducers: Material science concepts: Materials used as sensors and transducers. Analog and digital voltmeters, ammeters, multimeters, DC bridges, AC bridges, fault detection- short circuit, open circuit, shielding and grounding methods, display device-digital CRO, data storage. 12 hours

Data Acquisition and PLC programming: Introduction to data acquisition, elements of data acquisition system, concept of signal conditioning. PLC: Programming formats using contacts and coils, latching etc. Converting simple relay logic diagram to PLC ladder diagram, Digital logic implementation in ladder programming, Timer and counter functions, Arithmetic functions, R-trig / F- trig pulses, shift registers, sequence functions, PID principles and functional block, position indicator with PID control. 10 hours

Communication: Industrial Process Automation, Networks and Protocols: AS-i, CAN, MODBUS, PROFIBUS-DP, Wi-Fi, Wi-MAX, Connectors. 06 hours

TEXT / REFERENCES:

1. A.K. Sawhney, A course in Electrical and Electronic Measurements and Instrumentation, (19e), Dhanpat Rai & Co. Publishers, 2012.
2. R.K. Rajput, Electrical & Electronic Measurements & Instrumentation, (2e), S.Chand Publishers, 2010

DIGITAL SYSTEM DESIGN

IMET 234 **3– 0– 0 – 3**

Combinational Logic Design: Minimization of Boolean functions using Karnaugh Map, Design of arithmetic circuits-Half adder, Full Adder, Half subtractor, Full Subtractor, Parallel Adder, Parallel Subtractor, Parallel adder cum subtractor, Parity generators and checkers, comparators. Design of Code converters. Design of display units, Multiplexers, De-multiplexers, Decoder, Encoder. 06 hours

Synchronous Sequential Circuit Design: Need for sequential circuits, Binary cell, Latches and flip-flops. RS, JK, Master-Slave JK, D & T flip flops, Design of Synchronous and Asynchronous Counters, Shift registers & Ring counters, Design of Finite State Machines. Timing issues in synchronous circuits. Design examples such as elevator controls, traffic light controllers, vending machine. 08 hours

FPGA Architectures: ACTEL, XILINX and ALTERA logic families, logic module, switching technology, I/O cells, Programmable interconnect. 08 hours

Hardware Description Language: 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. 14 hours

TEXT / REFERENCES:

1. Ananda Kumar, "Switching Theory and Logic Design", Prentice Hall of India, 2009.
2. Morris Mano, "Digital design", Prentice Hall of India, (3e) 2002.

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 (6 hours)

BJT Amplifiers: Input and Output Impedances, Biasing: DC and Small-Signal Analysis, Simple Biasing, Resistive Divider Biasing, Biasing with Emitter Degeneration, Self-Biased Stage, Amplifier Topologies: Common-Emitter, Common-Base, Emitter Follower. (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. (6 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.

(10 hours)

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)

Feedback: Loop Gain, Properties of Negative Feedback: Gain Desensitization, Bandwidth Extension, Modification of I/O Impedances, Linearity Improvement, Types of Amplifiers: Simple Amplifier Models, Examples of Amplifier Types, Sense and Return Techniques, Polarity of Feedback, Feedback Topologies: Voltage-Voltage, Voltage-Current, Current-Voltage, Current-Current Feedback. (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 amplifer, Power efficiency of all Classes. (4 hours)

TEXT / REFERENCES:

1. Behzad Razavi, "Fundamental of Microelectronics", Wiley, 2013.
2. A. S. Sedra, K. C. Smith, "Microelectronic circuits", Oxford University Press, 2011.
3. R. L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", 2009.
4. J. Millman, C. C. Halkias, Chetan. D. Parekh, "Integrated Electronics", McGraw Hill. 2010.

CAD LABORATORY

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 plummer block, screw jack, knuckle joint etc.
3D modeling of machine components and assembly
3D modeling of simple machine parts like plummer block, bench vice, CPU fan, butterfly valve etc… and create a draft of the assembly.

Kinematic Simulation
Simulation of simple mechanisms to obtain position, velocity and acceleration parameters of different mechanisms like 4 bar mechanism, slider crank mechanism etc.

TEXT / REFERENCES:

1. Sham Tickoo, CATIA – for Engineers and Designers, Dreamtech Press, New Delhi 2005.
2. Gopalkrishna K. R., Machine Drawing, Subhas Publications, Bangalore, 2002.

DIGITAL ELECTRONICS LABORATORY

IEC 232 **0-0-6–2**

The experiments and mini projects are based on the following topics:
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:

1. Morris M. Mano, Digital Design, Prentice-Hall, 2nd edition.
2. William I. Fletcher, an Engineering Approach to Digital Design, Prentice Hall of India, 2009.
3. Anand Kumar, Fundamentals of Digital Circuits, Prentice Hall of India 2nd edition, 2012.
4. K. A. Krishnamurthy, Digital Lab Primer, Pearson Education.
5. J Bhaskar, VHDL Primer, Prentice Hall, 3rd edition.

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. (5 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. (5 hours)

Staffing: HR planning, recruitment, development and training. (3 hours)

Human Factors in Managing: Theories of Motivation, special motivational Techniques. Leadership- Leadership Behaviour & styles, Managerial Grid. (5 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:

1. Koontz D, "Essentials of Management", 7th edition, McGraw Hill, New York.
2. Peter Drucker, "The Practice of Management", Butterworth Hein Mann, 2003.
3. Thuesen G. J, "Engineering Economics", Prentice Hall of India, New Delhi, 2005.
4. Blank Leland T. and Tarquin Anthony J., "Engineering Economy", McGraw Hill, Delhi, 2002.
5. Prasanna Chandra, "Fundamentals of Financial Management", Tata Mc-Graw Hill Companies, New Delhi, 2005.

INTRODUCTION TO EMBEDDED SYSTEMS

IMET 241 3–0–0–3

Introduction: Introduction to embedded system, major application areas of ES, Design issues, Performance metrics, Characteristics and quality attributes of embedded systems, Processor and memory organization, Communication networks. **[08 hours]**

ARM: ARM Processor introduction, MU0 processor, RISC design philosophy, The Acron RISC machine, architectural inheritance, Programmer's model, developmental tools. ARM hardware and programming techniques: ARM assembly language programming: ARM instruction set, modes of operation, exception handlers, interrupts, programming examples. Pipelined architecture in ARM: 3- stage and 5- stage. THUMB instruction set: Instruction format, conditional, branch, data processing, coprocessor instructions, implementation and applications. Memory mapped peripherals: UART and D/A converter. Arm cortex M3 architectural features and programming examples and case study. **[18 hours]**

RTOS: Concept of Embedded Operating Systems, Differences between Traditional OS and RTOS, Introduction to Real time OS, Tasks and Task states – Semaphores – Shared data – Message queues, Mail boxes and pipes – Memory management – Interrupt routines. Hard Real-time systems, Soft Real-time systems, real time scheduling considerations, Multicore real time systems. Case studies on RTOS application domains. **[10 hours]**

References:

1. Wolf, Wayne, Computers as Components- Principles of Embedded Computing System Design, Morgan-Kaufmann, 2000.
2. Steve Furber, ARM System-on-chip Architecture, Pearson Education, 2000.
3. Andrew Sloss, Domnic Symes, Chris Wright, ARM system Developer's Guide, 1st edition.

AUTOMATED MANUFACTURING SYSTEMS

IMET 242 **3- 0 -0 –3**

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, , intepolators, 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 work station, types of FMS layouts, Analysis of FMS (Bottle neck model) Computer aided process planning, computer integrated planning systems., shop floor control. (10 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:

1. Groover Mikell P, Automation, Production Systems, and Computer Integrated manufacturing, (4e), Prentice Hall of India. New Delhi, 2016.
2. Kalpakajain, Manufacturing Engineering and Technology, (4e), Addison Wesley, New York, 2014.

INDUSTRIAL ROBOTICS

IMET 243 **3–0–3–4**

IMET 243 INDUSTRIAL ROBOTICS:

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.

04 hours

Autonomous mobile robots: Introduction, locomotion - key issues for locomotion, legged mobile robots, leg configurations & stability, examples of legged robot locomotion. Case studies.

04 hours

References:

1. K.R. Guruprasad, Robotics: Mechanics and Control (1st ed.). PHI, Delhi, 2019.
2. J. J. Craig: Introduction to robotics: Mechanics and Control, (3rd edition), Pearson Ed, 2004.
3. Asitava Ghosal, Robotics: Fundamental concepts and Analysis, oxford University Press, 2013.

ROBOTICS LABORATORY

Introduction to Robot Studio, an offline Programming Tool. Defining Targets and Path Generation. Creating a Custom Tool and Defining a Work object. Conveyor Tracking using Robot Studio. Pick and Place, Path tracing using ABB Robot and COBOT.

References:

1. John J. Craig, Introduction to Robotics: Mechanics and Control, (3e), PHI, 2005.

HYDRAULICS AND PNEUMATICS SYSTEMS

IMET 244 **3–1–0–4**

Introduction to pneumatic systems: Advantages and limitations, Structure and signal flow, Applications of pneumatic systems, Pneumatic power pack, Air reservoir, Air generation, and Distribution, different types of compressors, Constructional details and working of filter, lubricator and pressure regulator.

3 hours

Actuators and Control valves:

Various types of single acting and double-acting cylinders, Types of double acting

cylinders, Air motor and types, comparison between Air and electric motor, Various types of poppet valve, spool and rotary direction control valves, Check valves, Fixed and variable type one- and two-way flow control valves, Dual pressure valve, shuttle valves, Time delay valves, Pressure sequence valves, pneumatic counter.

5 hours

Manual pneumatics: Symbols of pneumatic valves, Traverse time diagram, Design of manually operated circuits, Direct and indirect control of actuators, Control of single and multiple actuators.

2 hours

Electro-pneumatics and Design of electro pneumatic circuits: Eectrically actuated direction control valves, Relay control systems, Limit switches, magnetic, inductive sensors, Capacitive, optical, ultrasonic, pneumatic proximity sensors, Symbols of electrical components, examples of circuits involving control of single acting cylinders, Examples of circuits involving control of double acting cylinders, Use of logics and sensors in applications. Design of pneumatic circuits using classic method, Cascade method and Step counter. Logic circuit design using K-V mapping and combinational circuit design.

12 hours

Introduction to Hydraulic systems: Advantages and limitations, Physical principles of oil hydraulics, Hydraulic power pack, Types of hydraulic pumps: Axial, Radial piston pump, Rotating cam radial type pump, gear pump, Vane pump, unbalanced vane type, Balanced vane pump, Pump specifications.

3 hours

Hydraulic actuators, valves, and accessories: Linear actuators, Rotary actuators, Accumulator: Weight loaded, spring-loaded accumulators, Gas loaded accumulators, application of accumulators, Check valve, pilot operated check valve, Pressure control valves: Direct acting relief valve, Compound relief valve, Break valve, Sequence valve, Pressure reducing valve, Flow control valves: Simple restrictor flow control valve, Simple restrictor with reverse free flow check valve, Pressure compensated flow control valve and direction control valves.

8 hours

Hydraulic circuits: Regenerative, meter in, meter out, bleed off, Sequencing, pressure reducing circuits, electro-hydraulic circuits.

3 hours

References:

1. Anthony Esposito, Fluid power with applications, Pearson Education, 2003.
2. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science & Technology Books, (3e) 2011.
3. Majumdar S.R., Pneumatic Systems - Principles and Maintenance, Tata McGraw Hill, 2000.

PROGRAMMABLE LOGIC CONTROLLER LABORATORY

IMET 245 0–0–3–1

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.

TEXT / REFERENCES:

1. Petruzella, F. D. (2017). Programmable Logic Controllers (5th ed.). McGraw-Hill Education.
2. Mechatronics Training Practice Module, FESTO Manual Germany 2011.
3. Siemens PLC Manual.
4. PLC training practice module, BOSCH REXROTH Manual Germany 2011.

LINEAR CONTROL THEORY

IMET 246 **3-0-0-3**

Introduction & mathematical modeling of physical systems:
Introduction: Feedback control systems terminologies, types of system configuration, control system design process Modeling in frequency domain*:* Differential equation of physical systems (electrical, mechanical, electromechanical, systems with gears), Transfer function representation, State space representation of physical systems.

12 hours

Time domain analysis and design:
System characteristics: Introduction to poles and zeros of a system, first and second order system response analysis, time domain specifications, Steady state error (SSE) specification, SSE for non-unity feedback systems with and without disturbances, generalized error series. Performance analysis: Stability, RH criteria, Root locus technique-construction and interpretation of system behavior 12 hours

Frequency domain analysis :
Concept of frequency response, Asymptotic approximation, Bode plot construction and interpretation of system behavior, frequency domain specification viz. gain margin & phase margin, relation between time domain & frequency domain specification, SSE characteristics from frequency response, modeling of time delay 12 hours

TEXT / REFERENCES:

1. Norman S. Nise, *Control Systems Engineering*, (6e), Wiley India.
2. R.C Dorf, R. H. Bishop, *Modern Control Systems*, (8e), Wesley Longman Inc.
3. B.C. Kuo, F. Golnaraghi, *Automatic Control Systems*, (8e), Wiley India.
4. K. Ogata, *Modern Control Engineering*, (5e), PHI.
5. M. Gopal, *Control System: Principles and Practices*, (4e), TMH.

MANUFACTURING PROCESS LABORATORY

IME 245 **0- 0 -3–1**

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:

1. Hajra Choudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy, Elements of Workshop Technology Vol.1, Media Promoters & Publishers Pvt. Ltd., Mumbai, 2004.

2. Raghuvanshi B. S., A Course in Workshop Technology Vol.1, Dhanpat Rai & Sons, Delhi, 1989.
3. Peter Smid, CNC Programming Hand book, Industrial Press, New York, 2000.

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