INTERNATIONAL ENGINEERING

UNDERGRADUATE PROGRAMME

REGULATIONS & SYLLABI

2023

PSG INSTITUTE OF ADVANCED STUDIES

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PSG INSTITUTE OF ADVANCED STUDIES

2023 REGULATIONS FOR
(3+1/2+2) BE/BS /BEng - AUTOMOBILE / BIOMEDICAL / COMPUTER SCIENCE / INNOVATIVE TEXTILES / MECHANICAL / MECHATRONICS / ROBOTICS & AUTOMATION / ELECTRONICS & COMMUNICATION ENGINEERING
(for the batches of students admitted in 2023-2024 and subsequently)*

NOTE: The regulations hereunder are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already undergoing the programme) as may be decided by the Academic Council and the partner institutions.

1. (a) PRELIMINARY DEFINITIONS AND NOMENCLATURE

In the following Regulations, unless the context otherwise requires

i) **"Programme"** means Degree Programme, that is **BE/BS/BEng Degree Programme.**

ii) **"Branch"** means specialization or discipline of BE/BS Degree Programme, like Mechanical/Mechatronics Engineering.

iii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics etc.

(b) CONDITIONSFORADMISSION

Students for admission to the BE/BS/BEng degree programme will be required to satisfy the conditions of admission there to prescribed by the Partner Institutions.

2. DURATION OF THE PROGRAMME

a. **Minimum Duration:** The programme will extend over a period of four years leading to the Degree of BE/BS/BEng. The four academic years will be divided into eight semesters with two semesters per year.(2/3years inIndia+2/1year in Partner Institution)

Each semester shall normally consist of 90 working days (or 450 hours or 540 periods of 50 minutes each).

3. UG PROGRAMMES OFFERED

The following are the branches of study under BE/BS /BEng degree programme.

BE/BS	Mechanical Engineering
BE/BS	Biomedical Engineering
BE/BS	Mechatronics Engineering (Robotics and Automation)
BE/BS	Computer Science Engineering
BEng	InnovativeTextiles
BE/BS	Automobile Engineering

4. STRUCTURE OF PROGRAMME

i. **Curriculum:** The curriculum will comprise courses of study as given in section I to V infra in accordance with the prescribed syllabi.

ii. **Summer Term Courses:** The courses under the title "Summer Term" shall be conducted for 4 weeks prior to the commencement of third semester during the summer. The evaluation of these courses will be done for 100 marks with full Continuous Assessment component and the pattern of evaluation will be as in 8(v) with single entry of marks for each component at the end of the course. The summer term courses will be evaluated by following absolute grading system discussed in sections 8(iii) infra. Students who fail to secure either 50% of total marks and, or the required attendance as in infra 5(i) shall be deemed to have failed in that course and shall

appear as a supplementary candidate in the next semester examinations, the supplementary examination being conducted similar to supplementary examination for courses with full Continuous Assessment component.

iii. **Medium of instruction:** The medium of instruction, examinations, project report etc. shall be English.

5. REQUIREMENTS OF ATTENDANCE AND PROGRESS

i) A student will be qualified to appear for final examinations of any semester only if

a) he/she has satisfied the attendance requirements as per the norms given below:

- Minimum attendance of 90% overall in all theory and laboratory courses together. However, a student who secures attendance between 80% and 90% in any course in the current semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College /University / State / National/International level sports events with prior permission from Director shall be given exemption from the prescribed attendance requirement and he / she shall be permitted to appear for the current semester examinations.

- Students who secure less than 90% in any one of the courses or secure an overall attendance less than 90% will not be permitted to write the current semester examinations of all courses under any circumstances and not permitted to go to next semester.

b) his/her progress has been satisfactory and

c) his/her conduct has been satisfactory.

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Students who do not qualify to appear for final examinations of any semester for want of attendance and/or progress and/or conduct have to register for and redo that semester programme at the next immediate available opportunity.

6. PROCEDURE FOR COMPLETING THE PROGRAMME

i) The course work of the odd semesters will normally be conducted only in odd semesters and that of the even semesters only in even semesters.

ii) A student will be permitted to proceed to the courses of study of any semester only if he/she has satisfied the requirements of attendance, progress and conduct in respect of the preceding semester and had paid fees for that semester.

7. PROCEDURE FOR REJOINING THE PROGRAMME

A student who is required to repeat the study of any semester for want of attendance/progress/conduct or who desires to rejoin the course after a period of discontinuance or who upon his/her own request is permitted by the authorities to repeat the study of any semester, may join the semester which he/she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of students and after obtaining the approval from the DIRECTOR. No student will however be enrolled in more than one semester at any time. In the case of repeaters, the marks secured earlier in the repeated courses will be discarded.

8. ASSESSMENT AND PASSING REQUIREMENTS

i) **Assessment:** The assessment will comprise of Final Examination (FE) and/or Continuous Assessment (CA), carrying marks as specified in the scheme in section 8(v) infra. The CA marks will be awarded on assessing the student continuously during the semester as per guidelines 8(v) framed by the college. The assessment for theory courses carrying CA+FE or only CA (Full CA) will be done on absolute grading system. However, for the purpose of reporting the performance of a student, letter grades and grade points will be awarded as per section 8(iii)

ii) **Final Examinations:** Final examinations will normally be conducted during October /November and during March / April of each year. Supplementary examinations may be conducted at such times as may be decided by the college.

A student will be permitted to appear for the examination of a semester only if he/she has completed the study of that semester (vide section 5 supra).A student will not be allowed to register for final examination of any semester unless she/she simultaneously registers for the examinations of the highest semester eligible and all the courses which he/she be in arrears of.

A student, who is not permitted to appear at the final examination of a semester, is not permitted to proceed to the following semester.

A student, who is not permitted to appear at the final examination of any semester has to register for and redo the courses of that semester at the next available opportunity.

iii) **Letter Grade and Grade Point:** Each student, based on his / her performance, will be awarded a final letter grade and grade point as given in the table infra for each course at the end of each semester by following Absolute Grading System.

Absolute Grading System

In absolute grading system, the letter grade and grade points are awarded to each student based on the percentage of marks secured by him/her in Theory/ Laboratory courses as detailed below:

For UK/AUSTRALIA/GERMAN PARTNERSHIP PROGRAMMES

Range of percentage of total Marks	Letter Grade	Grade Point
90 to100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
50 to 59	D	6
0 to 49 Or less than 50% in final examination	RE	0
Withdrawal from examination	W	0

- "RE" denotes REDO in a course.

For USA PARTNERSHIP PROGRAMMES

Range of percentage of total Marks	Letter Grade	Grade Point
90 to 100	A+	4.0
80 to 89	A	3.6
70 to 79	B+	3.2
65 to 69	B	2.8
60 to 64	C+	2.4
50 to 59	C	2
0 to 49 Or less than 50% in final examination	RE	0
Withdrawal from examination	W	0

- "RE" denotes REDO in a course.

iv) Passing a course:

a. A student shall be deemed to have passed a theory course with (CA+FE) component. if

i) he/she secures atleast 50% in the final examination paper and
ii) the total marks secured by him/her(CA+FE put together)is50%

A student is deemed to have passed a Laboratory Course, **if** the total mark secured by him/her is atleast 50%.

A student, who is absent for the final examination or withdraws from final examination or secures a letter grade **RE** (Grade point 0) in any course **including the summer term courses** has to register for supplementary examinations for all such courses at the next available opportunity and complete them.

b. A student, who absents or who withdraws or who secures a letter grade **RE** (Grade point 0) or less than 50% in final examination in any course carrying continuous assessment and final examination marks, will retain the already earned continuous assessment marks for the next immediate attempt only in the examination of that course and thereafter he/she will be solely assessed by final examination carrying the entire marks of that course.

A student, who absents or secures a letter grade **RE** (Grade point 0) in any course carrying only continuous assessment marks, will be solely examined by a final examination carrying the entire marks of that course, the continuous assessment marks obtained earlier being discarded.

c. A student who lacks in attendance or other serious deficiencies will have to register at the beginning of the subsequent semester, the CA mark already earned being not taken into account.

d. Supplementary Examinations: Examination in a course conducted as a regular examination for a batch of regular students and as a supplementary examination for a batch of other students.

v) Scheme of Evaluation for Theory/Laboratory/Industrial Visit cum Lecture/Inplant Training Courses

The under-mentioned categories of courses listed below will **carry 5 marks of CA** for course-wise attendance with official exemption as per the range of attendance % given below:

- Less than 90% — 0 Mark
- 90% of attendance — 3 Marks
- 91% to 95% of attendance — 4 Marks
- 96% to 100% of attendance — 5 Marks

a. Theory Courses (CA– 50%+FE– 50%) **Total: 100 Marks**

- **CA Distribution:**

(i) Attendance — 5 Marks
(ii) Assignment/ Objective Test (Minimum 2) — 10 Marks
(iii) Tutorials/Presentation*(Minimum 2) — 5 Marks
(iv) Internal Tests:(Average of 2Tests) — 30 Marks
[Scheduled by Academic Section]

- **Final Exam(FE)** — **100 Marks**

*Separate tutorial note books are to be maintained by the students for all such courses.

1. In regular tutorial classes, the students are to be guided to solve problems with faculty support.
2. Assessment Tutorials are open book tests, one each to be conducted, and evaluated as per the deadline for two assignment presentations and the marks entered (for senior classes).
3. In courses, where tutorial component is absent,10 marks are to be allotted for mini projects etc, the deadline of mark entry being as above.
4. In respect of first semester and final year courses, the deadline for mark entry for tutorial & surprise quiz will be as per that of CA2 and CA3.

b.Laboratory Courses (CA: 50%+FE:50%) **Total:** **100 Marks**

- **CA Distribution:**

(i)I Cycle

- Pre-Laboratory Reports & Observations 10 Marks
- Individual Report 10 Marks

(ii)II Cycle

- Pre-Laboratory Reports & Observations 10 Marks
- Individual Report 10 Marks

- **Final Examination**

a) Lab Examination 30 Marks
b) Viva Voce 20 Marks

9. WITHDRAWAL FROM EXAMINATION

i) A student may, for valid reasons, be granted permission to withdraw from appearing for the examination in any course or courses of one semester examination if he/she does not have any history of arrears at the time of request for withdrawal. Prior permission for withdrawal from semester examinations is to be obtained from DIRECTOR. Also, only one application for withdrawal is permitted for that semester examination in which withdrawal is sought.

ii) Withdrawal application shall be valid only if the student is otherwise eligible to write the examination and if it is made prior to the commencement of the examination in that course or courses and also recommended by the Course Coordinator.

iii) A student shall be eligible for award of ranking only if he/she has passed the examination in first class or first class with distinction in the first available chance (i.e., first attempt in all the subjects). Those who have availed the provision of break of study / withdrawal will not be eligible for ranks.

10. TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

i) A student is not normally permitted to temporarily break the study. However, if a student intends to temporarily discontinue the programme in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the programme in a later respective semester, he/she shall apply to the Director through the Coordinator and stating the reasons therefore.

ii) A student is permitted to rejoin the programme at the respective semester as and when it is offered after the break subject to the payment of semester fees and approval from the Director.

iii) If any student is detained for want of requisite attendance, progress and conduct, the period spent in that semester shall not be considered as permitted' Break of Study'.

11. ENTRY REQUIREMENTS FOR 3rd and 4th YEAR OF STUDY @ PARTNER INSTITUTIONS

German Programmes:

a. PASS in all subjects(Semester1to6)
b. Test DAF Score–16points (Max4pointson each skill)
c. Valid Passport

University of HoF, German Programme:

a) PASS in all subjects(Semester1to6)
b) German A1 and A2
c) Valid Passport

US Programmes:

a. PASS in all subject with Grades C and above
b. CGPA minimum 2.8/4(Semester1-6) (upto 4th Sem for 2+2 years)
c. TOEFL Score–minimum 80
d. Valid Passport

Australia Programmes:

a. PASS in all subject(Semester1to 4)
b. TOEFL / IELTSScore–minimum80
c. Valid Passport

UK Programmes:

a. PASS in all subjects(Semester1to 6)
b. TOEFL / IELTS Score–minimum 80
c. Valid Passport

Students satisfying the entry requirements are eligible for admission in the fourth year, else need to repeat the year in PSG, until to achieve grade points required.

BE/BS AUTOMOBILE ENGINEERING

BE/BS AUTOMOBILE ENGINEERING

S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks		
			L	T	P		CA	FE	Total
SEMESTER 1									
1	23IA101	Calculus and its Applications	3	1	0	4	50	50	100
2	23IA102	Physics	3	0	0	3	50	50	100
3	23IA103	Applied chemistry	3	0	0	3	50	50	100
4	23IA104	Engineering Materials and Production process	3	0	0	3	50	50	100
5	23IA105	English Language Proficiency	0	0	2	4	50	50	100
6	23IA110	Workshop Technology Laboratory	0	0	4	2	50	50	100
7	23IA111	Engineering Graphics Laboratory	0	0	4	2	50	50	100
8	23IG065	German Language - A1	12			4	_	100	100
SEMESTER 2									
1	23IA201	Complex Variables and Transforms	3	1	0	4	50	50	100
2	23IA202	Sensors for Engineering Applications	3	0	0	3	50	50	100
3	23IA203	Energy Sources and Storage	3	0	0	3	50	50	100
4	23IA204	Engineering Mechanics	3	1	0	4	50	50	100
5	23IA211	Basic Science Laboratory	0	0	4	2	50	50	100
6	23IA213	Foundations of Problem Solving Laboratory	0	0	2	0	50	50	100
7	23IG066	German Language - A2	12			4	_	100	100
SEMESTER 3									
1	23IA301	Computational Mathematics	3	1	0	4	50	50	100
2	23IA302	Strength of Materials	3	1	0	4	50	50	100
3	23IA303	Engineering Thermodynamics	3	1	0	4	50	50	100
4	23IA304	Automotive Chassis	3	0	0	3	50	50	100
5	23IA305	Engineering Economics	3	1	0	4	50	50	100
6	23IA310	Automotive Chassis Laboratory	0	0	4	2	50	50	100
7	23IA311	Machine Drawing Laboratory	0	0	4	2	50	50	100
8	23IG067	German Language - B1.1	12			4	_	100	100
SEMESTER 4									
1	23IA401	Theory of Machines	3	1	0	4	50	50	100
2	23IA402	Automotive Engines	3	0	0	3	50	50	100
3	23IA403	Basics of Electrical and Electronic engineering	3	0	0	3	50	50	100

4	23IA404	Machine Design	3	1	0	4	50	50	100
5	23IA405	Automotive Transmission	3	0	0	3	50	50	100
6	23IA410	Strength of materials Laboratory	0	0	4	2	50	50	100
7	23IA411	Basic Electrical and electronics Laboratory	0	0	4	2	50	50	100
8	23IA412	C Programming Laboratory	0	0	4	3	50	50	100
9	23IG068	German Language - B1.2	12			4	_	100	100
SEMESTER 5									
1	23IA501	Fluid Mechanics and Heat transfer	3	1	0	4	50	50	100
2	23IA502	Automotive Electrical and Electronics	3	0	0	3	50	50	100
3	23IA503	Vehicle System Design I	3	1	0	4	50	50	100
4	23IA504	Electric and Hybrid Vehicle Technology	3	1	0	4	50	50	100
5	23A510	Automotive Electronics Laboratory	0	0	4	2	50	50	100
6	23A511	Engine Testing Laboratory	0	0	4	2	50	50	100
7	23IG069	German Language - B2	12			4	50	50	100
SEMESTER 6									
1	23IA601	Vehicle Dynamics	3	1	0	4	50	50	100
2	23IA602	Vehicle System Design II	3	1	0	4	50	50	100
3	23IA603	Finite Element Analysis	3	1	0	4	50	50	100
4	23IA604	Electric Vehicle Thermal engineering	3	0	0	3	50	50	100
5	23A610	Design and Analysis Laboratory	0	0	4	2	50	50	100
6	23A611	Modelling and Simulation Laboratory	0	0	4	2	50	50	100
7	23IG70	German Language - C1	12			4	_	100	100

SEMESTER I

23IA101 CALCULUS AND ITS APPLICATIONS

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables.
INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems.

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits.
VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes' theorem.

TEXT BOOKS
1. J. Hass, C.Heil, Maurice D.W "'Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES
1. H. Anton, I.Bivens, S. Davis, "Calculus", John Wiley and Sons, USA, 2016.
2. Wylie C. R and Barrett L. C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D.G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23IA102 PHYSICS

STATICS OF PARTICLES: Introduction to Newtonian mechanics - vector mechanics; Forces on a particle, parallelogram law, resolution of a force, rectangular components of a force; Resultant of several concurrent forces: Equilibrium of a particle, free-body diagrams, forces in space - equilibrium of a particle in space.
KINEMATICS OF PARTICLES: Introduction to dynamics; Rectilinear motion of particles: Analytical and graphical solutions to problems, motion of several particles; Curvilinear motion of particles: projectile motion, rotary motion and rolling motion.

KINETICS OF PARTICLES - NEWTON'S SECOND LAW AND FRICTION: Rectilinear and rotary motion: Newton's second law, D'Alembert's principle, dependent motion of several particles; Friction: concepts of friction, problems involving dry friction; Wedges, square-threaded screws, journal bearings - axle friction, thrust bearings - disk friction, wheel friction - rolling resistance, belt friction.

KINETICS OF PARTICLES – ENERGY METHODS: Work-energy and power: Work of a force, Conservative and non-conservative forces, kinetic energy, principle of work and energy, potential energy, conservation of energy, power and efficiency; Solving problems using the concepts of friction wherever applicable.

KINETICS OF PARTICLES – MOMENTUM METHODS: Concept of conservation of momentum, co-efficient of restitution, Impulse-momentum principle, Impact – direct central impact, oblique central impact, problems involving impulse and momentum.

TEXT BOOKS:
1. Ferdinand P. Beer, E. Russell Johnston, David F.Mazurek, Philip J. Cornwell, SanjeevSanghi, Brian P. Self "VectorMechanics for Engineers Statics and Dynamics", McGraw Hill Education(India) Private limited,12th Edition 2019
2. Nelson. A "Engineering Mechanics -Statics and Dynamics", Tata Mcgraw-Hill., New Delhi, 2017

REFERENCES:
1. Rajasekaran S, Sankarasubramanian G "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2015
2. R.C. Hibbler "Engineering Mechanics -Statics and Dynamics", Pearson, 2022, 15thEdition
3. James L.Meriam, L. Glenn Kraige, J.N. Bolton, "Engineering Mechanics, Statics, Wiley India Private Limited, 2018

23IA103 APPLIED CHEMISTRY

POLYMERS AND COMPOSITES: Polymerisation- chain and condensation polymerization, polymer topologies – linear, branched and crosslinked.Copolymerisation, degree of polymerisation, polydispersity, average molecular weight. Polymer morphology – Amorphous and crystalline states, influence on properties of polymers- thermal properties-Tg and Tm, classification based on thermal behaviour – thermoplastics and thermosetting plastics, mechanical properties-stress-strain behaviour. Plastics- moulding constituents and functions, compression, injection, extrusion and blow moulding. Foamed plastics, elastomers- synthetic rubbers-vulcanization. **Composites:** classification, role of matrix and reinforcements, polymer matrix-thermoplastic and thermoset, reinforcements – glass, aramids, carbon based-carbonnanotube, carbonfibre, graphene.

ENGINEERING MATERIALS : Water quality parameters, water purification methods- ionexchanger, reverse osmosis, electrodeionization. **Metals and Alloys:** Steel- types, Aluminium and Titanium alloys. **Ceramics:**Glass:Types, properties and applications-laminated glass, toughened glass, wired glass, glass wool and insulating glass**.** Abrasives- properties, examples, natural and synthetic abrasives. Refractories- types, characteristics, examples, applications.

DETERIORATION OF MATERIALS : Metallic corrosion : Mechanisms-corrosion rate expressions-Faraday's law- emf and galvanic series–E/pH diagram of iron. Polarisation of electrodes-Tafelequation.Factors influencing corrosion,passivating metals-polarisation curves. Forms of corrosion-oxidation,Pilling–Bedworthrule,atmospheric corrosion, galvanic corrosion, pitting corrosion, filiform corrosion, stress corrosion cracking (SCC), corrosion fatigue, fretting corrosion.**Degradationin polymer:** Photo, thermal, oxidative and mechanical degradation. Protective additives for polymers-Photostabilizers, thermal stabilizers and antioxidants.

CORROSION PROTECTION OF METALS: Material selection and design, cathodic protection, anodic protection, use of inhibitors. Coating –galvanising and tinning, electroplating of Cu, Ni, Cr. Electroless plating of nickel and copper, anodization of aluminium. Paints-components and functions, varnishes, enamels, lacquers, electrophoretic painting in automotive industry. Phosphating and chromating. Superhydrophobic and self –healing coatings.

LUBRICANTS: Mechanisms of lubrication- properties of lubricants-determination of viscosity by redwood, Say-bolt and Brookfield viscometers, viscosity index, cloud and pour points, flash and fire points, steam emulsion number, saponification, iodine and neutralization numbers-aniline point and carbon residue- additives and improvers. Lubricating emulsions, cutting fluids, gels and greases, synthetic lubricants, fluolubes - silicone lubricants, solid lubricants (graphite and MoS_2).

TEXT BOOKS:

1. ShikhaAgarwal, "Engineering Chemistry: Fundamentals and Applications" Cambridge University Press 2015.
2. Gesser H.D., "Applied Chemistry - A Textbook for Engineers and Technologies", Springer, 2008.

REFERENCES:

1. ShashiChawla, "A Text Book of Engineering Chemistry", DhanpatRai& Co, 2005.
2. Rudolf S. and Vollrath L., "Plastics in Automotive Engineering – Exterior Applications", Hanser Gardner Publications, 2007.
3. ZakiAhamed, "Principles of Corrosion Engineering and Control", Butterworth-Heinemann Elsevier Publications, 2006.

23IA104 ENGINEERING MATERIALS AND PRODUCTION PROCESS

PROPERTIES OF ENGINEERING MATERIALS: Physical metallurgy of materials -Phase Diagram, Phase Transformations, strengthening processes –Mechanical –Alloying -Solution Strengthening -Dispersion Strengthening -Precipitation Hardening, Heat-treatment, Corrosion and Failure.

MATERIALS FOR AUTOMOTIVE INDUSTRY: Ferrous Alloys – Classification and properties of - Plain carbon steels - Low alloy steels -Stainless steels - Special steels - Tool steels -Wear resistant alloys -High strength low alloy steels, Non-ferrous alloys – Classification - properties and application of - Aluminium alloys -Magnesium alloys -Copper alloys, Structure, classification,application and properties of – Polymers and Composites.

PROCESSING OF MATERIALS: An overview of manufacturing and general introduction to manufacturing processes - Casting processes – sand casting - lost wax - lost foam - die casting, Bulk deformation processes – Forging – Extrusion – Drawing - Shaping, Material forming processes –Press forming – Thermoforming - hydroforming, Material removal processes – cutting.

PROCESSING OF UNCONVENTIONAL MATERIALS: Chemical, electrical, Processing of polymers – Injection moulding and its applications, Processing of powder metals – Production of metal powders - mixing and blending – compaction – sintering and secondary operations, Welding and other joining processes – MIG – TIG – Laser beam welding, soldering and brazing [9]

CONCEPTS OF MATERIAL SELECTION: Material design requirement – Materials and manufacturing techniques – Material selection strategy and charts- Selection of material and shape-Material processing and design – Case studies of material selection for automotive components –piston, connecting rod, cam shaft, engine cylinder, cylinder head, chassis, automotive body etc.,

TEXT BOOKS

1. Kalpakjian s and Schmid S.R., Manufacturing Engineering and Technology, 7 ed (SI) Pearson Ed 2021.
2. Callister W.D., Materials Science and Engineering An Introduction, 10th edition, Wiley, 2018

REFERENCES

1. Askeland D.R. The Science and Engineering of Materials 7th edition SI Edition, Chapman and Hall 2018
2. Ashby M.F., Materials Selection in Mechanical Design, 4thedition , Elsevier, 2012

23IA105 ENGLISH LANGUAGE PROFICIENCY

VOCABULARY: Etymology-Prefixes and suffixes–Synonyms–Antonyms–Guessing meanings from context–Word formation-Single-word substitutes-Different forms of a word–Phrasal verbs–Collocations.

LISTENING AND SPEAKING: Understanding listening – Listening techniques - Introducing oneself and others –Seeking and sharing information– Description-Conversation skills–Extempore speaking– Speech practice in varied formal contexts

GRAMMAR: Wh-questions–Yes/no questions–Parts of speech–Articles–Prepositions–Gerunds–Conjunctions-Degrees of comparison–Tenses– Modal verbs– Adverbs - Direct and indirect questions.

READING: Reading strategies: Skimming and scanning,Predicting–Reading comprehension: techniques –Practice reading.

WRITING: Discourse markers – Dialogue writing - Completing sentences – Jumbled sentences –Paragraph writing –Writing compare & contrast paragraphs – Letter writing.

TEXTBOOKS:

1. Shoba K.N.and Lourdes Joavani Rayen, Communicative English, Cambridge University press,Cambridge,2021.
2. Raymond Murphy,Intermediate English Grammar, Cambridge University Press, New Delhi,2020.

REFERENCES:

1. Raymond Murphy, English Grammar in Use, Cambridge University Press, New Delhi, 2020.
2. Sudharshana N P and Savitha C, English for Engineers, Cambridge University Press, New York, 2018.
3. Anne Laws, Writing Skills, Orient Black Swan, Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, Essential English Grammar, Cambridge University Press, New Delhi, 2019.

23IA110 WORKSHOP TECHNOLOGY LABORATORY

1. Study and experiment on Foundry practices
2. Study and experiment on Welding
3. Study and experiment on Sheet metal
4. Study and experiment on Plumbing
5. Study and experiment on Fitting
6. Preparation of three models on lathe involving - Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring and Internal Thread cut.
7. Drilling, Counter sinking, Counter Boring and Tapping using a Radial drilling machine
8. Cutting of Gear Teeth using gear Hobbing Machine.
9. Cutting a pocket or a T slot using Vertical Milling machine
10. Creating a fine surface using Surface Grinding machine

REFERENCES:

1. Faculty of Automobile Engineering. Lab manual Prepared by Department of Automobile Engineering. 2022

23IA111 ENGINEERING GRAPHICS LABORATORY

Unit- I: Introduction

Introduction to Engineering Drawing. Bureau of Indian Standards (BIS). BIS Engineering drawing practices SP 46:2003 – layout and folding of drawing sheets, Lines, Lettering and Dimensioning. Geometric Constructions.

Unit-II: Orthographic, Isometric and Perspective Projection

Theory of projection - Principle of orthographic projection– First angle, third angle projections. Profile planes and side views. Multiple views of 3D objects-Principles of perspective projection, methods, projection of solids. Isometric view of simple engineering components.

Unit –III: Projection of Solid Geometry

Projection of points, lines, planes and Solids

Unit-IV: Section of Solids

Sections of regular solids, types of sections, BIS conventions, selection of sectional views. Sectional views of simple engineering components.

Unit-V: Development of Surfaces
Development of lateral surfaces of regular solids, truncated solids and simple engineering sheet metal components.

TEXT BOOKS
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International Publishers, 2017.
3. Dhananjay A. Jolhe, "Engineering Drawing", Tata McGraw Hill, 2017.
4. John K.C., "Engineering Graphics" PHI, 2009.

REFERENCES
1. Bureau of Indian Standards, "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, New Delhi, 2003.
2. Luzadder W. J., "Fundamentals of Engineering Drawing", Prentice Hall Book Co., New York, 1998.

SEMESTER II

23IA201 COMPLEX VARIABLES AND TRANSFORMS

COMPLEX DIFFERENTIATION: Derivative, analytic function, Cauchy-Riemann equations, Laplace's equation, linear fractional transformations.

COMPLEX INTEGRATION: Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only).

LAPLACE TRANSFORMS: Laplace transform, linearity, first shifting theorem, transforms of derivatives and integrals, unit step function, second shifting theorem, Dirac's delta function, periodic functions, differentiation and integration of transforms, solving ODEs with constant coefficients and initial value problems.

FOURIER ANALYSIS: Fourier series – arbitrary period, even and odd functions, half range expansions. Fourier transforms, Fourier cosine and sine transforms.

PARTIAL DIFFERENTIAL EQUATIONS: Basic concepts of PDEs, wave equation, heat equation, steady state two-dimensional heat problems, solution by Fourier series.

TEXT BOOKS
1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.
2. Dennis G. Z, "Advanced Engineering Mathematics", Jones and Bartlett Pvt Ltd, New Delhi, 2017.

REFERENCES
1. Dennis G. Z and Patrick D. S, "A first course in Complex Analysis with applications", Jones and Bartlett Pvt Ltd, New Delhi, 2015.
2. Wylie C. R and Barret L. C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2018.
4. Dean G.D, "Advanced Engineering Mathematics with MATLAB", CRC Press, USA, 2017.

23IA202 SENSORS FOR ENGINEERING APPLICATIONS

STRAIN AND PRESSURE MEASUREMENT: Resistance strain gauge, piezoelectric pressure sensor, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic pressure sensor. capacitance pressure sensor.

ELECTRONIC SENSORS: Inductive, capacitive and ultrasonic based proximity sensors -Reed switch, Hall-effect switching sensors, capacitive based humidity sensor, liquid level detectors, flow sensors, smoke sensors

MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors, piezoelectric devices for motion sensing, Hall effect-based speed sensor.

LIGHT Sensors: Color temperature, light flux, photo sensors, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic sensors and their applications. LIDAR working principle and automotive applications

Thermal Sensors: Bimetallic strip, semiconductor-based temperature sensor, thermocouples, Resistance thermometers, thermistors, PTC and NTC thermistors and their applications. Infrared sensors: bolometer, Pyroelectric detector, photodiodes and phototransistor.

TEXTBOOKS:
1. Ian R Sinclair, Sensors and Transducersǁ, Third Edition, Newnes publishers, 2011
2. Krzysztof Iniewski, Smart sensors for industrial applications, CRC Press Taylor and Francis, 2019
3. Doebelin E O, Measurement Systems, Application and Designǁ , McGraw Hill, Fifth Edition, 2019

REFERENCES:

1. Jack P Holman, Experimental Methods for Engineersll, Seventh Edition, McGraw Hill, USA, 2011.
2. Jacob Fraden, Handbook of modern sensors: Physics,design,and applications, Springer, 4th Edition, 2016

23IA203 ENERGY: SOURCES AND STORAGE

FUELS AND COMBUSTION: Petroleum - refining, cracked and polymerized gasoline- petrol and diesel knocking-octane and cetane rating of fuels-reforming of gasoline. Liquefaction of coal (Bergius process). Alternate fuels – methanol, ethanol, CNG, biodiesel. Calorific value and calorific intensity-determination by Bomb calorimeter and Boy's gas calorimeter-calculation of heat of combustion - calculation of theoretical flame temperature. Combustion- theoretical air requirements. Chromotagoraphic analysis of fuels and exhaust gases, emission test, catalytic convertors – principles, Euro and Bharath emission standards. Propellants – requisites-examples. Explosives-Lead azide-automobile air bags-functions –calculations.

BATTERIES: Battery characteristics - voltage, current, capacity, electricity storage density, power, discharge rate, energy efficiency, cycle life and shelf life. Primary cells: Fabrication, performance aspects, packing and rating of zinc-carbon, Zn-air, Zn-alkaline manganese, Zn-silver oxide, lithium cells and reserve batteries.

SECONDARY BATTERIES: Lead-acid battery-Design,performance aspects, passivation, sulfation, Horizontal plate Pb-Acid batteries for transportation, cylindrical Pb-Acid battery vs. flat plate system, nickel-metal hydride batteries,zinc- alkaline batteries,lithium-ion batteries-design, characteristics and applications. Li-air batteries, Li-S batteries, Sodium-ion batteries.

SUPERCAPACITORS: Fundamentals of electrochemical supercapacitors, electrode and electrolyte interfaces and their capacitances, charge-discharge characteristics, energy/power density, design, fabrication, operation and evaluation, thermal management. Supercapacitors for transportation applications-aqueous and organic based supercapacitors, Pseudo and asymmetric supercapacitors. Advance battery-supercap hybrids for auto, space and marine applications.

ENERGY GENERATION: Fuel cells-classification, working principle, components, applications and environmental aspects of proton exchange membrane, solid oxide, molten carbonate, direct methanol fuel cells. Hydrogen as fuel-sources of hydrogen – methods of hydrogen production – gas clean-up –methods of hydrogen storage. Hydrogen as an engine fuel - features and limitations.Photogalvanic cells, semiconductor solar batteries (SC-SB), thermo-ionic converters, dye-sensitized solar cells (DSSC).

TEXT BOOKS:

1. ShikhaAgarwal, "Engineering Chemistry:Fundamentals and Applications" Cambridge University Press 2015
2. Dell, Ronald M. Rand and David A. J., "Understanding Batteries", Royal Society of Chemistry, 2001.
3. Vladimir S. Bagotsky, Alexander M. Skundin, Yurij VM. Volfkovich., "Electrochemical power sources : Batteries, fuel cells, and supercapacitors", John Wiley & Sons, Inc.,2015.

REFERENCES:

1. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
2. Kiehne H. A., "Battery Technology Handbook", Expert Verlag, RenningenMalsheim, 2003.
3. AuliceScibioh M. and Viswanathan B., "Fuel Cells – Principles and Applications", University Press, 2006.

23IA204 ENGINEERING MECHANICS

STATICS: Force on a particle – resultant of concurrent forces– resolution of force – equilibrium of a particle – free body diagram – force in space – equilibrium of a particle in space – transmissibility – moment of a force – resolution of a force into a force and a couple – reactions at supports – equilibrium of a two and three force bodies. Simple trusses – method of joints

FRICTION: Laws of dry friction – angles of friction – coefficient of static and kinetic friction – wedges – rolling resistance – belt friction.

CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA: Centroids of areas–composite areas–center of gravity–determination of moment of inertia–polar moment of inertia–radius of gyration – mass moment of inertia of simple solids.

KINEMATICS and KINETICS: Equation of motion – rectilinear and rotary motion – Energy – potential energy - kinetic energy – conservation of energy – work done by a force – work energy method.

IMPULSE & MOMENTUM: Impulse – Momentum principle –Direct central impact–oblique central impact – impact of a moving car on the spring board.

TEXT BOOKS

1. Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2010.
2. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2006.

REFERENCES

1. Bansal R K, “Engineering Mechanics”, Laxmi Publications Pvt. Ltd., New Delhi, 2006.
2. Bhavikatti S S, “Engineering Mechanics”, New Age International Pvt. Ltd., New Delhi, 2003.
3. Young D H and Timashenko S, “Engineering Mechanics”, Tata Mcgraw-Hill, 2006.
4. JivanKhachane, RuchiShrivastava, “Engineering Mechanics: Statics and Dynamics”, ANE Books, 2006.

23IA211 BASIC SCIENCES LABORATORY

Physics (Any eight experiments):

1. Determination of Young’s Modulus of a wooden bar – Cantilever method
2. Determination of rigidity modulus of a given material using Torsion pendulum
3. Determination of thermal conductivity of bad conductor using Lee’s Disc method
4. Determination of fibre thickness – air wedge method
5. Determination of wavelength of mercury spectrum using transmission grating
6. Measurement of vibration frequency of electrically maintained tuning fork using Melde’s apparatus
7. Determination of Hysteresis loss of a ferromagnetic material
8. Determination of thermal conductivity of a metallic material using Wiedemann – Franz law
9. Determine e/m (charge to mass ratio) of the electron by Thomson’s method.
10. Find the Hall voltage, Hall coefficient, mobility & charge density of the given ‘Ge’ crystal using Hall apparatus.

Demonstration:

1. Determine the excitation potential of Argon using the Franck Hertz method.
2. Determine the number of turns & radius of the coil and magnetic field of ‘Helmholtz’ coil using Biot-Savart’s Law – apparatus
3. Determine the charge of an electron by Millikan’s oil drop method.
4. Determine the Planck’s constant using Photo Electric method.
5. Determine the wavelength of the laser source by Michelson Interferometer.
6. Determine the thickness of the film by Mach Zehnder Interferometer.
7. Find the finesse and free spectral region of the Etalon.
8. Analyze the mercury spectrum and find wavelength using polynomial equation.
9. Determine the refractive index of given specimen using Brewster’s angle apparatus.

REFERENCES:

1. Department of Physics,” Physics laboratory observation”, 2022.
2. Jerry D Wilson; Cecilia A Hernandez Hall, “Physics laboratory experiments”, Boston, MA : Cengage Learning, 2016.

Chemistry (Any Eight Experiments)

1. Determination of kinematic viscosity of lubricating oil using Redwood viscometer.
2. Determination of flash and fire point, cloud and pour point of lubricating oil.
3. Estimation of hardness of water by EDTA method.
4. Proximate analysis of coal.
5. Examination of different forms of corrosion using Ferroxyl indicator and determination of corrosion rate by current measurement.
6. Determination of acid value, saponification value and iodine value of lubricating oil.
7. Electroplating of nickel & copper and determination of cathodeefficiency.
8. Anodizing of aluminium and determination of thickness of anodized film.
9. Determination of molecular weight of polymers by Ostwald / Ubbelohde Viscometer.
10. Study of a galvanic cell.

REFERENCE:

1. Laboratory Manual Prepared by the Department.

23IA213 FOUNDATIONS OF PROBLEM SOLVING

PROBLEM SOLVING:

1. Speed Mathematics (SAW, Oz, Mirror methods)
2. Speed Mathematics (High5, Minion, Butterfly methods)
3. Speed Mathematics (Inception, Goldeneye methods)
4. Thinking with Numbers
5. Problem Solving with Visual information
6. Words Puzzles
7. Resume Writing Essentials

REFERENCES:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.

SEMESTER III

23IA301 COMPUTATIONAL MATHEMATICS

SYSTEM OF LINEAR EQUATIONS, EIGENVALUES AND EIGENVECTORS: Approximations and errors. System of linear equations **-** Naïve Gauss elimination method, Cholesky method, Gauss–Seidel method. Eigenvalues and eigenvectors - Jacobi method. Applications - analysis of statically determinate truss, spring-mass systems

NON LINEAR EQUATIONS: False-position method, Newton-Raphson method, Graeffe's root squaring method, Applications - Openchannel flow model, vibration analysis.

INTERPOLATION, DIFFERENTIATION AND INTEGRATION: Interpolation **-**Newton's forward and backward, Lagrange, cubic-spline, approximation - Bezier curves, Numerical differentiation, Numerical integration - Newton-Cotes formulae, Trapezoidal rule, Simpson's1/3rd rule, Gaussian Quadrature, Applications – temperature gradient, velocity and pressure distribution, relation between stress and strain.

ORDINARY DIFFERENTIAL EQUATIONS: Taylor-series method, Euler method, 4th order Runge-Kutta method, Milne's method. Finite element method – Rayleigh Ritz method, Galerkin method, Applications - swinging pendulum, heat flow models.

PARTIAL DIFFERENTIAL EQUATIONS: Finite difference method: elliptic equations - Laplace equation, Poisson equation **–** Liebmann method, deflection of a plate, steady state heat conduction, parabolic equations – Crank Nicolson's method, transient heat conduction, hyperbolic equations – vibrating string.

TEXT BOOKS

1. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2021.
2. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, New Delhi, 2017.

REFERENCES

1. Richard L. B and Douglas J. F, "Numerical Analysis", Thomas Learning, New York, 2017.
2. G. Miller, "Numerical Analysis for Engineers and Scientists", Cambridge University Press, UK, 2014.
3. Amos G and Vish S, "Numerical Methods for Engineers and Scientists", Wiley India, New Delhi 2014.
4. Tai-Ran, "Applied Numerical Analysis", Wiley India, New Delhi, 2018.

23IA302 STRENGTH OF MATERIALS

STRESSES AND STRAINS: Stress and strain due to axial force – Strain energy due to axial force –sudden load and impact load. Poisson's ratio– volumetric strain– shear stress–shear strain. Thin cylindrical and spherical shells under internal pressure. Thermal stresses. Principal stresses and planes – Mohr's circle for plane stress and plane strain. Strain gauges and rosettes

BENDING MOMENT AND SHEAR FORCE IN BEAMS: Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, concentrated moments – maximum bending moment and point of contra flexure.

FLEXURE & TORSION IN BEAMS: Theory of simple bending and assumptions –flexure equation. Theory of torsion and assumptions – torsion equation – power transmitted by a shaft.

DEFLECTION OF DETERMINATE BEAMS: Governing differential equation – Macaulay's method – moment area method – application to simple problems (cantilever beams and simply supported beams only).

COLUMNS AND STRUTS: Columns – behavior of axially loaded short and long column members – buckling load – Euler's theory – different end conditions – Rankine's formula.

TEXT BOOKS

1. Jindal U C, "Strength of Materials", Asian Books Pvt Ltd, New Delhi, 2007.
2. Rajput.R K, "Strength of Materials", S.Chand& Co Ltd, New Delhi, 1996.

REFERENCES

1. Kumar D S, "Fluid Mechanics and Fluid Power Engineering ", Kataria S K and Sons, New Delhi, 1997.

23IA303 ENGINEERING THERMODYNAMICS

Basic Concepts of Thermodynamics: System and their behavior, properties of a system, state and equilibrium, process and cycles, pure substance and property diagram for phase change process, zeroth law and first law of thermodynamics - their application, energy and energy transfer - heat and work interactions, general energy equation and applications tothermal equipment's-turbines, compressors, nozzle, diffuser etc.First law - application on automobiles.

Second Law of Thermodynamics: Statements**-**heat engines, heat pump and refrigerator. Energy conversion efficiency, reversible and irreversible process, Carnot cycle and theorem, Entropy - Clausius inequality, change of phases of entropy, Second law - application on IC Engine.

Gas Power Cycles: Basic consideration in the analysis of power cycles, Otto, Diesel and their performance analysis, Brayton cycle with regeneration, intercooling and reheating - performance analysis.Problem solving of Aircraft engine and race car engine.

Vapour Power Cycles: Rankine cycle with reheating and regeneration, open and closed feed water heating system-performance analysis and comparison with Carnot cycle.Problem solving of Steam power plants.

Thermodynamic Relation: Equations of state, Maxwell relations, Clapeyron equation, Gibbs equation, Joule-Thomson effect, general relation for real gases - internal energy, enthalpy, and entropy. P-V-T relation for gas mixture,generalized charts and conventional tables for thermodynamic properties.

TEXT BOOKS

1. Cengel Y A and Boles M A, "Thermodynamics – An Engineering Approach" Eighth edition, Tata McGraw Hill Publishing Company, New Delhi, 2015.
2. Moran M J and Shapiro H N, "Fundamentals of Engineering Thermodynamics" - John Wiley and Sons Private Limited, New Delhi, India, 2014.

REFERENCES

1. Nag P K, "Engineering Thermodynamics", Tata McGraw Hill Publishing Company, New Delhi, 2004.
2. Holman J P, "Thermodynamics", McGraw Hill Book Company, Fourth Edition, New York, 1988.
3. Stephen R Turns, "Thermodynamics - Concepts and applications", Cambridge University Press, New York, USA, 2006.

23IA304 AUTOMOTIVE CHASSIS

FRAME AND BODY: Introduction, Vehicle classification, frame types-conventional, integral construction – ladder chassis, sub frames, functions and requirements, chassis lay out types, Loads acting on chassis, chassis members selection, frame materials, types of bodies, features of body, body structural requirements, material selection and mass estimation in preliminary design.

STEERINGSystem: Introduction, Functions and requirements, axles-live and dead axles, front axle and its types, stub axle and its types, steering mechanisms, arrangement of steering system, steering gear box types, center point steering, stub axle types, Wheel alignment, hydraulic power steering.

SUSPENSION SYSTEM: Introduction, suspension spring types-, types of suspension system, dampers, types, telescopic shock absorbers, air suspension,hydro-elastic suspension, hydro-pneumatic suspension system, semi-active and active suspension system.

BRAKE SYSTEM,: Introduction, principle, classifications, requirements, drum brake,disc brake, stopping distance calculations, weight transfer calculations, braking efficiency calculations,hydraulic brakes, vacuum servo brakes, air brakes, air assisted hydraulic brakes, introduction to Anti-lock braking system.

WHEELS AND TYRES :Tyres- basic construction of wheel, bias ply and radial ply tyres, tubeless tyres, wheel balancing, special wheels.

TEXT BOOK

1. Robert Bosch "Automotive Hand book", 2009.
2. Kenneth Garret T,Kenneth Newton and William Steeds," The Motor Vehicle", Butterworth-Heinemann Limited, 2012.
3. Anthony E S, "Motor Automotive Technology",Delmar Publishers,1998.

REFERENCES:

1. Heinz Heister, "Vehicle and Engine Technology", SAE International, 2011.
2. Robert Bosch, "Automotive Electrics Automotive Electronics", Professional Engineering Publication, 2009

23IA305 ENGINEERING ECONOMICS

Fundamentals of Economic Analysis: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency.

Cost and Inventory Control: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages-Depreciation Methods – Problems in Straight Line and Diminishing Balance Method.

Pricing, Revenue and Value Engineering: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering.

Project Management: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis.
Economic Growth and Development: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy.

Text Books
1. Panneerselvam. R., "Engineering Economics", PHI Learning Private Limited, 2012.
2. Metha P.L, "Managerial Economics – Analysis, Problems and Cases", Sultan Chand & Sons, 2016.

References
1. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, "Principles of Engineering Economics with Applications", Cambridge University Press, 2018.
2. Varshney, R.L and K.L. Maheshwari, "Managerial Economics", Sultan Chand & Sons, 2014.
3. McEachern and Indira., "Macro ECON", Cengage India Private Limited, 2017.
4. Shalini Goyal Bhalla, "Circular Economy (Re) Emerging Movement", Invincible Publishers, 2020.

23IA310 AUTOMOTIVE CHASSIS LABORATORY

1. Measurement of the Heavy duty vehicle chassis frame
2. Measurement of the Light duty vehicle chassis frame
3. Dismantle, service and assemble the Front Axle and Rear Axle
4. Dismantle, service and assemble the light duty vehicle differential unit
5. Dismantle, service and assemble the heavy duty vehicle differential unit
6. Servicing of steering gear boxes and verification of Ackerman steering geometry
7. Brake system troubleshooting and brake bleeding
8. Suspension system trouble shooting
9. Measurement of centre of gravity of a light duty vehicle
10. Study of types of frames and bodies

References:
1. Manual prepared by the department

23IA311 MACHINE DRAWING

UNIT I
Machine Drawing Conventions: Need for drawing conventions- introduction to IS conventions Conventional representation of material, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs. Parts not usually sectioned. Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centres, curved and tapered features. Limits ,Fits–Tolerancing of individual dimensions–Specification of Fits– reparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning &tolerancing. Title boxes, their size, location and details-common abbreviations & their liberal usage.

UNIT II
Drawing of Machine Elements and simple parts: Selection of Views, additional views for the following machine elements and parts with drawing proportions: Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws, Keys,cottered joints and knuckle joint, Rivetted joints for plates, flanged &protected flanged joint.Shaft coupling, spigot and socket pipe joint.Journal, and foot step bearings.

UNIT III
Assembly Drawings: Drawings of assembled views for the part drawings of the following. Engine parts- stuffing boxes, cross heads, Petrol Engine-connecting rod, piston assembly. Other machine parts- Screw jack, Machine Vice, single tool post. Valves: Steam stop valve, feed check valve. Non-return value.

TEXT BOOKS
1. Gopalakrishna K R, "Machine Drawing", Subhas Stores, Bangalore, 2013.
2. 2. Narayana K L, Kannaiah P, Venkata Reddy K, "Machine Drawing" New Age International, New Delhi, 2012.

REFERENCES
1. John K C, "Machine Drawing", PHI Learning, Delhi, 2009.
2. BIS,"SP:46-2003 "Engineering Drawing Practice for Schools and Colleges", New Delhi, 2003.
3. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", KalaikathirAchchagam, Coimbatore, 2012.
4. ASME Y 14.5M-1994, "Dimensioning and Tolerancing", ASME, New York, 1995.

SEMESTER IV

23IA401 THEORY OF MACHINES

BASICS OF MECHANISMS: Terminology and definitions, degree of freedom, mobility. Grashoff's law. Kinematic inversions - 4-bar chain, slider crank chain. Mechanical advantage. Transmission angle. Description of common mechanisms, applications of mechanisms. Introduction to 4-bar spatial mechanisms.

KINEMATICS: Displacement, velocity and acceleration analysis in four bar and slider crank mechanisms, graphical method-velocity and acceleration polygons. Kinematic analysis by analytical method, vector approach &Complex-algebraic method.

KINEMATICS OF CAM: Classifications, displacement diagrams-parabolic, uniform velocity, simple harmonic paths. Layout of plate cam profiles for different types of followers - knife edged, roller, mushroom, flat type. Derivatives of follower motion, pressure angle and undercutting. Jump speed analysis.

GEARS: Spur gear terminology and definitions. Fundamental law of toothed gearing and tooth forms. Interchangeable gears, gear tooth action - path of contact, arc of contact, number of pair of teeth in contact, interference and undercutting. Helical, bevel, worm, rack and pinion gears (basics only). Gear trains, epicyclic gear trains-analysis of epicyclic gear train, relative velocity and torque, automotive differential gear trains.

GOVERNORS & GYROSCOPE: Governors – Types – Centrifugal governors – Characteristics – Effect of friction – Controlling force. Gyroscopic couple and its effect in ship, car, motorcycle, Aeroplan's, Gyroscopic stabilization.

TEXT BOOKS:

1. John J. Uicker, Gordon R. Pennock& Late Joseph E. Shigley," Theory of Machines and Mechanisms", International Version,2009
2. Rattan S S, "Theory of Machines", Tata McGraw -Hill Publishers, New Delhi, 2009.

REFERENCES:

1. Thomas Beven, "The Theory of Machines", CBS Publishers and Distributors, New Delhi, 2005.
2. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", New Age International Publishers, New Delhi, 2006.
3. Sharma C.S, KamleshPurohit, "Theory of Mechanisms and Machines", PHI, New Delhi, 2006.
4. Sadhu Singh, "Theory of Machines", Pearson Education, New Delhi, 2009.

23IA402 AUTOMOTIVE ENGINES

ENGINE INTRODUCTION: Introduction to IC engines. Engine classification, firing order. Constructional details and working principle of four stroke spark ignition (SI) and four stroke compression ignition (CI) engines. Two stroke SI engines – construction and working. Valve timing and port timing diagram. Comparison of SI and CI engines. Emissions of IC engines.

FUEL SYSTEMS: Introduction of fuel system circuit of petrol and diesel engines.Air fuel ratio requirements.Carburettor, types, working of a simple carburettor. Diesel fuel injection systems-inline fuel injection pump, Jerk pumps, distributor pumps, types of nozzles. Introduction to electronic fuel injection system. Multipoint fuel injection system (MPFI),Common rail direct injection system(CRDI) and Gasoline direct injection system (GDI).

COMBUSTION AND COMBUSTION CHAMBERS: Introduction to combustion in SI and CI engines. Combustion chamber types, Direct and indirect injection combustion chambers, Stages of combustion in SI and CI engines. Combustion chemistry and emission formation. Ignition and injection timing. Knock, detonation and control.Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design.

COOLING AND LUBRICATION SYSTEMS: Need for cooling, types of cooling systems- air and liquid cooling systems. Water cooling circuit, radiator, water pump and cooling fan.Properties of coolants and additives.Need, requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties and chemistry of lubricants.

SUPERCHARGING, TURBO CHARGING AND ENGINE TESTING: Supercharging and Turbocharging, Different methods of turbocharging, Intercooling, Turbocharger controls - waster gate, variable geometry. Dynamometers, Engine testing standards thermal and volumetric efficiencies. Heat balance test, Measurement of friction, Cylinder pressure measurement. Engine performance curves.

TEXT BOOKS

1. Ganesan. V, "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi,2012.
2. Ramalingam K.K., "Internal Combustion Engines", Sci-Tech Publications, 2005.

REFERENCES

1. Heisler, "Advanced Engine Technology" SAE Publication, 1995
2. Gupta. H.N. "Fundamentals of Internal Combustion" Engines, reprint, PHI Learning Pvt. Ltd. 2006
3. Mathur. M.L., Sharma. R.P. "A course in internal combustion engines", Dhanpatrai publication, 2010.
4. John B. Heywood, "Fundamentals of Internal Combustion Engines", 1988

23IA403 BASICS OF ELECTRICAL AND ELECTRONICS ENGIINEERING

ELECTRIC CIRCUITS: Ohm's law, KCL, KVL, solving simple DC Circuits - Single phase AC circuit fundamentals – Power, Power factor – solving simple AC circuits – 3 phase AC circuits – Star and Delta Connection.

DC MOTORS& APPLICATIONS: Principle of Operation- types – back emf – torque equation - speed torque characteristics– losses and efficiency– speed control of DC motor – Electric Braking - Applications. Motor Selection – factors to be considered – power rating – types of Duty cycle – selection of motors for anautomobile application.

AC MACHINES& APPLICATIONS: 3 phase Induction Motor-construction– Principle of operation – types –torque equation - speed torque characteristics – 1 phase Induction Motor – Principle of operation- types. Synchronous Motors – construction - Principle of Operation. - Electric Braking of Induction Motor – Single phase Transformers – Construction and working principle – Types.

ELECTRONIC DEVICES& CIRCUITS: Operation of PN junction diodes, VI characteristics, Zener diode, BJT, FET, JFET, MOSFET- working principle, types, input and output characteristics.Opto Electronic Devices-Introduction, types, principles and applications.(Qualitative analysis only) Half wave and full wave rectifier, capacitive filters, Zener voltage regulator, RC- coupled amplifier, frequency response, oscillator, Barkhausen criteria, RC phase shift oscillator.

LINEAR INTEGRATED CIRCUITS&DIGITAL ELECTRONICS: Operational amplifiers, Ideal op-amp characteristics, Inverting and Non-inverting amplifier, op-amp applications - Adder- Subtractor, integrator, differentiator, comparator, zero crossing detector– 555 Timer IC – A stable mode.Number systems- representation of signed numbers: 1's complement and 2's complement, logic gates, Half adder, *full adder*, parallel adder/subtractor, Flip flops, RS,JK,JK Master slave, D and T type, counters and shift registers.

TEXT BOOKS

1) John Bird, "Electrical and Electronic Principles and Technology", Routledge Taylor and Franics, 6th edition, 2017.
2) Albert Malvino, "Electronic Principles",McGraw Hill Education, 7th edition,2017.

REFERENCES

1) Mehta V.K. and Mehta Rohit, "Principles of Electrical Engineering and Electronics", S.Chand& Co. Ltd., 2015.
2) Roy Choudhury and Shail Jain, "Linear Integrated Circuits", New Age International Limited, 4th Edition, 2018.
3) Leach D P, Malvino A P and GoutamSaha, "Digital Principles and Applications", Tata McGraw – Hill, 8th Edition, 2015.

23IA404 MACHINE DESIGN

DESIGN AGAINST STATIC AND FLUCTUATING LOAD: Concepts of design, preferred numbers – concurrent engineering – static stress equation in axial, bending and torsional loading – criteria for failure – Factor of safety. Static loading - Combination of normal and shear stresses - Principal stresses - Theories of failure. Fluctuating load- Mechanism of fatigue failure, fatigue limit and fatigue strength, S-N curves, Soderberg, Goodman and Gerber equations.

DESIGN OF SHAFTS, KEYS AND COUPLINGS: Design of shafts based on strength, rigidity and critical speed - Design of keys and keyways - Design of rigid and flexible couplings - Knuckle joints.

DESIGN OF BEARINGS AND SPRINGS: Sliding contact and rolling contact bearings - Cubic mean load, variable load, probability of survival - Selection of bearings - Helical springs, stresses and deflection in round wires - Concentric springs - accounting for variable stresses - Design of leaf springs - stress and deflection equations.

RIVETED, BOLTED AND WELDED JOINTS: Strength equations, efficiency, design of riveted joints - Thread forms, initial stress, stresses due to external loads, elastic analysis of bolted joints for pressure vessel flanges - Welded joints, types, weld symbols, strength of welds, centrally loaded unsymmetrical sections, axially loaded and eccentrically loaded joints.

BELT AND CHAIN DRIVES: Design of Spur and Helical Gears - Design of Flat belts and pulleys - Selection of V belts and pulleys – Design of Transmission chains and Sprockets.

TEXT BOOKS:

1. Bandari V B, "Design of Machine Elements ", Tata McGraw Hill, 2017.
2. Shigley and Mische, "Mechanical Engineering Design", McGraw Hill, 2011.

REFERENCES:

1. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s. Kalaikathi rAchagam, Coimbatore, 2020.
2. Maitra G M, "Handbook of Gear design", Tata McGraw Hill, New Delhi, 2004. 40
3. Gope P. C, "Machine Design: Fundamentals and applications", PHI learning, 2012.
4. Robert L Mott, "Machine elements in Mechanical Design", Macmillan Publishing Co, 2003.

23IA405 AUTOMOTIVE TRANSMISSION

CLUTCH: Introduction - types of clutches, single plate clutch, coil and diaphragm spring multiple plate clutch, centrifugal clutch- clutch wear theories

GEAR BOX: Introduction - types of gear boxes, constant mesh and synchromesh gear boxes, calculation of gear ratios, epicyclical gearboxes, overdrives, transfer case - auxiliary gearbox, gear shifting mechanisms. Automated Manual Transmission (AMT)

FLUID COUPLING AND TORQUE CONVERTER: Introduction – working principle of fluid coupling- construction details – advantages and limitations - slip in fluid coupling, performance characteristics. - Principal of torque conversion, single, multi stage and polyphase torque converters, performance characteristics.

DRIVE LINE AND AXLE: Introduction - propeller shaft drive, torque reaction and drive thrust Hotchkiss drive, universal joints, whirling and critical speed - constant velocity joint type. Live and dead axles, front axle and its types, stub axle and its types, rear axle and its types, fully floating, semi- floating and three-quarter floating axles, two speed axles, twin axles, swing axles.

FINAL DRIVE AND DIFFERENTIAL: Need for final drive and differential, types of final drives, single reduction and double reduction final drives, differential and its types, conventional and non-slip differentials, differential lock, Inter axle differential transaxle types.

TEXT BOOKS

1. Garrett TK, Newton K. and Steeds W. “Motor Vehicle”, Butter Worths& Co. Publishers Ltd., New Delhi, 2011.
2. Heinz Heisler, “Advanced Vehicle Technology”. Butterworth Heinemann Publishers, 2012.

REFERENCES

1. Crouse WH, "Automotive Chassis and Body," McG raw Hill Book Co., 1976.
2. Crouse WH, "Automotive Transmissions and Power Trains", McGraw Hill Book Co., 1976.
3. Fenton J, “Hand book of Automotive Power Trains and Chassis Design”, Progressive publisher,1998.
4. Martin W Stockel and Martin TStockel, “Auto Mechanics Fundamentals ", The Good Heart and Wilcox Co. Inc., 1982.

23IA410 STRENGTH OF MATERIALS LABORATORY

1. Tension test on metals.
2. Brinell hardness test on metals.
3. Vickers hardness test on metals.
4. Rockwell hardness test on metals.
5. Impact test on metals—Charpy, Izod impact tests.
6. Double Shear test on metals
7. Compression and tension springs tests on helical springs
8. Torsion test on beams
9. Deflection test on beams.
10. Cupping test on metal sheets

REFERENCES:

1. Laboratory Manual prepared by Department of Civil Engineering, 2012.

23IA411 BASICS OF ELECTRICAL AND ELECTRONICS LAB

1. Verification of Ohm’s and Kirchhoff’s Laws
2. Measurement of Power and Power factor in a single phase RLC Series Circuit.
3. Determination of mechanical characteristics of DC shunt and Compound Motors.
4. Performance characteristics estimation of three-phase induction motors.
5. Electric Braking of 3 Phase Induction Motor (Dynamic braking / plugging)
6. Study and analysis of half and full wave rectifiers.
7. Frequency responses analysis of RC Coupled amplifiers.
8. Application of Operational Amplifiers.
9. Study of logic gates and implementation of binary adder and subtractor.

REFERENCES:

1. Laboratory Manual prepared by Department 2020

23IA412 C PROGRAMMING LABORATORY

Implementation in the following Topics:
1. Working with RAPTOR Tool – Flowchart Interpreter
2. Simple programs to understand Operators and expressions.
3. Decision making Statements :simple if, if..else, nested if .. else,elseifladder, switch case
4. Loops : while , do..while, for
5. Implementation of one dimensional array
6. Implementation of two dimensional array
7. Working with Strings
8. Functions
9. Recursive functions
10. Structures: Arrays and Structures,Nested Structures.
11. Structures and functions
12. Implementation of pointer and pointer arithmetic
13. Types of pointer: const pointer, pointer to a constant, void pointer, null pointer Note: Problem Sheets will be provided during the course

REFERENCES:

1. Paul Deitel and Harvey Deitel, “C How to Program: With an Introduction to C++”, Eighth edition, Pearson Education, 2018.
2. Ajay Mittal, ”Programming in C - A Practical approach”.Pearson,New Delhi, 2010
3. Gottfried B., “Programming with C”, McGraw Hill Education, New Delhi, 2018.

SEMESTER V

23IA501 FLUID MECHANICS &HEAT TRANSFER

Fluid Statics: Basic fluid properties - Viscosity, Surface tension and capillarity**,** types of flow and significance, Conservation of laws - mass, momentum and energy, continuum hypothesis, Pressure in fluids at rest-hydrostatic force on submerged surfaces, Buoyancy and stability, Problem solving of hydrostatics analysis.

Fluid Dynamics: Motion of a fluid particle - Euler and Bernoulli's Equation and their applications,Boundary layer theory, Hagen-Poiseuille and Darcy's equations for friction and pressure drop, Flow through pipes- Major and minor losses through pipes, *Problem solving of* Bernoulli's Applications- Siphon, Pipe reducer, Venturi and Orifice Meter, Pitot Tubes, Turbines and Pumps.

Conduction: Basic Concepts of Heat Transfer; one-dimensional and multi-dimensional heat conduction equations for various geometries, steady state heat conduction with 1-D and 2-D, heat transfer from extended surfaces, transient heat conduction - Lumped system analysis, Problem solving of steady and transient heat conduction.

Convection and Radiation: External forced convection - flow over flat plates, flow across cylinders and spheres, Internal forced convection - Laminar and turbulent flow in tubes, convective correlations for circular and non-circular geometry, natural convection –Basics concepts.
Radiation process and properties, radiation heat transfer: between surfaces, two-surface enclosures, radiation shield, Problem solving of forced convection and radiation.

Heat Exchangers and Mass Transfer: Types of heat exchangers, overall heat transfer coefficient, fouling factor, compact heat exchangers, heat pipes, Performance evaluation - NTU method. Mass diffusion in binary mixtures, convective mass transfer, heat and mass transfer analogies.

TEXT BOOKS:

1. Yunus A Cengel and John M Cimballa, “Fluid Mechanics - Fundamentals and Application”, Tata McGraw Hill Publishing Company, New Delhi, 2018 (Indian Edition).
2. Munson, Young, Okiishi and Huebsch, “Introduction to Fluid Mechanics”, 5th Edition, John Willey and Sons, 2011.
3. Yunus A Cengel, “Heat and Mass Transfer – A Practical Approach”, Tata McGraw Hill, New Delhi, 2007.
4. Frank P. Incropera, Theodore L. Bergman, Adrienne S. Lavine, David P. DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, New Delhi, 2011.

REFERENCES:

1. Streeter Wylie and Bedford, "Fluid Mechanics", McGraw- Hill Publishing Company Limited, New York, 1998.
2. Irwing H Shames, "Mechanics of Fluids", Third Edition, McGraw Hill Inc., New York, 1992.
3. Holman J P, "Heat Transfer", McGraw Hill Inc., New York, 2001.
4. Kothandaraman C P, "Fundamentals of Heat and Mass Transfer", New Age International Publishers, Chennai, 1997.

23IA502 AUTOMOTIVE ELECTRICAL AND ELECTRONICS

BATTERIES AND IGNITION SYSTEM: Lead acid and alkaline batteries, construction and working, battery rating, battery charging methods, testing and maintenance - Construction and working of magneto coil and battery coil ignition systems, spark plug types, spark advance mechanisms, electronic ignition systems - Transistorized ignition system, solid state ignition systems, capacitor discharge ignition system and distributor less ignition system.

STARTING AND CHARGING SYSTEM: Principle, construction and working of starter motor, working of different starter drive units.- Alternators – Principle, construction and working – Regulators, Introduction to Start / Stop system, integrated starter generator (ISA/ISG)

SENSORS AND ACTUATORS: Classification of sensors, sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors and relay.

ELECTRONIC FUEL INJECTION: Concept of an electronic engine control system, electronic fuel injection - Throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control, engine mapping, on-board diagnostics – L- Jetronic Fuel Injection Systems.

LIGHTING SYSTEM AND ACESSORIES: Details of head light and side light, LED lighting system, head light dazzling and preventive methods.Automatic headlight- daytime running lamps- adaptive brake lights- instrument panel lighting .Fuses, cables, connectors and selection, multiplexing and de-multiplexing-Automotive Wiring-Insulated and earth return system, Wiring Diagrams, symbols and standards.Horn, wiper system – power window and mirrirors, sun roof, defrosters.

TEXT BOOKS

1. Barry Hollembeak, “Automotive Electricity and Electronics”Cengage Learning, Cliftorn Park, USA 2007
2. Kholi P L, “Automotive Electrical Equipment”, Tata McGraw Hill Co., Ltd., New Delhi, 2010

REFERENCES

1. Joseph Bell, “Diesel Engineering: Electricity and Electronics”, Cengage Learning, New Delhi, 2007.
2. Robert Bosch, “Automotive Hand Book” SAE, 2000.
3. “Automotive Electrics Automotive Electronics”, Robert Bosch GmbH, 2004.
4. Tom Denton, “Automobile Electrical and Electronics systems”, Routledge Taylor & Francis Group London & New York, 2002.

23IA503 VEHICLE SYSTEM DESIGN– I

INTRODUCTION: Selection of engine based on vehicle performance characteristics, Analysis of forces and Design procedure for cylinder, piston, piston rings and piston pin

CONNECTING ROD AND CRANKSHAFT: Design procedure for connecting rod and crank shaft

VALVE ACTUATING MECHANISM AND FLYWHEEL: Design of inlet and outlet valves, valve springs, rocker arm, tappet, Cam, camshaft. Design procedure for flywheel

CLUTCH AND GEAR BOX Design of single and multi-plate clutches: Design of Spur gear, helical and bevel gears. Selection of gear ratios.Design of gear box.

DRIVE LINE AND AXLE: Design of propeller shaft and final drive. Design of rear axle and selection of tyres

TEXT BOOKS:

1. Khurmi R S,Gupta J K “A Text Book of Machine Design”, Eursia Publishing house, New Delhi, 2010.
2. Lichty, “IC Engines”, Kogakusha Co., Limited , Tokyo, 2006. 42

REFERENCES:

1. Thomas D Gillespie, “Fundamentals of Vehicle Dynamics”, SAE USA 1992.
2. Giles J G, “Engine Design”, Illiffee Books Ltd., London 1968.
3. John Fenton., “Gasoline Engine analysis for CAD“, MEP, London 1986

23IA504 ELECTRIC AND HYBRID VEHICLE TECHNOLOGY

Introduction: Electric motor vs combustion engine- comparing drivetrains- sizing of EV powertrain-types of electric motor- QSS Toolbox Modeling- hybrid –Evs

Battery technology: introduction- EV batteries- Ragone plot- EV battery parameters-process material inside batteries- Battery Management- SOC-SOH- Thermal runaway- charging profile.

Power Electronics: Devices- MOSFETs,IGBTs, Wideband Devices- Uni and Bidirectional devices-power converters in electric cars- HEVs power converter -DC to DC converters-Buck -Boost converters -EMC compliances for power electronics devices and converters.

Charging Technology: conductive-inductive-battery swapping- Basic AC chargers-Type-1,2,CHAde MO and DC chargers – Case Study -TESLA chargers - charging time and power- Fast charging networks- battery swapping economics -vehicle to grid (V2G) – ICT protocols-overview.

Future Electric Mobility: Energy storage -Li-air- Li-sulphur- Solar powered vehicle-Queuing theory for charging- Fuel cell vehicle technology – Capstone project- drivetrain analysis of Mirai vs. FCX Clarity.

TEXT BOOKS

1. Per Enge, Nick Enge and Stephen Zoepf, “Electric Vehicle Engineering” McGraw Hill Publisher, New York, 2020.
2. Iqbal Husain, “Electric and Hybrid Vehicle -Design Fundamentals” CRC Publisher, Oxon, 2021.

REFERENCES

1. MehrdadEshani, Yimin Gao, Stefnazo and Ebrahimi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles" CRC PublishersOxon, 2018.
2. David Beeton and Gereon Meyer, “Electric Vehicle Model” Springer, Berlin, 2015.

23IA510 AUTOMOTIVE ELECTRONICS LABORATORY

1. Study of 8-bit microcontroller architecture & ARM processor.
2. Study of an integrated development environment.
3. 8 bit arithmetic and logic operations.
4. Code conversion and Waveform (square and rectangle) generation.
5. Display interface using microcontroller
6. Keyboard interface using microcontroller.
7. Sensor interface using microcontroller.
8. Stepper motor interface using microcontroller.
9. DC motor interface using microcontroller.
10. Simulation of automotive lighting system.

REFERENCES:

1. Laboratory Manual prepared by Department 2020

23IA511 ENGINE TESTING LABORATORY

1. Dismantling and assembling engines and measurement of engine parts
2. Valve timing diagram and Heat balance test on 4-stroke diesel engine
3. Compression test, vacuum test and valve clearance adjustment on petrol / diesel engine.
4. Diagnostic of engine using engine testerand Injector testing
5. Exhaust gas emission measurement on diesel and petrol engine
6. Performance test on SI and CI engines
7. Performance test on VCR engine
8. Morse test
9. Performance test on axial flow fan
10. Model study in wind tunnel

REFERENCES:

1. Laboratory Manual prepared by Department of Automobile Engineering, 2015.

SEMESTER VI

23IA601 VEHICLE DYNAMICS

INTRODUCTION: Earth and vehicle coordinate system. Longitudinal, lateral and vertical vehicle dynamics. Dynamic axle loads. Road loads - Aerodynamic forces and moments, viscosity effects, separation and its control; aerodynamic lift and its control, ground effect, styling for minimum drag. Rolling resistance, grade loads.

PERFORMANCE MODE: Acceleration - Free body diagram of accelerating vehicle, maximum transferable tractive force, gradability, Deceleration - free body diagram of decelerating vehicle, maximum decelerating rates, stopping distance, maximum braking force. Vehicle performance.

RIDE MODE: Degrees of freedom-single, two and multi degrees of freedom system, free, forced and damped vibration, model of an automobile, magnification factor, transmissibility, vibration absorbers, pitch and bounce motion, oscillation centers, active and semi active suspension, orthogonality of mode shapes, modal analysis.Quarter car Modeling and simulation.

SPRINGING SYSTEM: Requirements, sprung mass and un-sprung mass, wheel hop, shimmy, wheel wobble, choice of suspension spring rate, calculation of effective spring rate. Tyres - mechanics, stability of vehicle on slope, on curve and bankedroad.Pacejakas tire modelling and simulation.

HANDLING MODE: Vehicle control-low speed cornering and static steering-Ackerman steering geometry, steady-state cornering -steering factors, vehicle control parameters (under steer, neutral steer and over steer) roll steer, compliance steer, ride steer, slip angle steer, steady state handling-lateral acceleration gain, characteristic speed, yaw velocity gain, critical speed, effect of brakingon vehicle handling.

TEXT BOOKS:

1. Thomas D Gillespie, "Fundamentals of Vehicle Dynamics", SAE USA 2007
2. Rao S.S "Mechanical Vibrations", Pearson Education Publication, 2009.

REFERENCES:

1. GiriN.K "Automobile Mechanics", Khanna Publishers, New Delhi, 2006**.**
2. Cole D.E., "Elementary Vehicle Dynamics", Ann Arbor, Michigan, USA, 1972.
3. Wong J.Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978.

23IA602 VEHICLE SYSTEM DESIGN II

FRAME AND SUSPENSION: Force analysis and Design procedure for frame. design of Suspension system - leaf spring, coil spring and torsion spring

FRONT AXLE AND STEERING: Force analysis. Design procedure for front axle. Determination of steering torque, design of linkages, steering gear box

BRAKING SYSTEM: Force analysis, design of drum and disc brakes design of actuating mechanisms – mechanical, hydraulic and pneumatic.

ERGONOMICS AND SAFETY: Introduction, car interior ergonomics, ergonomics system design, seating dimensions dash board instruments, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Crash tests, forces in roll over, head on impact,

VEHICLE BODY ANALYSIS: Introduction, criteria for vehicle body design, sheet metal representation, Unit load method for structural deflection. Car body idealization, and bus body idealization for analysis, adhesives and sealants, goods vehicle structure design, chassis frame configuration

TEXT BOOKS:

1. Heinz Heisler, "Advanced Vehicle Technology", SAE International, 2012.
2 . John Fenton, "Handbook of Automotive Body and Systems Design", John Wiley & Sons, 2013

REFERENCES:

1. Heldt.P.M, "Automotive Chassis", Chilton Co, New York, 1992
2. Steeds. W, "Mechanics of Road Vehicles", Illiffe Books Ltd, London, 1990
3. Giles.K.G, "Steering, Suspension and tyres", Illiffe Books Ltd, London, 1988
4. JnuszPawlowski, "Vehicle Body Engineering", Business books limited, 1989.

23IA603 FINITE ELEMENT ANALYSIS

Introduction To FEA

Engineering design analysis-meaning and purpose, Steady state, propagation and transient problems. Basic concepts of FEM. Advantages and limitations of FEM. Test for convergence. Element choice.Commercial finite element packages-organization-advantages and limitations. Matrix approach –Handling of simultaneous equations-Gaussian elimination method and Choleski method. Solving eigen value problems-Jacobi method. Numerical integration

One Dimensional Analysis

Coordinates and shape functions– Assembly of stiffness matrix and load vector – Finite element equations - 1D spar and spring elements. Dynamic analysis - Consistent and lumped mass matrices.Formulation of element mass matrices.Equations of motion for dynamic problems. Free vibration problem formulation.

Two-Dimensional Analysis

Coordinates and shape functions – Stiffness matrix- beam elements, 2D triangular and quadrilateral elements, Isoparametricelements.Treatment of boundary condition.

Heat Transfer and Fluid Flow Analysis

Basic equations of heat transfer and fluid flow problems.Finite element formulation. One dimensional heat transfer and fluid flow problems.

Analysis of Automotive Structures
Force distribution on different parts of automotive structure, design of the parts, static, dynamic and thermal analysis of the parts using finite element method. Material redistribution to minimize stresses and deflection.Optimisation of location of ribs to maximize rigidity.

TEXT BOOKS:
1. Logan D L, “A First Course in the Finite Element Method”, Ceneage Learning India Pvt Ltd, 2007.
2. Chandrupatla T R and Belegundu A D, “Introduction to Finite Elements in Engineering”, Prentice Hall India, October 2011.

REFERENCES:
1. John D.A, “Computational Fluid Dynamics – The Basics with Applications”, International Edition, McGraw Hill, New Delhi, 2012.
2. Rao S.S, “The Finite Element Method in Engineering”, Elsevier, 6th edition, 2017.
3. Reddy J.N, “An Introduction to Finite Element Method”, McGraw Hill International, New Delhi, 3rd edition, 2017.
4. Seshu P, “A Text book on Finite Element Analysis”, Prentice Hall of India, New Delhi, 2013.

23IA604 ELECTRIC VEHICLE THERMAL ENGINEERING

INTRODUCTION: Introduction on Electric Powertrain Systems - Introduction to thermal management systems in EV - Source of heat generation in electric power train- Types of cooling architecture in EVs- Introduction to Thermodynamics and Heat transfer- Modes to heat transfer.

Thermal Management of electric Motor and HV Battery: Motor types and applications- Motor performance characteristics- Electric Motor thermal system – Modeling and simulation- HV battery classifications- Factors effecting battery performance- Types battery cooling methods- Control system design for BMS.

Thermal Management of Power electronics and 3D Thermal simulation: Introduction**-** Power Loss Modelling- Parameter Identification- Sensitivity Analysis- Heat transfer Mechanism- Thermal influence & component protection, evaluation on Battery management system- Heat network across vehicle sub system[motor]- Concept design & different type of cooling channel design.

HVAC Cooling: Introduction- Components of HVAC system- Power consumption from HVAC system-Impact of HVAC operation on EV performance- Modeling & Simulation of HVAC system

Controller design for Thermal system: State space control & Design of Observer- Introduction to Vehicle Control unit & Thermal controls- Performance Optimization by Thermal control- Parameter Identification- Sensitivity analysis.(9)

TEXT BOOKS
1. Ibrahim Dincerm, Halilm S Hamut and Nader Javani “Thermal Management of Electric Vehicle Battery Systems ” John Wiley 2017
2. Bruno Sacrasati and Werner Tillmatz “Advances in Battery Technology for Electric Vehicles ” Elsevier Woodhead Publishing Series in Energy 2015

REFERENCES
1. AliEmadi, “Advanced Electric Drive Vehicles” CRC Press, 2014.
2. Micah Toll, "The Ultimate Do It Yourself Ebike Guide: Learn How To Build Your Own Electric Bicycle" ISBN 978-09899067-9-1, 2013.

23IA610 DESIGN AND ANALYSIS LABORATORY

1. Static structural analysis – Automotive Structure, Auto Body, Automotive chassis etc.,
2. Transient analysis – Transmission Gears, Shafts, Connecting Rod etc.,
3. Crash analysis – Chassis, Bumper, Bonnet etc.,
4. Steady State and Transient Thermal analysis – Piston, Engine Cylinder, Cylinder Head etc.,
5. Modal analysis – Automotive Structure, Connecting rod, Auto Body etc.,
6. Contact stress analysis – Gear Pair, Leaf spring, Tyre etc.,
7. Stress and Strain Distribution – Composite structure, Entire Vehicle loaded/Unloaded condition
8. Vibration analysis – Sway bar, Coil Spring etc.,
9. Aerodynamic analysis – Passengers Car, Race Car, Truck etc.,
10. Thermal with Mechanical stress– Brake Disc, Piston rings, Cylinder liner etc.,

REFERENCE:
1. Laboratory Manual prepared by Department of Automobile Engineering, 2019

23IA611 MODELING AND SIMULATION LABORATORY

List of Experiments:

1. Studies on Quarter car model
2. Tyre modeling and analysis
3. Steering torque studies for autonomous vehicles
4. Tyre-Road friction Vs % slip Characteristics (Magic Formula)
5. Mathematical modeling and analysis cooling system
6. Mathematical modeling and analysis master cylinder for required deceleration
7. Mathematical modeling of traction control systems
8. Transfer function modeling of Human factors and driver modeling.
9. Vacuum Brake booster modeling for SI engines
10. Optimal Estimation and analysis of semi active and active suspensions.

Reference:

1. Laboratory Manual prepared by faculty of Automobile Engineering, PSGCT

BE/BS BIOMEDICAL ENGINEERING

BE/BS BIOMEDICAL ENGINEERING

S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks		
			Lecture	Tutorial	Practical		CA	FE	Total
SEMESTER 1									
1	23ID101	Calculus and its Applications	3	1	0	4	50	50	100
2	23ID102	Electromagnetic Fields	3	1	0	4	50	50	100
3	23ID103	Chemistry	4	0	0	4	50	50	100
4	23ID104	Engineering for Healthcare	4	0	0	4	50	50	100
5	23ID105	English Language Proficiency	2	1	0	3	50	50	100
6	23ID110	Engineering Graphics	0	0	4	2	50	50	100
7	23ID111	Basic Sciences Laboratory	0	0	4	2	50	50	100
SEMESTER 2									
1	23ID201	Complex Variables and Transforms	3	1	0	4	50	50	100
2	23ID202	Radiation Physics	3	0	0	3	50	50	100
3	23ID203	Engineering Mechanics	3	0	0	3	50	50	100
4	23ID204	Basics of Electrical and Electronics	4	0	0	4	50	50	100
5	23ID205	Foundations of Problem Solving	2	0	0	0	-	-	-
6	23ID210	C Programming Laboratory	0	0	4	2	50	50	100
7	23ID211	Circuits and Devices Laboratory	0	0	2	1	50	50	100
8	23ID212	Professional skills	2	0	0	2	-	-	-
SEMESTER 3									
1	23ID301	Matrix Theory and Numerical Methods	3	1	0	4	50	50	100
2	23ID302	Telemedicine	3	0	0	3	50	50	100
3	23ID303	Physio Anatomy	4	0	0	4	50	50	100
4	23ID304	Analog and Digital Electronics	4	0	0	4	50	50	100
5	23ID305	Engineering Economics	3	1	0	4	50	50	100
6	23ID310	Physio Anatomy Laboratory	0	0	4	2	50	50	100
7	23ID311	Analog and Digital Electronics Laboratory	0	0	4	2	50	50	100
8	23IH073	Organizational Behavior	3	0	3	3	50	50	100
SEMESTER 4									
1	23ID401	Probability and Statistical Methods	3	1	0	4	50	50	100
2	23ID402	Control Systems	4	0	0	4	50	50	100
3	23ID403	Linear Systems and Signal Processing	2	2	0	4	50	50	100
4	23ID404	Biomedical Equipments - I	4	0	0	4	50	50	100
5	23ID405	Sensors and Measurements	3	0	0	3	50	50	100
6	23ID410	Biomedical Equipments Laboratory	0	0	2	1	50	50	100
7	23ID411	Python Programming Laboratory	0	0	4	2	50	50	100
8	23IH072	American History	2	1	0	3	50	50	100

SEMESTER I

23ID101 CALCULUS AND ITS APPLICATIONS

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables.

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems.

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits.

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes's theorem.

TEXT BOOKS

3. J. Hass, C. Heil, Maurice D.W "'Thomas' Calculus", Pearson Education, New Delhi, 2018.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES

5. Howard Anton, IrlBivens, Stephen Davis, "Calculus", John Wiley and Sons, USA, 2016.
6. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
7. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
8. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23ID102 ELECTROMAGNETIC FIELDS

VECTOR ANALYSIS : scalars and vectors – coordinate systems and transformations: cartesian, cylindrical and spherical coordinates – line, surface and volume integrals- del operator - gradient of a scalar - divergence of vector - curl of a vector and stokes theorem.

ELECTROSTATIC FIELDS : Coulomb's law - field intensity - electric field due to point charges and continuous charge distributions such as line charge, surface charge and volume dense - electric flux density - Gauss's law - Maxwell's equation - application of Gauss's law - electric potential - relationship between field intensity and potential, electrostatic energy and energy Density.

ELECTRIC FIELDS IN MATERIAL SPACE : properties of materials - convection current - conduction current - polarization in dielectrics - dielectric constant and strength - linear, isotropic and homogeneous dielectrics, continuity equation and relaxation time - boundary conditions. Poisson's and Laplace's equations - simple solutions of Laplace's equations - resistance and capacitance.

MAGNETIC FIELD : Biot - Savart's law - Ampere's circuital law - Maxwell's equation - applications of ampere's law - field due to infinite line current, infinite sheet of current and infinity long coaxial transmission line - field produced by a toroid with circular cross section - magnetic flux density - - magnetic scalar and vector potentials.

MAGNETIC FORCES, MATERIALS AND SERVICES : forces due to magnetic fields - magnetic torque and moment - magnetic dipole - magnetization in materials - classification of magnetic materials - magnetic boundary conditions - inductors and inductances - magnetic energy - introduction to EMI/EMC-Case study: Evaluating EMI in hospital.

TEXT BOOKS :

1. William H Hayt, "Engineering Electromagnetics", Tata McGraw Hill, New Delhi, 2018.
2. Sadiku M H, "Elements of Electromagnetics", Oxford University Press In., Chennai, 2018.

REFERENCES :

1. David K Cheng, "Fields and Wave Electromagnetics", Pearson Education, New Delhi, 2014.
2. Gerd Mrozynski Matthias Stallein," Electromagnetic Field Theory: A Collection of Problems" Springer vieweg , Berlin,2013.
3. Narayana Rao N, "Elements of Engineering Electromagnetics" Prentice Hall of India, New Delhi, 2007.
4. Ashutosh Pramanik, "Electromagnetism - Theory and Applications", Prentice Hall of India, New Delhi, 2014.

23ID103 CHEMISTRY

BIOMOLECULES I: Carbohydrates – classification. Monosaccharides – structure, cofigurations, chemical reactions and derivative of biochemical significance. Disaccharides, polysaccharides – structure, applications as biomaterials. Aminoacids –classification, pH related ionic structures – isoelectric point, chemical reactions –action of formaldehyde, Sanger's and Edman reagents, peptide formation – biologically important peptides. Proteins - classification, primary, secondary and tertiary structures, applications as biomaterials.

BIOMOLECULES II: Lipids – structure and classification – biochemical functions. Nucleic acids – DNA, RNA - structure, biochemical functions, hybridisation, synthesis of polynucleotide – DNA polymerase reaction. Enzymes – chemical nature, characteristics –pH and temperature sensitivity, catalysis and regulation, specificity. Metabolism –outline of catabolism, overview of carbohydrate metabolism – glycolysis, overview of lipid and aminoacid metabolism, oxidation of Acetyl-CoA - TCA cycle.High energy compounds - bioenergetics – mitochondrial electron transport chain. Respiratory/ metabolic acidosis and alkalosis – regulation of blood pH.

BIOMATERIALS I: Terminologies, extra cellular matrix, cell-material interactions – hydrophobic and hydrophilic interactions - contact angle measurement on biomaterial surface, adsorption – cell-protein adhesion, cell migration, biomineralisation. Characterisation of surface properties – AFM, SEM, TEM. Biocompatibility – host immune response – assessment. Types of biomaterials – metals – stainless steel, titanium alloys – shape memory alloys, properties, corrosion of metals in biological environment – electrochemical aspects, pourbaix diagram – passivity, rates of corrosion, ceramics –inert – alumina zirconia, bioactive – hydroxyapatite – chemical structure, synthesis, tricalcium phosphate.

BIOMATERIALS II: Synthetic polymers - degree of polymerisation, chain and condensation polymerisation, copolymers, topology, states of aggregation – amorphous and crystalline states. Thermal behaviour – glass transition, thermoplastics and thermosetting plastics. Mechanical properties – stress- strain analysis.Properties and biomedical applications of PE, PP, perfluorinated polymers, acrylic polymers, polyamides, hydrogels – swelling mechanism, application in 3D printing of artificial organs. Synthetic biodegradable polymers – PVA, PLA and PGA – applications.Nanomaterials in biomedical applications. Surface modification of biomaterials.

CHARACTERIZATION TECHNIQUES: Spectroscopy- Beer Lambert law - UV-Visible, ,FTIR, Raman, NMR and Mass spectroscopy, XRD - Instrumentation and applications. Electroanalytical techniques – potentiometry, amperometry, electrochemical impedance measurements for sensors.

TEXT BOOKS:

1. Kantesh Balani, Vivek Verma, Arving Agarwal, Roger Narayan, " Biosurfaces – A Materials Science and Engineering Perspective", John Wiley and Sons Inc., 2015.
2. Morrison and Byod, " Organic Chemistry" Printice Hall of India , 2002.

REFERENCES:

1. Sujata V. Bhat, " Biomaterials", Narosa Publishing House, 2002.
2. Joon B. Park, Joseph D. Bronzino, " Biomaterials – Principles and Applications", CRC Press LLC, 2003.
3. Khandpur R.S, " Handbook of Analytical Instruments", McGraw Hill Education (India) Private Limited, 2015.
4. Cox M. M. and Nelson D. L "Lehninger Principles of Biochemistry", W H Freeman and Co., 2011.

23ID104 ENGINEERING FOR HEALTHCARE

INTRODUCTION: Evolution of modern healthcare system, Biomedical Engineering: Meaning – Roles - Status, Overview of human anatomy and physiology: circulatory system - Respiratory system, Bio-electric signals and conductivity, Homeostasis: Chemical regulation - Thermoregulation - Osmoregulation.

BIOINSTRUMENTATION & BIOMOLECULAR ENGINEERING: Overview of measurement system,Types of Sensors, Vital parameters, Instruments in medical practices, Instruments in research laboratories, Biosensors, Antigens, Antibodies: Manufacturing - Clinical use, mAbs, Drugs, Vaccines.

BIOMEDICAL DEVICES: Medical devices vs Medical instruments, Classification of medical devices, Screening, Diagnostics, Handheld and wearable devices, Prognostics, Theranostics, Calibration and testing of medical devices, Patient and operator safety, Electromagnetic interference, Powerline interference.

HEALTHCARE INDUSTRY IN INDIA: Hospital Sector, Medical tourism, Healthcare financing, Pharmaceutical sector, Medical device sector, Regulatory bodies, Rise of artificial intelligence in healthcare applications.

ETHICS AND CLINICAL RESEARCH: Morality and ethics, Human experimentation, Regulation of medical device innovation, Healthcare economics and health rationing, Principles of clinical research, Phases of clinical trials - Randomized and Controlled trials.

TEXT BOOKS:

1. Laurence J. Street, "Introduction to Biomedical Engineering Technology", CRC Press, London, 2018.
2. Adam Bohr, "Artificial intelligence in healthcare", Academic press, 2020.

REFERENCES:

1. W. Mark Saltzman, “Biomedical Engineering: Bridging medicine and technology”, Cambridge university press, 2015.
2. Lawton Robert Burns, “India’s Healthcare Industry”, Cambridge University press, 2014.
3. Gail D Baura, “Medical Device Technologies”, Academic Press, 2012.
4. Joseph D Bronzino, “Introduction to Biomedical engineering”, Academic Press, 2011.

23ID105 ENGLISH LANGUAGE PROFICIENCY

VOCABULARY: Etymology- prefixes and suffixes – synonyms – antonyms – guessing meanings from context – word formation - single-word substitutes - different forms of a word– phrasal verbs – collocations.

LISTENING AND SPEAKING: Understanding listening – listening techniques - introducing oneself and others – seeking and sharing information– description - conversation skills – extempore speaking .

GRAMMAR: Wh-questions –Yes/no questions – parts of speech – articles – prepositions – gerunds – degrees of comparison – tenses – modal verbs – direct and indirect questions.

READING: Reading strategies: skimming & scanning, predicting – reading comprehension: techniques.

WRITING: Discourse markers – dialogue writing - completing sentences – jumbled sentences –paragraph writing - writing compare & contrast paragraphs.

TEXTBOOKS:

1. Shoba K.N.and Lourdes Joavani Rayen, “Communicative English”, Cambridge University Press, Cambridge, 2021.
2. Raymond Murphy, “Intermediate English Grammar”, Cambridge University Press., New Delhi, 2020.

REFERENCES:

1. Raymond Murphy, “English Grammar in Use”, Cambridge University Press., New Delhi, 2020.
2. Sudharshana N P and Savitha C, “English for Engineers”, Cambridge University Press, New York, 2018.
3. Anne Laws, "Writing Skills", Orient Black Swan., Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, “Essential English Grammar”, Cambridge University Press, New Delhi, 2019.

23ID110 ENGINEERING GRAPHICS

INTRODUCTION TO ENGINEERING DRAWING :
Drawing instruments, standards and conventions , principles of lines Lettering Rules and problems on dimensioning.

PICTORIAL PROJECTION :
Principles, Projection of points straight lines planes and solids.

ORTHOGRAPHIC PROJECTION :
Principles of pictorial views, Orthographic views from given pictorial views.

SECTIONS OF SOLIDS :
Types of sections,Selection of section views, Sectional views of simple engineering components.

COMPUTER AIDED DESIGN :
Computer aided design Software Lettering and Dimensioning with CAD Selection of Drawing Sheet Size and Scale Simple drawing using CAD.

TEXT BOOKS:

1. Luzadder , Duff "Fundamentals of Engineering Drawing", Prentice Hall of India Pvt. Ltd, New Delhi, 2015
2. Venugopal K , Prabhu Raja V. "Engineering Graphics", New Age International Publishers, New Delhi, 2017

REFERENCES:

1. Natarajan K. V "Engineering Drawing and Graphics", Dhanalakshmi Publishers, Chennai,2018
2. Cencil jenson, Jay D. Helsel, Dennis R.short "Engineering Drawing and Design", McGraw Hill publishers, New Delhi, 2017

23ID111 BASIC SCIENCES LABORATORY

Physics (Any eight experiments):

1. Determination of Young’s Modulus of a wooden bar – Cantilever method
2. Determination of magnetic field along the axis of a coil
3. Determination of Hysteresis loss of a ferromagnetic material
4. Determination of resistivity of metal and alloy using Carey Foster bridge
5. Determination of capacitance using LCR bridge
6. Study of reverse bias characteristics of Germanium diode and determination of its band gap
7. Thermistor: Measurement of temperature and band gap
8. Hall effect - Determination of Hall coefficient
9. Determine e/m (charge to mass ratio) of the electron by Thomson’s method.
10. Determine the number of turns & radius of the coil and magnetic field of ‘Helmholtz’ coil using Biot-Savart’s Law - apparatus

Demonstration:
1. Determine the excitation potential of Argon using the Franck Hertz method.
2. Find the Hall voltage, Hall coefficient, mobility & charge density of the given 'Ge' crystal using Hall apparatus.
3. Determine the charge of an electron by Millikan's oil drop method.
4. Determine the Planck's constant using Photo Electric method.
5. Determine the wavelength of the laser source by Michelson Interferometer.
6. Determine the thickness of the film by Mach Zehnder Interferometer.
7. Find the finesse and free spectral region of the Etalon.
8. Analyze the mercury spectrum and find wavelength using polynomial equation.
9. Determine the refractive index of given specimen using Brewster's angle apparatus.

REFERENCES:
1. Department of Physics," Physics laboratory observation", 2022.
2. Jerry D Wilson; Cecilia A Hernandez Hall, "Physics laboratory experiments", Boston, MA : Cengage Learning, 2016.

Chemistry (Any eight experiments)
1) Estimation of amount of amino acid in given solution by Formol titration
2) Lipid analyses: acid value, iodine number and saponification value
3) Estimation of iron by potentiometry .
4) Estimation of glucose present in given sample
5) Determination of isoelectric point of an amino acid by pH metry
6) Estimation of iron by photocolorimetry
7) Determination of rate of corrosion of steel by weight loss method
8) Anodizing of Aluminium and determination of thickness of anodic film and corrosion resistance.
9) Determination of molecular weight of polymers by Ostwald viscometer /Ubbelohde viscometer
10) Determination of buffering capacity of biological buffers.

SEMESTER II

23ID201 COMPLEX VARIABLES AND TRANSFORMS

COMPLEX DIFFERENTIATION: Derivative, analytic function, Cauchy-Riemann equations, Laplace's equation, linear fractional transformations.

COMPLEX INTEGRATION: Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only).

LAPLACE TRANSFORMS: Laplace transform, linearity, first shifting theorem, transforms of derivatives and integrals, unit step function, second shifting theorem, Dirac's delta function, periodic functions, differentiation and integration of transforms, solving ODEs with constant coefficients and initial value problems.

FOURIER ANALYSIS: Fourier series – arbitrary period, even and odd functions, half range expansions. Fourier transforms, Fourier cosine and sine transforms.

PARTIAL DIFFERENTIAL EQUATIONS: Basic concepts of PDEs, wave equation, heat equation, steady state two-dimensional heat problems, solution by separating variables and Fourier series.

TEXT BOOKS
1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.
2. Dennis G. Z, "Advanced Engineering Mathematics", Jones and Bartlett Pvt Ltd, New Delhi, 2017.

REFERENCES
1. Dennis G. Z and Patrick D Shanahan, "A first course in Complex Analysis with applications", Jones and Bartlett Pvt Ltd, New Delhi, 2015.
2. Wylie C R and Barret L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2018.
4. Dean G. D, "Advanced Engineering Mathematics with MATLAB", CRC Press, USA, 2017.

23ID202 RADIATION PHYSICS

ELECTROMAGNETIC SPECTRUM: Introduction toElectromagnetic spectrum, Light : Physics of light- Intensity of light- limits of Vision and color vision, Sound: Physics of sound- Normal sound levels, Ultrasound fundamentals-Ultrasound Transducer- Overview of non – ionizing radiation effects: Low Frequency effect, High frequency effect- Thermography-Application.

PRINCIPLES OF RADIOACTIVE NUCLIDES: Radioactive Decay, Spontaneous Emission,Isomeric Transition, Gamma ray emission- alpha- beta- Positron decay- electron capture, Sources of Radioisotopes: Natural and Artificial radioactivity, Production of radionuclides:fission- neutron activation- cyclotron -generator, Radionuclide in Medicine

INTERACTION OF RADIATION WITH MATTER: Interaction of charged particles with matter :Specific ionization- Linear energy transfer range- Bremsstrahlung- Annihilation, Interaction of X and Gamma radiation with matter: Photoelectric effect- Compton Scattering - Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance

RADIATION DOSE AND ITS EFFECTS: Dose and Exposure measurements : SI Units- Inverse square law- Maximum permissible exposure- Relationship between the dosimetric quantities, Radiation biology : Effects of radiation- concept of LD 50- Stochastic and Non-stochastic effects- Radiation Syndrome

RADIATION DETECTION AND DOSIMETRY: Principles of radiation detection, Properties of dosimeters, Radiation detectors: Gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Scintillation detectors, Radiation detection instruments: Area survey meters- Personal Radiation monitoring device: Film badge-TLD- OSLD

TEXT BOOKS:

1. B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford, D.R. Hose, "Medical Physics and Biomedical Engineering", Institute of physics publishing, Bristol and Philadelphia, 2017.
2. Ervin B Podgorsak, "Radiation Physics for Medical Physicists: Biological and Medical Physics, Biomedical Engineering", Springer, Heidelberg,2016

REFERENCES:

1.W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology" Varghese Publishing house, 2013.
2.Steve Webb, "The Physics of Medical Imaging", Taylor & Francis, Newyork, 2012.
3. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2014.
4. Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine", Springer, 2012.

23ID203 ENGINEERING MECHANICS

INTRODUCTION TO STATICS: Units and Dimensions, Laws of Mechanics, Lami's theorem- Parallelogram and triangular Law of forces, Vectorial representation of forces, Vector operations of forces: additions – subtraction - dot product - cross product, Coplanar Forces, rectangular components, Equilibrium of a particle, Forces in space, Equilibrium of a particle in space, Equivalent systems of forces, Principle of transmissibility.

EQUILIBRIUM OF RIGID BODIES: Free body diagram, Types of supports, Action and reaction forces, stable equilibrium, Moments and Couples: Moment of a force about a point and about an axis - Vectorial representation – Scalar components of a moment, Varignon's theorem, Single equivalent force, Equilibrium of Rigid bodies in two dimensions, Equilibrium of Rigid bodies in three dimensions.

DYNAMICS AND FRICTION: Displacements, Velocity, acceleration, Relative motion, Curvilinear motion, Newton's laws of motion, Work Energy Equation, Impulse and Momentum, Impact of elastic bodies, Friction force, Laws of sliding friction, wedge friction, Rolling resistance.

THERMODYNAMICS: Heat energy, specific heat, power, latent heat, Boyle's and Charles Law's, pressure/volume diagram, first law of thermodynamics, internal energy, Gas process: constant pressure - constant volume – adiabatic - polytrophic, isothermal process - work done during a process.

FLUID MECHANICS: Hydrostatics, pressure in liquids, manometry, hydrostatic force: on plane surfaces - immersed surface - curved surfaces, archimedes principle, buoyancy - introduction to hydrodynamics - fluid flow, velocity.

TEXT BOOKS:

1. Anup Goel, "Engineering Mechanics", Technical Publications, Pune, 2021.
2. RS Khurmi, "A Textbook of Engineering Mechanics", S Chand and Company Limited, New Delhi, 2019.

REFERENCES:

1. Rajput R K, "Thermal Engineering", Laxmi Publications, New Delhi, 2020.
2. Andrew M Steane, "Thermodynamics", Oxford University Press, UK, 2017.
3. Ethirajan Rathakrishnan, "Fluid Mechanics: An Introduction", PHI Learning Pvt. Ltd., New Delhi, 2012
4. Agarwal B, Agarwal C M, "Basic Mechanical Engineering", Wiley India, 2008.

23ID204 BASICS OF ELECTRICAL AND ELECTRONICS

INTRODUCTION TO AC AND DC CIRCUITS: Charge and Current, Voltage, Energy and Power - Sinusoidal Voltage and Current - Average value - RMS value - Power factor - Phasor representation. - Circuit elements and symbols - Ohm's law - Kirchhoff's law - Mesh and Nodal analysis - Thevenin's theorem - Norton's theorem - Superposition theorem - Maximum Power transfer theorem.

DC MACHINES: Types of DC motors, Construction and Principle of operation: Shunt motor - Series motor - Compound motor, Speed-torque characteristics, Starting, Speed Control, Braking.

AC AND SPECIAL MACHINES: Types of AC motors - Signal phase induction motor - Three phase induction motor - Synchronous motor – Starting – single phase transformers: Construction, EMF equation- variable reluctance stepper motor- brushless DC motor- servo motors.

ELECTRONIC DEVICES: PN junction diode - Zener diode - LED – BJT: Biasing, Amplifier and switch, Frequency response characteristics – MOSFET: Types, Biasing, Current-voltage characteristics, Amplifier, High frequency model, Junction Field-Effect Transistor (JFET) - Comparison of BJT and FET - Optocouplers - SCR- TRIAC - DIAC.

ELECTRONIC CIRCUITS: Half wave and full wave rectifiers: analysis, ripple factor, filtering – Clippers and Clampers – Zener voltage regulator- series voltage regulators – RC coupled amplifier - RC phase shift oscillator.

TEXT BOOKS:

1. William Hayt, Jack Kemmerly, Jaime Phillips, Steven Durbin “Engineering Circuit Analysis” , Tata McGraw Hill, New Delhi, 2019.
2. D. P. Kothari, I. J. Nagrath “Basic Electrical and Electronics Engineering”, Tata McGraw Hill, New Delhi, 2014.

REFERENCES:

1. Charles Alexander, Mathew Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, New Delhi, 2021.
2. Mittle V N, Aravind Mittal, “Basics of Electrical Engineering”, Tata Mc Graw Hill, New Delhi, 2017.
3. Warsame Hassan Ali, Samir Ibrahim Abood, Matthew N. O. Sadiku “Fundamentals of Electric Machines” , CRC press, New York, 2019.
4. Robert l. Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson, New Delhi, 2013.

23ID205 FOUNDATIONS OF PROBLEM SOLVING

PROBLEM SOLVING:

1. Speed Mathematics (SAW, Oz, Mirror methods)
2. Speed Mathematics (High5, Minion, Butterfly methods)
3. Speed Mathematics (Inception, Goldeneye methods)
4. Thinking with Numbers
5. Problem Solving with Visual information
6. Words Puzzles
7. Resume Writing Essentials

REFERENCES:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.

23ID210 C PROGRAMMING LABORATORY

Implementation in the following Topics:

1. Working with RAPTOR Tool – Flowchart Interpreter
2. Simple programs to understand Operators and expressions.
3. Decision making Statements : simple if, if..else, nested if .. else, else if ladder, switch case
4. Loops : while , do..while, for
5. Implementation of one dimensional array
6. Implementation of two dimensional array
7. Working with Strings.
8. Functions
9. Recursive functions
10. Structures: Arrays and Structures,Nested Structures.
11. Structures and functions
12. Implementation of pointer and pointer arithmetic
13. Types of pointer:const pointer, pointer to a constant, void pointer, null pointer

Note: Problem Sheets will be provided during the course

REFERENCES:

1. Paul Deitel and Harvey Deitel, “C How to Program: With an Introduction to C++”, Eighth edition, Pearson Education, 2018.
2. Ajay Mittal, ”Programming in C - A Practical approach”.Pearson,New Delhi, 2010
3. Gottfried B., “Programming with C”, McGraw Hill Education, New Delhi, 2018.
4. Herbert Schildt, “C: The Complete Reference”, McGraw Hill, New Delhi, 2017.
5. Kernighan B. W. and Ritchie D. M., “C Programming Language (ANSI C)”, Prentice Hall of India, New Delhi, 2013

23ID211 CIRCUITS AND DEVICES LABORATORY

LIST OF EXPERIMENTS:

1. Verification of Kirchhoff’s Voltage and Current law.
2. Verification of Thevenin’s theorem
3. Experimental verification of Superposition theorem.
4. Experimental verification of Maximum power transfer theorem.
5. Characteristics of PN diode and Zener diode
6. Frequency response characteristics of BJT
7. Characteristics of FET
8. Design and testing of RC coupled Amplifier
9. Design and testing of voltage regulator
10. Design and testing of RC phase shift oscillator

23ID212 PROFESSIONAL SKILLS

UNIT I A: HISTORICAL PERSPECTIVE OF MANUFACTURING ENGINEERING: Industrial revolution, purpose and evolution of production engineering, materials in manufacturing, conscious design & manufacturing, economics - time and cost analysis, recent technologies - digital manufacturing, case studies.

UNIT I B: TRAINING IN CAD PACKAGE:
Solid modeling and assembly practice, Extraction of 2D view from 3D modeling, Coloring and shading of 3D models.

UNIT II: SEMINAR PRESENTATION AND TECHNICAL REPORT WRITING

WRITING COHERENT PROJECT REPORT: Overview structure of reports, gathering informations - synopsis / abstract - title – headings – table of contents – list of figures – list of tables – list of appendices
– chapters – structured paragraphs – inferences, conclusions – figures – tables – flow charts – complete design (headers and footers).-Plagiarism. Each student will be required to submit a technical report based on the guidelines provided by the department.
PROJECT PRESENTATION: Each student will be required to make one technical presentation for a minimum 15 minutes duration in this course. Individual topics will be assigned to the students by the department.

PROFESSIONAL COMMUNICATION –ORAL SKILLS: Principles of group communication, interviewing, and making presentations- group discussions, role plays, mock interviews- talking about some visual information- giving and receiving instructions.

SEMESTER – III

23ID301 MATRIX THEORY AND NUMERICAL METHODS

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors of a real matrix – characteristic equation, properties - diagonalization - quadratic forms, reduction to canonical form by orthogonal reduction - Errors and approximations in numerical methods, power method for dominant eigenvalue.

LINEAR ALGEBRIAC SYSTEM OF EQUATIONS AND NONLINEAR EQUATIONS: System of linear equations – Gauss elimination method, Crouts method, Gauss Seidal iterative method, Roots of equations - false- position method, Newton-Raphson method, Graeffe's root squaring method.

INTERPOLATION, DIFFERENTIATION AND INTEGRATION: Newton's forward and backward interpolating polynomials, Lagrange and Newton's divided difference interpolating polynomials. Numerical differentiation, numerical integration - Newton-Cotes formulae, Trapezoidal rule, Simpson's 1/3 rule.

ORDINARY DIFFERENTIAL EQUATIONS: Taylor-series method, Euler method, 4^{th} order Runge-Kutta method, multi-step method – Milne's method.

PARTIAL DIFFERENTIAL EQUATIONS: Finite difference: elliptic equations – Laplace equation, Poisson equation – Liebmann method, parabolic equations – heat conduction equation – Crank Nicolson's method, hyperbolic equations – vibrating string.

TEXT BOOKS:

1. David C Lay, Judi J. McDonald, Steven R. Lay "Linear Algebra and its Applications", Pearson Education, New Delhi, 2021.
2. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2021.

REFERENCES:

1. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, New Delhi, 2017.
2. Rizwan Butt, "Introduction to Numerical Analysis Using MATLAB", Infinity Science Press, Hingham, 2010.
3. Richard L Burden and Douglas J Faires, "Numerical Analysis", Thomas Learning, NewYork, 2017.
4. Howard Anton, Chris Rorres, Anton Haul "Elementary Linear Algebra", Wiley India, New Delhi, 2019.

23ID302 TELEMEDICINE

TELEMEDICINE: Biomedical telemetry, Benefits, Types of telemedicine services, Delivery mechanisms, Challenges in implementing telemedicine, Telemedicine standards and guidelines, Telemedicine System: Process in telemedicine-Parameters-Trends- Delivery modes in telemedicine -Setting up a telemedicine facility.

TECHNOLOGIES: Transmission of data: Audio- Still images- Video, Telemedicine workstation and interfacing techniques, Telecommunication technologies for telemedicine, Networking in telemedicine, Wireless technologies for telemedicine.

APPLICATIONS AND ISSUES: Teleradiology, PAC, Telepathology, Teledermatology, Teleopthalmology, Telecardiology, Telesurgery, Teleoncology , Teleneurology, Teleaudiology, Telepsychiatry, Telerehabilitation, Issues in telemedicine systems: Ethical- Privacy- Security- Legal issues.

MOBILE HEALTHCARE: Key technologies for mHealth , Wireless connectivity in mHealth ,Ubiquitous healthcare: WBAN -WPAN -WSN, mHealth in intensive care monitoring, Mobile telemedicine, Telehome care and telehealth: Categories-Technologies-Requirements , Chronic disease management ,mHealth Apps and challenges , Personal health monitors.

EHEALTH AND CYBER MEDICINE: Internet and telemedicine, Cyber medicine and telemedicine, Future developments in cyber medicine, Multimedia data exchange, Multipoint video conferencing, Standards and other audio/video interactive system.

TEXT BOOKS:

1. Khandpur R S , "Telemedicine: Technology and Applications (mHealth,TeleHealth and eHealth)", PHI Learning, New Delhi, 2017.
2. Karen A. Wager, Frances W. Lee, John P. Glaser , "Health Care Information Systems: A Practical Approach for Health Care Management", Jossey-Bass, San Francisco, 2017.

REFERENCES:

1. Victor Lyuboslavsky , "Telemedicine and Telehealth 2.0: A Practical Guide for Medical Providers and Patients",CreateSpace Independent Publishing, USA, 2015.
2. Brown Mary, "Introduction to Healthcare Delivery", Kendall Hunt Publishing, USA, 2012.
3. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley &Sons, England, 2008.
4. Bernard Fong, Fong A C M, Li C K , "Telemedicine Technologies: Information Technologies in Medicine andTelehealth", John Wiley & Sons, United Kingdom, 2011.

23ID303 PHYSIO ANATOMY

ANATOMY AND SPECIAL SENSES : Circulatory system, Digestive system, Respiratory system, Nervous system, Musculoskeletal system, Optics of vision: Receptor - Neural function of the retina - Photochemistry of vision - Central neurophysiology of vision , Physiology of hearing mechanism, Hearing loss, Hearing tests ,Taste sensors, Smell sensors.

THE CELL AND GENERAL PHYSIOLOGY : Structure of the cell, Function of each components of the cell, Genetic control of protein synthesis, Cell reproduction, Membrane potential, Action potential: Generation – Conduction, Electrical simulation, Blood cells, Immunity, Blood clotting, Blood groups, Estimation of : RBC – WBC – Platelets.

CARDIAC AND NERVOUS SYSTEM: Cardiac cycle, Blood pressure, Feedback control of blood pressure, Nervous control of heart, Coronary and Peripheral reflex action, Velocity of conduction of nerve impulses, Central nervous system.

RESPIRATORY SYSTEM: Pulmonary ventilation, Physical principles of gas exchanges, Transport in the blood and body fluids: Oxygen - Carbon dioxide, Regulations of respiration, Distribution of respiratory function.

DIGESTIVE AND EXCRETORY SYSTEMS : General principles of gastrointestinal function, Secretory functions of the alimentary tract, Digestion and Absorption in the gastrointestinal tract, Structure of Nephron, Mechanism of urine formation, Skin and Sweat gland, Temperature regulation.

TEXT BOOKS:

1. Jain A K , "TextBook of Physiology", Avichal Publishing Company, New Delhi, 2021.
2. Arthur C Guyton, John E Hall , "Textbook of Medical Physiology", Saunders Elsevier, Pennsylvania, 2020.

REFERENCES:

1. Anil Baran Singha Mahapatra , "Essential of Medical Physiology", Current Book International, Kolkata, 2019.
2. Ranganathan T S , "TextBook of Human Anatomy", S.Chand & Co. Ltd, New Delhi, 2012.
3. Sujit K Chaudhuri , "Concise Medical Physiology", New Central Book Agency Pvt. Ltd, Kolkata, 2011.
4. Sarada Subramanyam, K Madhavan Kutty, Singh H D, "Textbook of Human Physiology", S Chand and Company Ltd, New Delhi, 2012

23ID304 ANALOG AND DIGITAL ELECTRONICS

BASICS OF OPERATIONAL AMPLIFIERS: Functional Block Diagram – Symbol- Characteristics of an ideal operational amplifier-Circuit schematic of µA 741- Open loop gain-CMRR -Input bias and Offset currents- Input and Output offset voltages- Offset compensation techniques, Frequency response characteristics: Stability – Limitations-Transfer characteristics, Need for single power supply op-amp, Slew rate operational amplifiers.

LINEAR APPLICATIONS: Inverting and Non-inverting amplifier -Voltage follower-Summing amplifier, Differential amplifier-Instrumentation amplifier- Integrator and Differentiator, Practical considerations, Voltage to Current and Current to Voltage converters, Sinusoidal oscillators.

NON-LINEAR APPLICATIONS : Active filters: Filter design-Low pass filter -High pass filter -Wide band pass and Band stop Butterworth filters, Comparator- Regenerative comparator, Zero crossing detector, Window detector, Sample and hold circuit, Precision diode, Half and Full wave rectifiers, Active peak detector, Clipper and Clamper, Multiplier and Divider, Square and Triangular waveform generators.

DIGITAL CIRCUITS AND NUMBER SYSTEMS: Introduction to digital Circuits, Representation of number system: Binary – Octal-Decimal -Hexadecimal- Conversion between number systems ,1's and 2's complement representation of numbers ,Signed and Unsigned numbers, Fixed point and Floating point numbers ,Computer codes **:** Binary codes-Error detecting and correcting codes,ASCII code-Gray code to BCD code-BCD code to Gray code.

COMBINATIONAL CIRCUITS: Logic Gates: Operation-Truth table, Boolean algebra: Basic postulates - fundamental theorems, Boolean functions: Canonical forms - Standard forms, Gate level minimization methods: K map - Quine McClusky, Applications: Binary adder- Binary subtractor- Magnitude comparator- Encoders- Decoders-Multiplexers- De-multiplexers - Code converters.

SEQUENTIAL CIRCUITS: Latches: SR - D latches ,Flip flops : Level and Edge triggering –SR-D-JK- T - Master slave configuration , Mealy/Moore models of finite state machines : Concept of state - State diagram - State table , Applications: Sequence detector - Serial adder-Shift register – Counters: Up/down- Modulus-Ring- Johnson counter- Timing diagram.

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., New Delhi, 2018.
2. Ramakant A, Gayakwad, "OP-AMP and Linear ICs", Prentice Hall of India, New Delhi, 2017.

REFERENCES:

1. B. Visvesvara Rao,"Linear Integrated Circuits" India, Pearson Education India, 2015.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Mc Graw Hill India, New Delhi, 2017.
3. Salivahanan, Bhaaskaran, " Linear Integrated Circuits", McGraw Hill India,New Delhi, 2017.
4. Raju Hazare, Raghunandan G. H, "Linear Integrated Circuits Concepts and Applications", Cengage Learning India Private Limited, New Delhi, 2019

23ID305 ENGINEERING ECONOMICS

Fundamentals of Economic Analysis: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency.
Cost and Inventory Control: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages-Depreciation Methods – Problems in Straight Line and Diminishing Balance Method.

Pricing, Revenue and Value Engineering: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering.

Project Management: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis.
Economic Growth and Development: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy.

Text Books

1. Panneerselvam. R., "Engineering Economics", PHI Learning Private Limited, 2012.
2. Metha P.L, "Managerial Economics – Analysis, Problems and Cases", Sultan Chand & Sons, 2016.

References

1. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, "Principles of Engineering Economics with Applications, Cambridge University Press, 2018.
2. Varshney, R.L and K.L. Maheshwari, "Managerial Economics", Sultan Chand & Sons, 2014.
3. McEachern and Indira., "Macro ECON", Cengage India Private Limited, 2017.
4. Shalini Goyal Bhalla, "Circular Economy (Re) Emerging Movement", Invincible Publishers, 2020.

23ID310 PHYSIO ANATOMY LABORATORY

1. Microscope with Neubauer chamber
2. Estimation of RBC count
3. Estimation of WBC count
4. Estimation of eosinophil count
5. Estimation of platelet count
6. Estimation of differential count
7. Hemoglobin estimation
8. Packed cell volume/ ESR
9. Blood grouping/ osmotic fragility
10. Bleeding time/ clotting time

23ID311 ANALOG AND DIGITAL ELECTRONICS LABORATORY

1. Inverting and Non-inverting amplifier
2. Integrator and Differentiator
3. Instrumentation amplifier
4. Active low pass, High pass filter and Band pass filter
5. Astable and Monostable Multivibrator
6. Code converters
7. Multiplexers and De-multiplexers
8. Shift registers
9. Counters
10. Sequence detector

23IH 073 ORGANIZATIONAL BEHAVIOR

Introduction to OB: Meaning & Importance of OB – Historical Development & Contributing Disciplines

Personality – Personality determinants & attributes, Emotional Intelligence and Wor k Values
Employment relationship and the psychological contract
Motivation - Basic Concepts, Motivation Theories, Problems in Motivation
Leadership - Theories of leadership, Leadership styles and effectiveness
Group Dynamics: Types of Groups, Group Norms and Cohesiveness: Group Roles.
Organizational Culture - Elements, Culture and Performance, merging organizational cultures, changing and strengthening culture.
Organizational Change - Forces for change force field analysis model Organization Development
Work Stress - Causes and consequences – Stress coping strategies
Case studies

REFERENCES:

1. Mc Shane Von Glinow and Radha Sharma, “Organisational Behaviour”, Tata Mc Graw Hill, 4th Edition, 2008
2. Stephen P Robbins, “Organisational Behaviour”, Prentice Hall (India) Pvt. Ltd., New Delhi, 13 th Edition, 2009
3. Kreitner Robert, Kinicki , Angelo, “Organsiational Behaviour”, Irwin Inc., Illinois, 2 nd Edition, 2006
4. Hellriegel, “Organsiational Behaviour” Thomson Learning, 1st edition, 2005
5. Ivancevich, “Organsiational Behaviour” Tata Mc Graw Hill, 7th Edition, 2006.

SEMESTER IV

23ID401 PROBABILITY AND STATISTICAL METHODS

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axiomatic approach to probability, Baye’s theorem, discrete random variables, probability distributions and probability mass functions, cumulative distribution functions, mean and variance, discrete uniform, binomial, Poisson and geometric distributions.

CONTINUOUS RANDOM VARIABLES: Continuous random variables, probability distributions and probability density functions, cumulative distribution functions, mean and variance, uniform, Weibull, exponential, and normal distributions.

JOINT PROBABILITY DISTRIBUTIONS: Two dimensional discrete and continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation and linear regression.

STATISTICAL INFERENCE: Point estimation – maximum likelihood estimation - interval estimation – hypotheses concerning means – large, small samples and matched pairs - hypotheses concerning variances – hypotheses concerning proportions, chi square test for goodness of fit and independence of attributes.

ANALYSIS OF VARIANCE ANDSTATISTICAL QUALITY CONTROL: Analysis of variance - completely randomized designs, randomized block designs - process capability - control charts for measurements – $\bar{X}$, R charts - control charts for attributes - p, np, c charts.

TEXT BOOKS

1. Douglas C. Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers”, Wiley India, New Delhi, 2018.
2. Richard A. Johnson, “Miller & Freund's Probability and Statistics for Engineers”, Pearson education, New Delhi, 2017.

REFERENCES

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, “Probability & Statistics for Engineers & Scientists, Pearson Education, New Delhi, 2016.
2. Robert V. Hogg, Elliot Tanis and Dale Zimmerman, “Probability and Statistical Inference”, Pearson Education, New Delhi, 2021.
3. Jay L. Devore, “Probability and Statistics for Engineering and the Sciences”, Cengage Learning**,** New Delhi 2020.
4. Sheldon M Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic press, USA, 2020.

23ID402 CONTROL SYSTEMS

PHYSICAL SYSTEM MODELING: Elements of control systems - Mathematical model of control systems, Electrical and Mechanical transfer function models- Force to Current, Force to Voltage analogy, Block diagram reduction techniques, Transfer function of DC and AC servomotor, Signal flow graph: Mason's gain formula.

TIME RESPONSE AND STABILITY ANALYSIS : Standard test signals - Time response of second order system - Time domain specifications and Characteristics, Steady state error - Static error constant , Introduction to P-PI- PID controller and its Simulation , Concept of stability: Necessary conditions, Routh Hurwitz criterion ,Nyquist criterion, Stability margins, Root locus method.

FREQUENCY DOMAIN ANALYSIS: Relationship between Time and Frequency response, Performance specifications in frequency domain, Polar plots: Magnitude and Phase angle curve, Bode plots and its Simulation, Assessment of stability.

SIGNAL CONDITIONING CIRCUITS: Functions of signal conditioning circuits – Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges: Wheat stone, Kelvin, Maxwell, Hay, Schering.

PHYSIOLOGICAL CONTROL SYSTEMS: Physiological control system analysis, Difference between Engineering and Physiological control system , Linear model of physiological system: Respiratory mechanics, Chemical regulation of Ventilation, Thermal Regulation - Regulation of Cardiac output.

TEXT BOOKS:

1. Nagrath I J, Gopal M , "Control System Engineering", New age International, New Delhi, 2018.
2. Michael C.K.Khoo , "Physiological Control Systems", Prentice Hall of India, New Delhi, 2018.

REFERENCES:

1. Norman S. Nise , "Control Systems Engineering", Wiley, New Delhi, 2018.
2. Farid Golnaraghi, Benjamin C. Kuo , "Automatic Control Systems", McGraw-Hill Education, India, 2017.
3. Laszlo Keviczky, Ruth Bars, JenoHetthessy , "Control Engineering (Advanced Textbooks in Control and Signal Processing)", Springer Publishers, USA, 2018.
4. Ghosh P.K, Satyajit Anand , "Linear Control Systems", Platinum Publishers, Kolkata, 2015.

23ID403 LINEAR SYSTEMS AND SIGNAL PROCESSING

SIGNALS AND SYSTEMS: Signals: Transformation of signals - Basic continuous time signals - Basic discrete time signals, System - Properties of system , Linear time invariant system - Continuous time LTI system - Convolution integral, Discrete time LTI system - convolution sum, Properties of LTI system, Systems described by differential and difference equation.

FOURIER ANALYSIS OF SIGNALS AND SYSTEMS: CTS & DTS: - Response of LTI system to complex exponentials, Representation of periodic and aperiodic signals- properties of Fourier series and Fourier transform - Frequency response of system characterized by constant coefficient differential equation and difference equation, Sampling and reconstruction, DIT-FFT algorithm and its applications

TRANSFORMS FOR SYSTEMS: Laplace transform: ROC-Inverse Laplace transform - Geometric Evaluation of the Fourier Transform from the Pole-ZeroPlot- Properties - Analysis and Characterization of LTI system, Z- transform: ROC- Inverse Z-transform - Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot – Properties - Analysis and Characterization of LTI system -Transformation between Continuous time and Discrete Time Systems.
FILTERS: Time domain filtering: Synchronous averaging - Moving average filters - Derivative based, Frequency domain filtering: Analog Butterworth filter, bilinear transformation, Digital filter: FIR - IIR -Notch - Comb ,Optimal filtering - Adaptive filtering using LMS algorithm-Applications: Nature of biomedical signals: Characteristics - Interference associated with each bio-signal and artefact removal.

FREQUENCY DOMAIN CHARACTERIZATION: Fourier spectrum, Non parametric methods for power spectral density(PSD) estimation - Periodogram – Modified Periodogram - Bartlett, Welch & Blackman - Tukey methods - Performance comparison, Measures derived from PSD's**.**

TEXT BOOKS:

1. Oppenheim A V, Wilsky A S and Hamid Nawab S, "Signals and Systems", Pearson Education, 2021.
2. Manolakis, Dimitris G., and Proakis, John G "Digital Signal Processing", United States, Pearson Taiwan Limited, 2016.

REFERENCES:

1. Rangaraj M Rangayyan "Biomedical Signal Analysis: A Case-Study Approach", Wiley India, New Delhi, 2015.
2. Northrop, Robert B.. Signals and Systems Analysis In Biomedical Engineering. United States, CRC Press, 2016.
3. John Semmlow, "Circuits, Signals and Systems for Bioengineers: A MATLAB-Based Introduction", Elsevier, Academic press,UK,2018
4. Holton, Thomas. Digital Signal Processing: Principles and Applications. India, Cambridge University Press, 2021.

23ID404 BIOMEDICAL EQUIPMENTS – I

BIOELECTRIC SIGNALS AND ELECTRODES: Action potential and resting potential, Origin of biopotentials: ECG- EEG- EMG- ENG- ERG- EOG- MEG, Biopotential electrodes: Electrodes for ECG- EEG- EMG, Bioelectric amplifiers: Isolation amplifiers- Optically coupled isolation amplifier-Transformer coupled isolation amplifier.

CARDIOVASCULAR SYSTEM MEASUREMENTS: Characteristics of ECG signal- Normal and abnormal waveform, Interpretation and diagnosis, ECG leads connections, Einthoven triangle, ECG recorder, Vectorcardiography, Blood flow measurement- Plethysmography, Blood pressure measurement- Direct and indirect methods, Cardiac output measurements, Origin of heart sounds- Phonocardiography.

RESPIRATORY SYSTEM MEASUREMENTS AND THERAPY: Mechanics of breathing, Parameters of respiration, Respiratory volume measurement: Respiratory plethysmography- Impedance Pneumograph- Spirometers-Respiratory gas analyzers, Pneumotachometers, Ventilators: Types of ventilators, Ventilator testing, Anesthesia machine: need for anesthesia- Electronics in the anesthetic machine.

MUSCULAR SYSTEM MEASUREMENTS AND NERVE STIMULATION: Stimulation of muscles- Muscle potential generation-, Recording and analysis of EMG waveforms- Muscle and nerve stimulation- Fatigue characteristics. Electrotherapy: Strength - Duration curve, Types of stimulators: Electro diagnostic / therapeutic stimulator- Nerve-muscle stimulator-Peripheral nerve stimulator- Ultrasonic stimulators- Stimulators for pain and relief.

INSTRUMENTATION FOR MEASURING BRAIN FUNCTION: Review ofEEG signal- 10-20 electrode placement system and recording- Modes of recording- EEG machine - Visual and auditory evoked potential recordings.

TEXT BOOKS:

1. Joseph J Carr, John M Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, New Delhi, 2011.
2. John G Webster, “Medical Instrumentation Application and Design”, John Wiley & Sons, Singapore, 2021

REFERENCES:

1. Khandpur R S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2014.
2. John G Webster, “Bioinstrumentation”, John Wiley & Sons, New York, 2012
3. Scott K N, Mathur A K, ”Textbook of Biomedical Instrumentation”, CBS publishers, New Delhi, 2019.
4. Joseph D Bronzino., “ The Biomedical Engineering Handbook”, CRC Press, Fourth Edition, 2015.

23ID405 SENSORS AND MEASUREMENTS

SYSTEM OF MEASUREMENT: Measurement System-Classification and Characteristics of Transducers, Errors in Measurements, Statistical analysis - Calibration - Primary and Secondary standards.

BIOMECHANICAL SENSORS: Strain Gauge: Gauge factor- Sensing elements- Bonded and Unbonded strain gauge, Capacitive transducer, Inductive transducer, LVDT, Pressure transducer, Fluid Property Sensors, Gyroscope, Point level sensors

BIOTHERMAL SENSORS: Passive type: RTD materials and range- Relative resistance versus temperature characteristics- Characteristics of Thermistors, Negative Temperature Coefficient (NTC) Thermistors, Semiconductor-based temperature sensors, Active type: Characteristics of Thermocouple, types of thermocouple, Case Study: Sensors for Environmental monitoring.

BIO ELECTRIC AND OPTICAL SENSORS : Introduction to electrochemical sensors, PH sensor, Nanosensors and its types, Phototube - Scintillation counter - Photo multiplier tube - Photovoltaic - Photo conductive cells -Photo detector-Phototransistor - Comparison of photoelectric transducers, Optical displacement sensors, Proximity sensors, Piezoelectric active transducer: Equivalent circuit and its characteristics, Case study: Optical sensors for diagnosis - Oxygen Saturation monitor.

DISPLAY AND RECORDING DEVICES: Digital voltmeter, Multi meter , CRO: Block diagram , CRT , Vertical & horizontal deflection system, DSO, LCD monitor , PMMC writing systems , Servo recorders , Photographic recorder , Magnetic tape recorder , Inkjet recorder , Thermal recorder.

TEXT BOOKS:

1. A.K.Sawhney , "Electrical & Electronics Measurement and Instrumentation", Dhanpat Rai & Co, New Delhi, 2017.
2. John G. Webster , "Medical Instrumentation Application and Design", Wiley India Pvt Ltd, New Delhi, 2020.

REFERENCES:

1. Leslie Cromwell , "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2015.
2. Albert D.Helfrick, William D. Cooper , "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, New Delhi, 2016.
3. KhandpurR.S , "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2014.
4. BanshiDhar Gupta, Anand Mohan Shrivastav and SruthiPrasood Usha , "Optical Sensors for Biomedical Diagnostics and Environmental Monitoring", CRC Press, New York, 2018.

23ID410 BIOMEDICAL EQUIPMENTS LABORATORY

1. Recording of ECG and Heart Rate measurement
2. Recording of EEG
3. Recording of EMG
4. Blood pressure measurement
5. Heart sounds measurement using PCG
6. Measurement of respiration rate and lung volume
7. Measurement of vital parameters using Patient Monitoring System
8. Real time biosignal acquisition using labVIEW
9. Testing of cutting and coagulation using surgical diathermy
10. Study of electrical isolation using electrical safety analyzer

23ID411 PYTHON PROGRAMMING LABORATORY

PROBLEM SOLVING RELATED TO THE FOLLOWING TOPICS:

1. Programs related to integers, float, complex, Boolean data types in the shell
2. Input/output and conditional statements in scripts
3. Different operator and conversion functions
4. Loops : for and while
5. String datatype: Creation, Operations, Methods
6. Tuple data type: Creation, Operations, Methods
7. Set and frozenset datatypes: Creation, Operations, Methods
8. Dictionary datatype:Creation, Operations, Methods
9. Functions: definitions , parameter passing, returning datatypes
10. Lambda and recursive functions
11. Creating modules and packages
12. Handling exceptions
13. File handling

REFERENCES:

1. Mark Summerfield , "Programming in Python 3: A Complete introduction to the Python Language", Addison- Wesley Professional, 2009.
2. Reema Thareja , "Python Programming : Using Problem Solving Approach", Oxford university Press, 2017.
3. Paul Barry , "Head First Python: A Brain-Friendly Guide", O'Reilly Media, 2016.

23IH 072 AMERICAN HISTORY

Unit – I	Western civilization - A brief survey of ancient and medieval civilizations followed by extensive treatment of the ascondancy of early mordern western civilization.
Unit – II	Spread of western civilization – social, economic and political revolutions.
Unit – III	Discovery of America – colonization – American war of independence.
Unit – IV	History of the United States – major political, social cultural and economic changes.
Unit – V	Jacksonian Democracy – Abraham Lincoln and civil wars – Reconstruction.
Unit – VI	Western Front – Effects of first world war and its impact on socio-cultural economical and political front.
Unit – VII	The great economic depression – second world war.

Reference

1. Charles A. Bear & Mary R Beard., "New Basic History of the United States", DoubleDay & Company,New York, 1968.
2. Edwin Fenton &Allan O. Kownslar, "The Americans",Holt, Rinehart & Winston, INC, New York,1975.
3. Henry Bamford Parkes, "The United States of America A History", Scientific Book Agency,Calcutta,1969.
4. Miller (Douglas T)., "The Birth of Modern America", Bobbs–Merril Company, INC, Publisher, IndianApolis, Indiana, 1975.
5. Robert K Carr & Marver H Bernstein., American Democracy, Dryden Press, Illinois,1977.

BE/BS COMPUTER SCIENCE ENGINEERING

BE/BS COMPUTER SCIENCE ENGINEERING

S.No	Course Code	Course Title	Hours / Week				Maximum Marks		Total
			Lecture	Tutorial	Practical	Credits	CA	FE	
SEMESTER I									
1	23IZ101	Calculus and its Applications	3	1	0	4	50	50	100
2	23IZ102	Basics of Electrical and Electronic Systems	3	0	0	3	50	50	100
3	23IZ103	Applied Chemistry	3	0	0	3	50	50	100
4	23IZ104	Computational Thinking	3	1	0	4	50	50	100
5	23IZ105	English Language Proficiency	3	1	0	4	50	50	100
6	23IZ110	Python Programming Laboratory	0	0	4	2	50	50	100
7	23IZ111	Basic Science Laboratory	0	0	4	2	50	50	100
8	23IG065	German Language A1	12			4		100	100
SEMESTER 2									
1	23IZ201	Transforms and its Applications	3	1	0	4	50	50	100
2	23IZ202	Sensors for Engineering Applications	3	1	0	4	50	50	100
3	23IZ203	Digital Design	3	1	0	4	50	50	100
4	23IZ204	C Programming	3	0	0	3	50	50	100
5	23IZ211	Engineering Practices	0	0	4	2	50	50	100
6	23IZ212	C Programming Laboratory	0	0	4	2	50	50	100
7	23IZ213	Foundations for Problem Solving	0	0	2	0	50	50	100
8	23IG066	German Language A2	12	0	0	4		100	100
9	23IH072	American History	2	1	0	3	50	50	100
SEMESTER 3									
1	23IZ301	Linear Algebra	3	1	0	4	50	50	100
2	23IZ302	Computer Organization and Architecture	3	1	0	4	50	50	100
3	23IZ303	Data Structures	3	0	0	3	50	50	100
4	23IZ304	Discrete Structures	3	1	0	4	50	50	100
5	23IZ305	Engineering Economics	3	1	0	4	50	50	100
6	23IZ310	Object Oriented Programming Laboratory	0	0	4	2	50	50	100
7	23IZ311	Data Structures Laboratory	0	0	4	2	50	50	100
8	23IH073	Organizational Behavior	3	0	3	3	50	50	100
9	23IG067	German Language B1	12	0	0	4	-	100	100
SEMESTER 4									
1	23IZ401	Probability, Stochastic Processes and Statistics	3	1	0	4	50	50	100
2	23IZ402	Database Management Systems	3	0	0	3	50	50	100
3	23IZ403	Design and Analysis of Algorithms	3	1	0	4	50	50	100
4	23IZ404	Theory of Computation	3	1	0	4	50	50	100

5	23IZ405	Software Engineering	3	1	0	4	50	50	100
6	23IZ410	Database Management Systems Laboratory	0	0	4	2	50	50	100
7	23IZ411	Application Development Laboratory	0	0	4	2	50	50	100
8	23IZ413	Problem Solving	0	0	2	1	50	50	100
9	23IG068	German Language B2.1	12	0	0	4	-	100	100
10	23IH074	TOEFL/ IELTS Training	6	0	9	2	50	50	100
SEMESTER 5									
1	23IZ501	Operating Systems	3	0	0	3	50	50	100
2	23IZ502	Artificial Intelligence	3	1	0	4	50	50	100
3	23IZ503	Compiler Design	3	1	0	4	50	50	100
4	23IZ504	Computer Networks	3	0	0	3	50	50	100
5	23IZ510	Computer Networks Laboratory	0	0	4	2	50	50	100
6	23IZ511	System Software Laboratory	0	0	4	2	50	50	100
7	23IG069	German Language B2.2	12	0	0	4		100	100
SEMESTER 6									
1	23IZ601	Machine Learning	3	0	0	3	50	50	100
2	23IZ602	Graph Theory	3	1	0	4	50	50	100
3	23IZ603	Embedded Systems	2	2	0	4	50	50	100
4	23Z610	Machine Learning Laboratory	0	0	4	2	50	50	100
5	23Z611	Innovation Practices Laboratory	0	0	2	1	50	50	100
6	23IG070	German Language C1	12	0	0	4		100	100

SEMESTER – I

23IZ101 CALCULUS AND ITS APPLICATIONS

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables.

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems.

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits.

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes' theorem.

TEXT BOOKS

1. J. Hass, C. Heil, Maurice D.W "'Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES

1. H. Anton, I. Bivens, S. Davis, "Calculus", John Wiley and Sons, USA, 2016.
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23IZ102 BASICS OF ELECTRICAL AND ELECTRONIC SYSTEMS

DC CIRCUIT: current-voltage –power-energy, electrical circuit elements: resistors-inductor- capacitor, source of electrical energy. Ohm's law-Kirchhoff's laws, series and parallel circuits, Maxwell's loop current method, Network theorems: superposition theorem-thevenin'stheorem-Norton's theorem-maximum power transfer theorem.

AC CIRCUITS: Single phase AC circuits: Average and RMS values of sinusoidal wave form-RLC Circuit-Phasor representation-active, reactive apparent power –power factor, analysis of RLC Circuit, three phase circuit: star and delta connection-phase and line quantities-balance and unbalance systems

ELECTROMAGNETISM AND MAGNETIC CIRCUITS: Electromagnetic induction; induced currents, Faraday's law, induction and energy, motional emf and Lenz's law. Magnetic field-magnetic circuit-inductance and mutual inductance-magnetic materials –ideal transformers and real transformers

SEMICONDUCTOR DEVICES: Basic diode concepts-diode circuit: half wave rectifier-full wave rectifier-bridge rectifier-special purpose diodes-zener diode –transistor fundamentals –transistor biasing-bipolar junction transistors-basis amplifier concept-loading effect-power supplies and efficiency.

OPERATIONAL AMPLIFIERS: Op-Amp Basics, Ideal characteristics of Op-Amp, practical Op-Amp circuits, differential and common mode operation, Inverting and non-inverting amplifiers, Op-Amp as Adder, Subtractor, integrator and differentiator.

TEXT BOOKS

1. Edward Hughes, John Hiley and Keith Brown, "Electrical and Electronic Technology", Pearson education, 2020
2. Murugesh Kumar K, Basic Electrical Science and Technology", Vikas Publishing House, 2016
3. Theraja B L, "Basic Electronic Solid State", S. Chand & Company Ltd., New Delhi, 2010

REFERENCES

1. Leach DP, "Digital Principles & Applications", Tata McGraw Hill, 2021
2. Hambley A R., "Electrical Engineering Principles and Applications", Pearson education, 2018
3. Boylestad R. L., and Nashelsky L., "Electronic Devices and Circuit Theory", Pearson Education, Noida, 2013

23IZ103 APPLIED CHEMISTRY

ELECTRONIC MATERIALS: Inorganic semiconductors – Elemental – Si and Ge - band theory, doping, compound semiconductors – band gap engineering – applications. Organic semiconductors – conjugated polymers – mechanism of charge transport, doping, states of aggregation, material properties – thermal, mechanical, electrical, chemical, electrochemical. Applications – OLED, OPV – working principle. Liquid crystalline materials – display application.

PROCESSES IN ELECTRONICS MANUFACTURE: Microchip fabrication – overview, photoresists – chemistry, types. Fabrication facilities – clean rooms - maintenance, ultrapure water– specification, production processes – ion exchange, reverse osmosis, continuous electrodeionisation. PCB fabrication – electroless and electroplating of copper – principle, bath chemistries and process parameters, formation of copper track on plastic board.

ELECTRONICS PACKAGING AND PROTECTION: Packaging materials-encapsulants and underfills - adhesives – chemical types, application methods, factors influencing adhesion, soldering alloys – phase diagrams, lead free alloys, phase change materials for cooling. Conducting inks for printed electronics - metal and carbon based – graphene, CNT– synthesis, structure, electrical properties. Corrosion in electronics – types, protection – vapour phase inhibitors.

ELECTROCHEMICAL POWER SOURCES: Electrochemical cells – emf, electrode potential, dependence of emf on electrolyte concentration – Nernst equation. Batteries**–**performance characteristics. Materials, construction, reactions, characteristics of lechlanche cell, primary lithium batteries, lead - acid battery and lithium-ion batteries. Supercapacitors – EDLC – fundamentals, electrode materials, electrolytes, pseudocapacitors– materials.

CHEMICAL SENSORS:– Sensors – basic components. Electrochemical sensors- potentiometrictransducers – principle, ion-selective electrodes – configurations, response functions and selectivity, applications –potentiometric titrations, water quality monitoring - pH, Hardness, fluoride ion sensors Amperometric transducers – principle, application - glucose biosensors, conductivity sensors – principle – application in conductometric titrations. Colorimetric sensors - Beer-Lambert's law, components, application - determination of ferric ion in water sample. Chemiresistive sensors - principle, application – environmental monitoring – CO2 sensor. Microelectrodes for sensors – fabrication.

TEXT BOOKS:

1. Shashi Chawla, "A Textbook of Engineering Chemistry", 1st Edition, New Delhi: Dhanpat Rai and Co. , 2005.
2. Cowie J.M.G,ValeriaArrighi "Polymers: Chemistry and Physics of modern materials", CRC Press., London, third edition, 2007.

REFERENCES:

1. Bansi D. Malhotra "Handbook of Polymers in Electronics", Rapra Technology Ltd.., UK, 1st edition, 2002.
2. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Mc Graw Hill,., 6th edition, 2014.
3. Derek Pletcher and Frank C. Walsh. "Industrial Electrochemistry", 2nd Edition London: Chapman and Hall , 1993.
4. Florinel-Gabriel Banica, " Chemical Sensors and Biosensors – Fundamentals and Applications", 1st edition, John Wiley & Sons Ltd, 2012.

23IZ104 COMPUTATIONAL THINKING

INTRODUCTION: Computational thinking - Logical thinking - Flow charts - Algorithmic thinking - Characteristics of algorithms – Pseudocode - Example problems

PROBLEM SOLVING AND DECOMPOSITION: Defining the problem - Devising a solution - Decomposition - Other effective strategies - Patterns - Example problems

ABSTRACTION AND MODELING: Generalization - Abstraction - Modeling– Examples

ITERATIVE LOGIC: Iterator - Variable - Filtering - Dynamic filtering - Example problems

CASE STUDIES: Text processing - Pattern search - Linear search - Sorting

TEXT BOOKS:

1. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021

REFERENCES:

1. R.G.Dromey, "How to Solve it by Computer", Pearson Education, Second Edition, 2008.
2. Peter j Denning , Matti Tedre, "Computational Thinking", The MIT Press, 2019
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017
4. Peter William Mcowan (Author), Paul Curzon (Author), "Power of Computational Thinking, The: Games, Magic And Puzzles To Help You Become A Computational Thinker ", World Scientific Europe Ltd, 2017

23IZ105 ENGLISH LANGUAGE PROFICIENCY

VOCABULARY: Etymology-prefixes and suffixes–synonyms–antonyms–guessing meanings from context–word Formation - single-word substitutes-different forms of a word–phrasal verbs–collocations.

LISTENING AND SPEAKING: Understanding listening – listening techniques - introducing oneself and others –seeking and sharing information– description-conversation skills–extempore speaking– speech practice in varied formal contexts

GRAMMAR: Wh-questions–Yes/no questions–parts of speech–articles–prepositions–gerunds–conjunctions-degrees of comparison–tenses– modal verbs– adverbs - direct and indirect questions.

READING: Reading strategies: skimming and scanning, predicting–reading comprehension: techniques – practice reading.

WRITING: Discourse markers – dialogue writing - completing sentences – jumbled sentences –paragraph writing –writing compare & contrast paragraphs – Letter writing.

TEXTBOOKS:

1. Shoba K.N.and Lourdes JoavaniRayen,"Communicative English", Cambridge University press,Cambridge,2021.
2. Raymond Murphy,"Intermediate English Grammar", Cambridge University Press, New Delhi,2020.

REFERENCES:

1. Raymond Murphy, "English Grammar in Use", Cambridge University Press, New Delhi, 2020.
2. Sudharshana N P and Savitha C, "English for Engineers", Cambridge University Press, New York, 2018.
3. Anne Laws, "Writing Skills", Orient Black Swan, Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, "Essential English Grammar", Cambridge University Press, New Delhi, 2019.

23IZ110 PYTHON PROGRAMMING LABORATORY

1. Algorithm and Flowchart
2. Programs using Decision Making statements and Looping Statements
3. Applications using Set, Lists, Tuples, Dictionary
4. Applications using Functions
5. Iterative
6. Text processing
7. Sorting algorithms
8. Linear Searching
9. Application Debugging

REFERENCES:

1. Romano, Fabrizio,"Learn Python Programming: A Beginner's Guide to Learning the Fundamentals of Python Language to Write Efficient, High-Quality Code", 2nd Edition. India, Packt Publishing, 2018.
2. R. Nageswara Rao, "Core Python Programming",Second edition, Dreamtech press, 2019
3. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, ShashwatPathak,"Python Programming: A Practical Approach", United States, CRC Press, 2021.
4. MeenuKohli, "Basic Core Python Programming: A Complete Reference Book to Master Python with Practical Applications",First edition, BPB Publications, 2021.
5. Cogliati, Josh,"Non-Programmers Tutorial For Python 3",Platypus Global Media, 2019.

23IZ111 BASIC SCIENCE LABORATORY

Physics (Any eight experiments)

1. Determination of Hysteresis loss of a ferromagnetic material
2. Determination of resistivity of metal and alloy using Carey Foster bridge
3. Determination of capacitance using LCR bridge
4. Study of reverse bias characteristics of Germanium diode and determination of its band gap
5. Study of I-V characteristics of solar cell and determination of its efficiency
6. Thermistor: Measurement of temperature and band gap
7. Study of characteristics of Photo Diode
8. Operational Amp. (741) – Inverting and non inverting modes
9. Determine the Planck's constant using Photo Electric method.
10. Determine the refractive index of given specimen using Brewster's angle apparatus.

Demonstration:

1. Determine the excitation potential of Argon using the Franck Hertz method.
2. Determine the number of turns & radius of the coil and magnetic field of 'Helmholtz' coil using Biot-Savart's Law – apparatus
3. Find the Hall voltage, Hall coefficient, mobility & charge density of the given 'Ge' crystal using Hall apparatus.
4. Determine e/m (charge to mass ratio) of the electron by Thomson's method.
5. Determine the charge of an electron by Millikan's oil drop method.
6. Determine the wavelength of the laser source by Michelson Interferometer.
7. Determine the thickness of the film by Mach Zehnder Interferometer.
8. Find the finesse and free spectral region of the Etalon.
9. Analyze the mercury spectrum and find wavelength using polynomial equation.

REFERENCES:

1. Department of Physics," Physics laboratory observation", 2022.
2. Jerry D Wilson; Cecilia A Hernandez Hall, "Physics laboratory experiments", Boston, MA : Cengage Learning, 2016.

CHEMISTRY (Any eight experiments)

1. Determination of total hardness of water by EDTA method.
2. Demineralisation of water using ion-exchange resins and determination of water quality - pH, TDS and conductivity.
3. Electroplating of copper and Nickel and determination of cathode efficiency of electroplating.
4. Construction of phase diagram for a simple eutectic system.
5. Demonstration of different forms of metallic corrosion using ferroxyl indicator test and determination of rate of galvanic corrosion using zero-resistance ammeter.
6. Designing a battery and determination of its characteristics.
7. Potentiometric estimation of ferrous iron.
8. Preparation of a chloride ion sensor and ascertaining nerstian response by construction of calibration curve.
9. Conductometric estimation of a mixture of strong and weak acids.
10. Photocolorimetric estimation of Ferric ion in a water sample.

REFERENCE:

1. Laboratory Manual Prepared by the Department.

SEMESTER – II

23IZ201 TRANSFORMS AND ITS APPLICATIONS

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t – shifting, Dirac's delta function, periodic functions, differentiation and integration of transforms.
APPLICATION OF LAPLACE TRANSFORMS: Convolution, solving differential equations with constant coefficients and variable coefficients, integral equations, systems of ODEs by using Laplace transform technique.
Z TRANSFORM: Z-transform, the relationship of the Z-transforms to the Laplace transform, some useful properties, inverse Z-transforms, solution of difference equations.
FOURIER SERIES: Fourier series – even and odd functions, half range expansion, convergence of Fourier series, basic concepts of PDE's, wave equation, solution of one dimensional heat equation and steady state two dimensional heat equation.

FOURIER TRANSFORMS: Fourier integral, Fourier cosine and sine integrals, Fourier transform, Discrete Fourier transform, Fast Fourier transform – DIT algorithm.

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.
2. Dean G. D, "Advanced Engineering Mathematics with MATLAB", CRC Press, USA, 2017.

REFERENCES

1. Peter V.O. Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2018.
2. Wylie C. R. and Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Jain. R. K. and Iyenger, S. R. K., "Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, 2018.
4. Alexander D Poularikas, "Transforms and applications primer for engineers with examples and MATLAB", CRC press, USA, 2010.

23IZ202 SENSORS FOR ENGINEERING APPLICATIONS

STRAIN AND PRESSURE MEASUREMENT: Resistance strain gauge, piezoelectric pressure sensor, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic pressure sensor. capacitance pressure sensor.
ELECTRONIC SENSORS: Inductive,capacitive and ultrasonic based proximity sensors Reed switch, Hall-effect switching sensors, capacitive based humidity sensor, liquid level detectors, flow sensors, smoke sensors
MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors, piezoelectric devices for motion sensing, Hall effect-based speed sensor.

LIGHT Sensors: Color temperature, light flux, photo sensors, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic sensors and their applications. LIDAR working principle and automotive applications.

Thermal Sensors: Bimetallic strip, semiconductor-based temperature sensor, thermocouples, Resistance thermometers, thermistors, PTC and NTC thermistors and their applications. Infrared sensors: bolometer, Pyroelectric detector, photodiodes and phototransistor.

TEXTBOOKS:

1. Ian R Sinclair, —Sensors and Transducers, Third Edition, Newnes publishers, 2011.
2. Krzysztof Iniewski, Smart sensors for industrial applications, CRC Press Taylor and Francis, 2019.
3. Doebelin E O, —Measurement Systems, Application and Design, McGraw Hill, seventh Edition, 2019.

REFERENCES:

1. Jack P Holman, —Experimental Methods for Engineers, Eighth Edition, McGraw Hill, USA, 2011.
2. JacobFraden, Handbook of modern sensors: Physics,design,and applications, Springer, 5th Edition, 2016.

23IZ203 DIGITAL DESIGN

NUMBER SYSTEM: Number Systems and Number-Base Conversion - Complements of Numbers (Diminished Radix Complement, Radix Complement) - Signed Binary Numbers - Arithmetic Operation with the Binary Numbers - fixed and floating point representation, Binary Codes (BCD, 2421Code, Gray Code, ASCII)
BOOLEAN ALGEBRA: Boolean Algebra - Basic Theorems and Properties of Boolean Algebra - Simplification of Boolean Functions - Canonical and Standard Forms - Other LogicOperation

DESIGN OF COMBINATIONAL CIRCUITS: Introductory Digital Concepts - Digital Logic Gates - Karnaugh Map Method - Don't Care Conditions - The Tabulation Method - NAND and NOR Implementation - Design Procedure - Adder - Subtractor - Magnitude Comparator - Decoders - Encoders - Priority Encoder - Multiplexers - Demultiplexers - Three State Gates - Design Example.

DESIGN OF SEQUENTIAL CIRCUITS: Introduction - Storage Elements: - Latch(S-R Latch, D-Latch) - Flip-Flops(S-R Flip Flop,D-Flip Flop, J-K Flip Flop, T-Flip Flop) - Master Slave Configuration of J-K Flip Flop - Shift Registers - Design of Asynchronous and Synchronous Counter. Mealy and Moore Models of Finite State Machines(FSM) - Synchronous Sequential Logic - State Reduction and Assignment - Design Procedure Algorithmic

MEMORY AND PROGRAMMABLE LOGIC: Introduction - Random Access Memory - Memory Decoding - Read Only Memory-Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Sequential Programmable Devices

TEXT BOOKS

1. M. Morris Mano,Michael D. Ciletti. Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog Sixth Edition USA: Pearson Education, 2018.
2. M. Morris Mano. Digital Logic and Computer Design India: Pearson Education, 2017.
3. Thomas L. Floyd. Digital Fundamentals USA: Pearson Education, 2015.

REFERENCES

1. Charles H. Roth,Jr,Larry L. Kinney. Fundamentals of Logic Design USA: Cengage Learning , 2014.
2. John F. Wakerly. Digital Design: Principles and Practices USA: Pearson Education , 2018.
3. Roger L Tokheim. Digital Electronics: Principles and Applications USA: McGraw-Hill Education , 2013.
4. Ronald Tocci,NealWidmer,Greg Moss. Digital Systems USA: Pearson Education , 2016.
5. Donald D. Givone. Digital Principles and Design USA: McGraw-Hill Education , 2003.

23IZ204 C PROGRAMMING

C PROGRAMMING BASICS: Introduction to C programming - C Program Structure - Program Compilation & Execution - Character Set - Keywords - Data Types - Library functions - Control Statements :Branching and Looping.

ARRAYS AND STRINGS: Single Dimensional Array, Two Dimensional Arrays, Multidimensional Array:Initialization, Unsized Array Initialization. - Strings : Defining, initializing of strings, Processing strings, Array ofStrings)

FUNCTIONS: Definition of Function - Prototypes - Storage Classes - Scope Rules - Recursion - Command Line Argument.
POINTERS: Pointer Declaration - Operations on Pointer - Passing Pointers to a Function - Calling Function: Call by Value, Call by Address - Return Statement - Passing Arrays to Function - Pointers and One Dimensional, two dimensional Array - Array of Pointers - Dynamic Memory Allocation.
STRUCTURES, UNION AND FILES: Definition - Processing a Structure - Typedef - Array of Structure, and Pointer to Structure - Passing Structure to Functions. - Self-Referential Structures - Nested Structures - Union - Introduction to Files - FileAccess - File Organization –FileOperations.

TEXT BOOKS:
1. Byron S. Gottfried, Jitendar Kumar Chhabra "Programming with C", Tata McGraw Hill Publishing Company., New Delhi, 2018., fourth edition
2. Kernighan B. W., Ritchie D. M. "C Programming Language (ANSI C)", Prentice Hall of India Private Limited., New Delhi, 2010, second edition

REFERENCES:
1. Herbert Schildt "C – The Complete Reference", Tata McGraw Hill Publishing Company., New Delhi, 2010 , fourth edition
2. PradipDey and Manas Ghosh "Programming in C", Oxford University Press., New Delhi, 2018
3. Yashavant P. Kanetkar "Let Us C", BPB Publications., 2017 , 16th edition
4. H. M. Deitel, P. J. Deitel "C How to Program", Pearson Education., New Delhi, 2013. , seventh edition

23IZ211 ENGINEERING PRACTICES

1. Study of PC Components
2. Assembling and disassembling of PC.
3. Study of passive and active components (resistors, capacitors, inductors, diodes and transistor).
4. Generation of Signals (DSO, Function generator).
5. Construction of series and parallel circuits using resistors.
6. Study of Digital IC Technologies.
7. Verification of Logic Gates and Implementation of Boolean equations
8. Design and Implementation of Arithmetic Circuits.
9. Design and Implementation of Registers.
10. Design and Implementation of Counters

REFERENCES
1. Hambley A.R., “Electrical Engineering Principles and Applications”, PHI Learning Pvt. Ltd., New Delhi, 2017.
2. Thomas L. Floyd,“Digital Fundamentals”, Pearson Education,USA,2015.
3. WikibooksContributors,”How to assemble your Desktop PC”, Platypus Global Media, 2011.
4. Govindarajalu B,”IBM PC and CLONES:Hardware, Troubleshooting and Maintenance”, TATA McGraw-HillEducation,2008.

23IZ212 C PROGRAMMING LABORATORY

1. Formatted I/O statements.
2. Decision Making statements: Simple If, If – else, Switch- case.
3. Looping Statements: For, While, Do – while.
4. Single dimensional arrays and multi-dimensional arrays.
5. Operations on Strings.
6. Pass by value and pass by address, Recursion using functions.
7. Structures and nested structures.
8. String handling operations using pointers.
9. Operations on arrays using pointers.
10. File operations using command line arguments

REFERENCE
1. Byron S. Gottfried, Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company., New Delhi, 2018,Fourth edition
2. Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company., New Delhi, 2010,Fourth edition
3. PradipDey and Manas Ghosh, "Programming in C", Oxford University Press., New Delhi, 2018
4. Yashavant P. Kanetkar, "Let Us C", BPB Publications., 2017,Sixteenth edition
5. H. M. Deitel, P. J. Deitel, "C How to Program", Pearson Education., New Delhi, 2013,Seventh edition

23IZ213 FOUNDATIONS FOR PROBLEM SOLVING

1. Speed Mathematics (SAW, Oz, Mirror methods)
2. Speed Mathematics (High5, Minion, Butterfly methods)
3. Speed Mathematics (Inception, Goldeneye methods)
4. Thinking with Numbers
5. Problem Solving with Visual information
6. Words Puzzles
7. Resume Writing Essential

REFERENCES:

1. R.S. Aggarwal, “Quantitative Aptitude for Competitive Examination”, S Chand Publishing, New Delhi, 2017.

SEMESTER – III

23IZ301 LINEAR ALGEBRA

VECTOR SPACES: General vector spaces - real vector spaces - Euclidean n-space - subspaces – linear independence-coordinates and basis - dimension – change of basis - row space, column space and null space – consistency of linear systems - rank and nullity.

LINEAR TRANSFORMATIONS: General linear transformation - matrix transformations- geometry of linear operators on R^2-matrices for general linear transformations – similarity.

INNER PRODUCT SPACES: Inner products - angle and orthogonality in inner product spaces, Gram - Schmidt process: QR decomposition, best approximation: least squares - least squares fitting to data.

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors, diagonalization - orthogonal diagonalization - quadratic forms.

MATRIX DECOMPOSITION AND OPTIMIZATION: Spectral decomposition - singular value decomposition - reduced singular value decomposition - optimization using quadratic forms.

TEXT BOOKS

1. Howard Anton, Chris Rorres, Anton Haul “Elementary Linear Algebra”, Wiley India, New Delhi, 2019.
2. David C Lay,Judi J. McDonald, Steven R. Lay “Linear Algebra and its Applications”, Pearson Education, New Delhi, 2021.

REFERENCES

1. Gareth Williams, “Linear Algebra with Applications”, Narosa Publishing House, New Delhi, 2017.
2. Gilbert Strang, “Linear Algebra and Learning from Data”, Wellesley-Cambridge Press, USA, 2019.
3. Friedberg, Insel and Spence, “Linear Algebra”, Pearson Education, USA, 2015.
4. Steven J Leon, “Linear Algebra with Applications”, Pearson Education, USA, 2015.

23IZ302 COMPUTER ORGANIZATION AND ARCHITECTURE

COMPUTER ORGANIZATION & DESIGN: Stored program organization (Von Neumann architecture) - Computer Registers - Computer Instructions - Timing and Control (Hardwired and Micro programmed) - Instruction Cycle - Memory reference instructions - Input / Output Instructions - Quantitative Principles of computer design.
PROCESSOR DESIGN: Stack organization - Instruction Formats - Addressing modes - Fixed point arithmetic: addition, subtraction, multiplication (booth‘s algorithm) and division (restoring and non restoring division algorithm) - RISC Vs CISC

MEMORY AND I/O SYSTEMS: Memory Hierarchy - Associative Memory - Cache Memory - Mapping policies – Cache optimization; I/O Systems: Introduction-Interrupts-Modes of Transfer -DMA.

PARALLELISM: Pipelining - Pipelining Hazards - Overcoming Hazards - Instruction Level Parallelism – Dependencies

MULTIPROCESSOR SYSTEMS: Symmetric and Distributed shared memory architectures - Challenges – Cache Coherence - Snooping protocol

TEXT BOOKS:

1. Morris Mano, "Computer System Architecture", Prentice Hall of India, Prentice Hall of India, 2007.
2. John L. Hennessey, David A. Patterson, "Computer Architecture: A Quantitative Approach", Elsevier India Pvt. Ltd, New Delhi, 2015.

REFERENCES:

1. Carl Hamacher, "Computer Organization", Tata McGraw Hill Publishing, New Delhi, 2002.
2. Kai Hwang, "Advanced Computer Architecture Parallelism, Scalability, Programmability", Tata Mc Graw Hill, New Delhi, 2010.
3. William Stallings, "Computer Organization and Architecture", Pearson Education / Prentice Hall of India, New Delhi, 2006.
4. Kai Hwang, Faye A Briggs, "Computer Architecture and Parallel Processing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

23IZ303 DATA STRUCTURES

INTRODUCTION: Need for Data Structures - Types of Data Structures - Abstract Data Type –AlgorithmComplexity Analysis - Best case and worst-case complexities - Asymptotic notations

ARRAYS AND LISTS: Array Representation and Operations - Matrix representation using Multi-dimensional arrays - Linked List Representation - Operations on a Singly Linked List - Types of Linked List - Polynomial Addition - Sparse Matrices

STACKS AND QUEUES: Stack ADT - Representation and Operations - Expression Handling - Role of Stack in implementing recursive algorithms - Queue ADT - Representation and Operations - Types of Queues - Circular Queue - Deque - Priority Queue

TREES: Terminologies - Binary Tree - Traversal - Expression Trees - Binary Heap - Priority Queue implementation using Binary Heap - Binary Search Tree - AVL Tree - m-way search trees - B Tree - B+ Tree - Applications - Trie Structure

HASHING AND GRAPHS: - Hash Table - Hash Functions - Resolving Collisions - Rehashing.
GRAPHS: Graph Terminologies- Types of Graphs - Representation - Breadth First Search - Depth First Search - Topological Sort

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.
2. Venkatesan R, Lovelyn Rose S, "Data Structures", 2nd Edition, Wiley India Pvt Ltd, 2019.

REFERENCES:

1. Jean Paul Tremblay, Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Publishing Company, New Delhi, 2017.
2. Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press, 2019.
3. Salaria R S, "Data Structures and Algorithms using C", 5th Edition, Khanna Book Publishing, New Delhi, 2017.
4. Amol M. Jagtap, Ajit S. Mali, "Data Structures Using C - A Practical Approach for Beginners", Chapman and Hall/CRC; 1st edition , 2021
5. Aaron M Tanenbaum, Moshe J Augenstein and YedidyahLangsam, "Data structures using C and C++", Prentice Hall, 2016.

2IZ304 DISC7RETE STRUCTURES

LOGIC AND PROPOSITIONAL CALCULUS: Propositional logic - connectives- compound propositions - logic and bit operations - propositional equivalences - normal forms - rules of inference.

PREDICATE CALCULUS AND PROOF STRATEGY: Predicates - quantifiers - quantifiers with restricted domain - logical equivalences involving quantifiers - rules of inference for quantified statements - introduction to proofs - direct proof - contraposition - contradiction - mathematical induction - program correctness.

RELATIONS AND LATTICES: Relations and their properties – representing relations – types of relations - closures of relations – partial orderings - lattices as posets – Hasse diagram - properties of lattices.

ALGEBRAIC STRUCTURES: Semi groups and monoids - groups – subgroups – group homomorphism - permutation groups - rings - integral domain – fields.

CODING THEORY: Encoding and decoding functions - Hamming distance - error correction and detection - group codes - maximum likelihood decoding technique - polynomial rings and codes.

TEXT BOOKS:

1. Kenneth H Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, New Delhi, 2021.
2. Tremblay J P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Bernard K, Robert C B and Sharon C R, "Discrete Mathematical Structures", Prentice Hall, New Delhi, 2018.
2. Ralph P G,"Discrete and Combinatorial Mathematics - An Applied Introduction", Addison Wesley, USA, 2019.
3. Richard J, "Discrete Mathematics", Pearson Education, New Delhi, 2018.
4. Herstein I N, "Topics In Algebra", Wiley India, New Delhi, 2013.

23IZ305 ENGINEERING ECONOMICS

Fundamentals of Economic Analysis: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency.
Cost and Inventory Control: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages- Depreciation Methods – Problems in Straight Line and Diminishing Balance Method.

Pricing, Revenue and Value Engineering: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering.

Project Management: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis.

Economic Growth and Development: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy.

TEXT BOOKS

1. Panneerselvam. R., “Engineering Economics”, PHI Learning Private Limited, 2012.
2. Metha P.L, “Managerial Economics – Analysis, Problems and Cases”, Sultan Chand & Sons, 2016.

REFERENCES

1. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, “Principles of Engineering Economics with Applications, Cambridge University Press, 2018.
2. Varshney, R.L and K.L. Maheshwari, “Managerial Economics”, Sultan Chand & Sons, 2014.
3. McEachern and Indira., “Macro ECON”, Cengage India Private Limited, 2017.
4. Shalini Goyal Bhalla, “Circular Economy (Re) Emerging Movement”, Invincible Publishers, 2020.

23IZ310 OBJECT ORIENTED PROGRAMMING LABORATORY

1. Study of JDK,JRE,JVM, IDE and REPL
2. Classes and Methods
3. Inheritance
4. Interfaces and packages
5. Exception Handling
6. I/O and Files
7. Collection classes
8. Generics and Lambda Expressions

REFERENCES:

1. Schildt H, "Java: The Complete Reference", Eleventh Edition, McGraw-Hill Education, 2018.
2. Deitel P and Deitel H, "Java: How to Program", Eleventh Edition, Prentice Hall, 2018.
3. Hortsmann CS and Cornell G, "Core Java: Volume 1 - Fundamentals", Eleventh Edition, Prentice Hall, 2018.
4. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, "The Java Language Specification – Java SE", Thirteenth Edition, Oracle America Inc., USA, 2019.
5. Daniel Liang L, "Introduction to Java Programming", Tenth Edition, Pearson Education, New Delhi, 2015.
6. Matt Weisfeld, "The Object Oriented Thought Process", Fifth Edition, Addison-Wesley Professional, US, 2019

23IZ311 DATA STRUCTURES LABORATORY

1. Solving Problems using arrays
2. Searching and Sorting algorithms
3. Implementation of Linked List
4. Applications of Linked List
5. Implementation Stack and queue
6. Applications of Stack
7. Operations on Binary Search Trees
8. Applications of Binary Search Tree, AVL tree
9. Graphs - Depth First Search and Breadth First Search
10. Hashing and Collision Resolution

REFERENCES:

1. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, Universities Press, 2011.
2. Jean Paul Tremblay and Sorenson, “An Introduction to Data Structures with Applications”, McGraw Hill Publishing Company, New Delhi, 2012.
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, “Introduction to Algorithms”, MIT Press, England, 2009.
4. Salaria R S, "Data Structures and Algorithms using C", 5th Edition, Khanna Book Publishing, New Delhi, 2017.
5. Amol M. Jagtap, Ajit S. Mali, ”Data Structures Using C - A Practical Approach for Beginners”, Chapman and Hall/CRC; 1st edition , 2021

23IH 073 ORGANIZATIONAL BEHAVIOR

Introduction to OB: Meaning & Importance of OB – Historical Development & Contributing Disciplines
Personality – Personality determinants & attributes, Emotional Intelligence and Wor k Values
Employment relationship and the psychological contract
Motivation - Basic Concepts, Motivation Theories, Problems in Motivation
Leadership - Theories of leadership, Leadership styles and effectiveness
Group Dynamics: Types of Groups, Group Norms and Cohesiveness: Group Roles.
Organizational Culture - Elements, Culture and Performance, merging organizational cultures, changing and strengthening culture.
Organizational Change - Forces for change force field analysis model Organization Development
Work Stress - Causes and consequences – Stress coping strategies
Case studies

REFERENCES:

1. Mc Shane Von Glinow and Radha Sharma, “Organisational Behaviour”, Tata Mc Graw Hill, 4th Edition, 2008
2. Stephen P Robbins, “Organisational Behaviour”, Prentice Hall (India) Pvt. Ltd., New Delhi, 13 th Edition, 2009
3. Kreitner Robert, Kinicki , Angelo, “Organsiational Behaviour”, Irwin Inc., Illinois, 2 nd Edition, 2006
4. Hellriegel, “Organsiational Behaviour” Thomson Learning, 1st edition, 2005
5. Ivancevich, “Organsiational Behaviour” Tata Mc Graw Hill, 7th Edition, 2006.

SEMESTER – IV

23IZ401 PROBABILITY, STOCHASTIC PROCESSES AND STATISTICS

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axioms, conditional probability, law of total probability, Baye’s theorem, discrete random variables, probability mass function, cumulative distribution function, binomial, Poisson and geometric random variables, expected values.

CONTINUOUS RANDOM VARIABLES: Cumulative distribution function, probability density function, uniform, exponential and Gaussian random variables, expected values.

PAIRS OF RANDOM VARIABLES: Joint cumulative distribution function, joint probability mass function, marginal probability mass function, joint probability density function, marginal probability density function, independent random variables, expected values, covariance, correlation and independence, central limit theorem, weak law of large numbers.

STOCHASTIC PROCESSES: Types of stochastic processes, Bernoulli process, Poisson process, discrete time Markov chains, classification of states, limiting state probabilities.

STATISTICAL INFERENCE: Point estimation, Bayesian estimation, interval estimation. Hypothesis testing: one and two tailed tests, tests concerning mean, proportion, and variance, single and two samples, tests for goodness of fit and independence of attributes.

TEXT BOOKS

1. Roy D Yates and David J Goodman, “Probability and Stochastic Processes”, Wiley India, New Delhi, 2021.
2. Ronald E. Walpole, Raymond H Myers, Sharon L Myers and Keying Ye, **“**Probability and Statistics for Engineers and Scientists”, Pearson Education, New Delhi, 2016.

REFERENCES

1. Saeed Ghahramani, “Fundamentals of Probability with Stochastic Processes”, CRC Press, USA, 2018.
2. Dougles C Montgomery and George C Runger, “Applied Statistics and Probability for Engineers”, Wiley India, New Delhi, 2018.
3. Athanasios P and Unnikrishna P S, “Probability, Random Variables and Stochastic Processes”, Tata McGraw Hill, New Delhi, 2017.
4. D. Bertsekas and J. Tsitsiklis, “Introduction to Probability”, Athena Scientific, USA, 2008.

23IZ402 DATABASE MANAGEMENT SYSTEMS

INTRODUCTION TO DATABASE: Purpose of Database System - Data Models - Database System Architecture – DBMS ComponentsConceptual design withEntity-Relationship model - Enhanced-ER Model -Traps

Relational model:E-R to relational model - Codd's rules- Integrity constraints- Relational Algebra- SQL Basics. Normalization: Armstrong rules - Functional Dependencies –First Normal Form to Fifth Normal Form - Denormalization

DATA STORAGE AND QUERYING: RAID - File Organization - Organization of Records in Files – Indexing and Hashing – Ordered Indices - B+ tree Index Files - B tree Index Files - Static Hashing - Dynamic Hashing - Query Processing stages – Query Optimization using Heuristics and Cost Estimation

TRANSACTION MANAGEMENT: Transaction Concepts - ACID Properties - Schedules - Serializability - Concurrency Control- Need for Concurrency - Locking Protocols - Two Phase Locking - Deadlock - Transaction Recovery-Savepoints-Isolation Levels –SQL Facilities for Concurrency and Recovery-Backup and Recovery System.

ADVANCED TOPICS: Parallel Database - Multidimensional Database - Datawarehouse-Multimedia Database - Web Database-Mobile Database- NoSQL database.

TEXT BOOKS:

1. Abraham Silberchatz, Henry F Korth and Sudarshan S, "Database System Concepts", Seventh Edition,Tata McGraw-Hill, New Delhi, 2021.
2. RamezElmasri and Shamkant B Navathe, "Fundamentals of Database Systems", Seventh Edition, Addison Wesley, USA, 2010.

REFERENCES:

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Fourth edition, Tata McGraw-Hill, New Delhi, 2008.
2. Gupta G K, "Database Management System", Tata McGraw-Hill, New Delhi, 2011.
3. Jeffrey A. Hoffer, Ramesh Venkataraman, HeikkiTopi , "Modern Database Management", 12th Edition, Pearson, NewDelhi, 2016.
4. AtulKahate , "Database ManagEment Systems", 1st Edition, Pearson, New Delhi, 2011.

23IZ403 DESIGN AND ANALYSIS OF ALGORITHMS

DIVIDE AND CONQUER: Introduction to Algorithm Design techniques - Divide and Conquer Methodology - Solving recurrence relations - Finding Maximum and Minimum Element - Quick sort - Merge sort - Convex Hull.

GREEDY METHOD: Greedy Strategy - Knapsack Problem - Minimum Spanning Trees - Single Source Shortest Path Method - Huffman Trees

DYNAMIC PROGRAMMING: Principle of Optimality - Knapsack Problem - All Pairs Shortest Path - Optimal Binary Search Tree - Multistage Graphs

BACKTRACKING: State Space Tree - Knapsack Problem - The Eight Queens Problem - Sum of subsets - Graph Coloring

BRANCH AND BOUND: Bounding Functions - 0/1 Knapsack Problem - Traveling Sales Person Problem - Assignment Problem

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Prentice Hall of India, New Delhi, 2017.
2. Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", GalgotiaPublications, New Delhi, 2010.

REFERENCES:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, England, 2009.
2. Donald E. Knuth, —The Art of Computer Programming‖, Volumes 1& 3 Pearson Education, 2009.
3. Jeffrey J McConnell, "Analysis of Algorithms", Jones and Bartlett Publishers, 2008.
4. Parag Himanshu Dave, HimanshuBhalchandra Dave, "Design and Analysis of Algorithms", Pearson Education, 2008.

23IZ404 THEORY OF COMPUTATION

FINITEAUTOMATA : Need for automata theory - Finite Automaton –DFAand NFA- Finite Automaton with ε- moves - Regular Languages- Properties - Regular Expression -Equivalence of NFAand DFA-Equivalence of NFA's with and without ε-moves - Equivalence of finite Automaton and regular expressions –Minimization of DFA - Pumping Lemma for Regular sets . (9+4)

GRAMMARS: Types of Grammar - Chomsky's hierarchy of languages - Context Free Grammars and Languages– Properties- Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees –Simplification of CFG-GreibackNormalform–Chomskynormalform–pumpinglemmaforCFL.

PUSH DOWN AUTOMATA: Definitions - Moves - Instantaneous descriptions - Deterministic and non deterministic pushdown automata – Equivalence of Pushdown automata and CFL.

TURING MACHINE: Definitions of Turing machines - Models - Computable languages and functions –Turing machineconstruction- MultiheadandMultitapeTuringMachines- TheHaltingproblem
UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS : Unsolvable Problems and Computable Functions – Primitive recursive functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine - Measuring and classifying complexity- Tractable and Intractable problems- Tractable and possibly intractable problems – complexity classes - Polynomial time reductions – P and NP completeness – SAT--problem - Clique problem - Space complexity.

TEXT BOOKS:
1. John C Martin , "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2011.
2. Hopcroft J.E., Motwani R. and Ullman J.D , "Introduction to Automata Theory, Languages and Computations", 3rdEdition, Pearson Education, New Delhi, 2008.

REFERENCES:
1. Harry R Lewis and Christos H Papadimitriou , "Elements of the Theory of Computation", 2nd Edition, Prentice Hall ofIndia, New Delhi, 2015.
2. Peter Linz , "An Introduction to Formal Language and Automata", 6th Edition, Narosa Publishers, New Delhi, 2016.
3. Ganesh Gopalakrishnan , "Automata and Computability", 1st Edition, Chapman and Hall/CRC, USA, 2019.
4. D Shanthi, N Uma Maheshwari, S Jeyanthi , "Theory of Computation", 1st Edition, Yesdee, India, 2017.

23IZ405 SOFTWARE ENGINEERING

PRELIMINARIES: Definition of Software – Software characteristics – Types of Software – Evolution of Software – Software Development Lifecycle – Waterfall Model – Incremental Model – Prototyping – Spiral Model – Unified Process – Agile Development Approach – Software Myths

REQUIREMENTS ENGINEERING: Requirements elicitation – Functional and Non-functional Requirements – Prioritization – Use cases – Use case diagram –– Data flow diagrams – UML – Object Model – Class diagram – State diagram – Sequence diagram – Activity diagram – CRC cards – Software Requirements Specification document (SRS)

SOFTWARE DESIGN: Architectural Design: Views and Viewpoints – Styles and Patterns – Layered Architecture. Detailed Design:Functional Decomposition – Object Oriented Design – User Interface Design – Good Design Attributes – Design Specifications – Coding Standards
SOFTWARE TESTING: Testing fundamentals: Black Box and White Box Testing – Test Cases – Equivalence Partitioning – Boundary Value Analysis – Basis Path Testing – Cyclomatic Complexity. Testing Strategies:Unit Testing – Integration Testing – System Testing – Acceptance Testing. Special Testing: Regression Testing – Smoke Testing – Stress Testing - User Interface Testing – Test Automation – Test Documenting and Reporting – Testing Object Oriented System

SOFTWARE ENGINEERING MANAGEMENT: Software Quality:Views of Quality – Quality Attributes – Cost of Quality – Quality Control vs. Quality Assurance – Formal Technical Reviews – Guidelines for Reviews – Quality Metrics. Software Configuration Management: Software Baselines – Version Control – Change Control – Software Configuration Audit. Software Maintenance: Maintenance Phase – Activities – Reengineering – Metrics.

TEXT BOOKS:
1. Roger S Pressman and and Bruce Maxim, “Software Engineering - A Practitioner‘s Approach”, McGraw Hill International Edition, Singapore, 2020.
2. Pankaj Jalote, “A Concise Introduction to Software Engineering”, Springer, New Delhi, 2011

REFERENCES:
1. Ian Sommerville, “Software Engineering”, Pearson Addison Wesley, Boston, 2017
2. Shari Lawrence Pfleeger, “Software Engineering: Theory and Practices”, Pearson Education, New Delhi, 2009
3. Orlando Karam, Frank Tsui, “Essentials of Software Engineering”, SBS Publishers and Distributors (P) Ltd, 2007 New Delhi.

23IZ410 DATABASE MANAGEMENT SYSTEMS LABORATORY

1. SQL Practice: DDL, DML, DCL,TCL commands.
2. Implement Views and stored procedures.
3. Implement functions, Cursors, Triggers and Embedded SQL
4. Study of performance monitoring and tuning Tools
5. Study of NoSQL databases
6. Mini project- Application development

REFERENCES:
1. Abraham Silberchatz, Henry F Korth and Sudarshan S, “Database System Concepts”, 7th Edition, Tata McGraw-Hill, New Delhi, 2021.
2. RamezElmasri and Shamkant B Navathe, “Fundamentals of Database Systems”, 7th Edition, Addison Wesley, USA, 2016.

3. Ivan Bayross, “SQL, PL/SQL the Programming Language of Oracle”, 4th Edition,BPB Publications New Delhi, 2020.
4. Rosenzweig,” Oracle PL/SQL by Example 5/e, For Dummies”,5th Edition, Pearson Education India, 2015.
5. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, 4th edition, Tata McGraw-Hill, New Delhi, 2015.

23IZ411 APPLICATION DEVELOPMENT LABORATORY

<Problem Formulation and Design>:
1. Problem Identification
2. Requirements Analysis and Design

<Implementation>:
1. Development of required packages
2. Implementation of the application using coding standards and the packages developed.

<Testing and Documentation>:
1. Application Testing
2. Documentation of the development process

NOTE: The students can develop Web based Application or Mobile Application of their choice. The Language for development can be chosen based on their application requirement.

REFERENCES:
1. Love, Chris. Progressive Web Application Development by Example: Develop Fast, Reliable, and Engaging User Experiences for the Web. United Kingdom, Packt Publishing, 2018.
2. Robbins, Jennifer. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics. United States, O'Reilly Media, 2018.
3. User Interface Design: Bridging the Gap from User Requirements to Design. United States, CRC Press, 2018.
4. Carlson Ph D, John R, and Carlson, John. Cross-Platform Mobile Application Development: A Beginner's Guide Using the Corona SDK. N.p., Amazon Digital Services LLC - KDP Print US, 2019.
5. Mobile Apps Engineering: Design, Development, Security, and Testing. United Kingdom, CRC Press, 2018.

SEMESTER – V

23IZ501 OPERATING SYSTEMS

INTRODUCTION: Functions - History - Operating System Concepts - System Calls - Services - User Operating System Interface - Design and Implementation - Introduction to Virtual Machines.

PROCESS MANAGEMENT: Process Model - Creation – Termination - Hierarchies - States - Implementation - Scheduling Criteria - Scheduling Algorithms - Multithreading Models - Thread Libraries - Threading Issues - Thread and Multiprocessor Scheduling Algorithms - Interprocess Communication.

PROCESS SYNCHRONIZATION AND DEADLOCKS: Race Conditions - Critical Section - Mutual Exclusion - Peterson’s Solution – **Synchronization:** Hardware - Semaphores - Mutex - Monitor - Message Passing, Dining Philosophers Problem - Readers Writers Problem. **Deadlocks:** Conditions - Detection - Recovery - Prevention - Avoidance.

MEMORY MANAGEMENT:Main Memory: Swapping - Contiguous Memory Allocation - Paging - Structure of Page Table - Segmentation - Examples. **Virtual Memory:** Demand Paging - Copy on Write - Page Replacement - Allocation of Frames - Thrashing - Memory Mapped Files - Allocating Kernel Memory - Memory Management Utilities.

STORAGE MANAGEMENT:Files: Naming - Structure - Types - Access - Attributes - Operations - Implementation. Directories: Operations - Path Names - Hierarchical Directory System - Implementation - Allocation Methods - Free Space Management - NFS - Efficiency and Performance - Recovery. Mass Storage:Disk Structure - Disk Scheduling Algorithms - Swap Space Management - Streams.

TEXT BOOKS:
1. Silberschatz A, Galvin P, Gagne G , "Operating Systems Concepts", John Wiley and Sons, Singapore, 2018.
2. William Stallings , "Operating Systems: Internals and Design Principles", Pearson Education, New Delhi, 2018.

REFERENCES:
1. Andrew S. Tanenbaum , "Modern Operating System", 4th Edition, PHI Learning, New Delhi, 2018.
2. Dhamdhere , "Operating Systems: A Concept Based approach", 3rd Edition, Tata McGraw Hill, New Delhi, 2015.
3. Harvey M Deitel, Paul J Deitel, David R Choffnes , "Operating Systems", 3rd Edition, Pearson Education, New Delhi, 2013.
4. RemziArpaci-Dusseau , Andrea Arpaci-Dusseau, “Operating Systems: Three Easy Pieces”,1st edition,Arpaci-Dusseau Books,2015 , Achyut S Godbole, Atul Kahate, “Operating Systems”, McGraw Hill Education, 2016.

23IZ502 ARTIFICIAL INTELLIGENCE

INTRODUCTION: Artificial Intelligence - The state of art - Intelligent Agents - Rationality - Nature of Environments – Structure of Agents - Examples.

PROBLEM SOLVING AGENTS: Searching for solutions: Uninformed search - BFS, DFS, Uniform cost search, Iterative deepening search - Informed Search - Greedy Best First search, A* search, AO* search - Adversarial search – Games - Optimal decisions in Games, alpha - beta pruning

KNOWLEDGE AND REASONING: Representations and mappings – Approaches to knowledge representation – Property inheritance algorithm - First Order Predicate logic- Instance and ISA relationships – Computable functions and predicates - Unification-Resolution – Question Answering.

ACTING UNDER UNCERTAINTY: Quantifying uncertainty – Efficient representation of conditional distributions – Probability and Bayes Theorem - Bayesian Networks - Exact and approximate inferences - Making simple decisions – Utility theory - Decision networks – Value of information – Decisions with multiple agents
PLANNING: Classical Planning- Algorithms for Planning as state space search - Planning Graphs – Classic planning as Boolean Satisfiability - Analysis of planning approaches –Time, schedules and resources – Hierarchical planning

TEXT BOOKS:
1. Stuart J Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Prentice Hall of India, Pearson Education, New Delhi, 2021.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2019.

REFERENCES:
1. George F Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", 6th Edition, Pearson Education, New Delhi, 2021.
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education, New Delhi, 2017.
3. John Paul Mueller, “Artificial Intelligence For Dummies”, Wiley, 2018
4. LavikaGoel, “Artificial Intelligence: Concepts and Applications”, Wiley,2021
5. Pradeepta Mishra, “Practical Explainable AI Using Python: Artificial Intelligence Model Explanations Using Python-based Libraries, Extensions, and Frameworks”, Apress,2022

23IZ503 COMPILER DESIGN

INTRODUCTION TO COMPILERS: Translators - Compilation and Interpretation - The Phases of Compiler – Errors Encountered in Different Phases - The Grouping of Phases - Compiler Construction Tools - JIT.

LEXICAL ANALYSIS: Need and Role of Lexical Analyzer - Input Buffering - Lexical Errors - Expressing Tokens by Regular Expression - Finite Automata: NFA- DFA - Converting NFA to DFA - Minimization of DFA- Converting Regular Expression to DFA. LEX Tool: Structure of LEX Program – Predefined Variables – Library routines – Design of Lexical Analyzer for a Sample Language.

SYNTAX ANALYSIS: Need and Role of the Parser - Context Free Grammars - Top Down Parsing: Recursive Descent Parser- Predictive Parser. Bottom Up Parsers: Shift Reduce Parser - LR Parser - LR (0) Item - Construction Of SLR Parsing Table - CLR Parser - LALR Parser. Error Handling and Recovery in Syntax Analyzer – YACC Tool: Structure of YACC Program – Communication between LEX and YACC - Design of a Syntax Analyzer for a Sample Language.

INTERMEDIATE CODE GENERATION: Benefits- Intermediate Languages - Generation of Three Address Code - Declarations - Assignment Statements - Arrays - Boolean Expressions - Backpatching - Flow of Control Statements – Procedure calls.

RUN-TIME ENVIRONMENT, CODE OPTIMIZATION AND GENERATION: Source Language Issues - Storage Organization - Storage Allocation - Symbol Tables. Principal Sources of Optimization - Optimization of Basic Blocks - Global Optimization - Global Data Flow Analysis - Issues in Design of A Code Generator - A Simple Code Generator Algorithm.

TEXT BOOKS:
1. Alfred V Aho, Monica Lam, Ravi Sethi , Jeffrey D Ullman , "Compilers - Principles, Techniques and Tools", Essex Pearson, Harlow, 2014.
2. Sudha SadasivamG , "Compiler Design", Scitech Publications (India) Private Limited, Chennai, 2010.

REFERENCES:
1. Dick Grone, Henri E Bal, Ceriel J H Jacobs , Koen G Langendoen , "Modern Compiler Design", John Wiley & Sons,USA,2000.
2. Dhamdhere D M , "Compiler Construction Principles & Practice", Macmillan India Limited, New Delhi, 1997.
3. O.G. Kakde , "Compiler Design", 5th Edition, An Imprint of Laxmi Publications Pvt. Ltd., 2015.
4. V Raghavan, "Principles Of Compiler Design", Tata Mcgraw Hill Publishing Co Ltd, 2016.

23IZ504 COMPUTER NETRKSWO

INTRODUCTION AND MEDIUM: Building a Network - Network Edge and Core - Layering and Protocols - TCP/IP Protocol suite - OSI Reference Model - Network Topologies - Internet Architecture–Physical Layer: Signal Characteristics – Transmission media – Signal Encoding Techniques – Performance Metrics.

LINK LAYER SERVICES: Link Layer Services - Framing - Flow Control - Error Control - Media Access Control - Ethernet - Wireless LAN – Introduction about Bluetooth, Zigbee.

SWITCHING AND ROUTING: Switching: Circuit Switching - Packet Switching - IPV4 - Global Address - Datagram Forwarding - Subnetting - CIDR - ARP- ICMP - Routing Algorithms: Distance Vector Routing and Link State Routing - IPV6 Addressing – IPV6 Protocol.

CONNECTION-ORIENTED AND CONNECTIONLESS SERVICES: Overview of Transport Layer - UDP - TCP – Reliable Byte Stream - Connection Management - Flow Control - Congestion Control - SCTP.

APPLICATION LAYER SERVICES: Needs/Principles of Application Layer Protocols – Role of proxy, Web and HTTP - FTP - Electronic Mail (SMTP - POP3 - IMAP - MIME) - DHCP - DNS - DASH - QUIC.

TEXTBOOKS:

1. Larry L Peterson and Bruce S Davie," Computer Networks: A systems approach", Morgan Kaufmann Publishers, USA, 6th Edition 2021.
2. James F Kurose, Keith W Ross," Computer Networking - A Top-Down Approach Featuring the Internet", Pearson Education, New Delhi, Sixth Edition, 2012.

REFERENCES:

1. Behrouz A.Forouzan ," Data Communications and Networking with TCP/IP Protocol Suite", 6th Edition, McGraw Hill, 2021.
2. Andrew S Tanenbaum and David J Wetherall, "Computer Networks", Prentice Hall of India/ Pearson Education, New Delhi,6th Edition, 2021
3. Prakash C Gupta," Data Communication and Computer Networks", Prentice Hall of India, New Delhi, 2014.
4. Prakash C Gupta," Data Communication and Computer Networks", 2nd Edition, Prentice Hall of India, New Delhi, 2013
5. Ajit Pal, "Data Communication And Computer Networks", 1st Edition, PHI Learning,2013

23IZ510 COMPUTER NETWORKS LABORATORY

LIST OF EXPERIMENTS:

1. Study of Network Components,Basic Network Commands and Network Configuration Commands 2. Chat Program using TCP Sockets using C language
2. Sliding Window Protocol using TCP Sockets using C language
3. DNS using UDP Sockets using C language
4. Study of Wireshark Tool
5. Capturing of packet header at each layer using Wireshark
6. Tracing of TCP and UDP Connection using Wireshark
7. Study of any Simulator Tool
8. Performance comparison of TCP and UDP protocols using Simulation tool
9. Set up a typical network in a lab
10. Set up a typical network in a lab

23IZ511 SYSTEM SOFTWARE LABORATORY

1. Linux commands
2. Shell Programming
3. Programs on system calls
4. Process management: creation, synchronization and inter-process communication
5. Introduction and exploration of xv6
6. Study of lex and yacc tool
7. Scanner implementation
8. Parser implementation
9. Syntax directed translation engine implementation
10. Code generation implementation with generalized assembly code

SEMESTER – VI

23IZ601 MACHINE LEARNING

INTRODUCTION: Designing a learning system - concept learning - Find-s Algorithm - Candidate Elimination – Polynomial Curve Fitting – Bayesian Probabilities – The Gaussian Distribution – Curve Fitting with Probabilistic Perspective – Bayesian Curve Fitting.

LINEAR MODELS: Linear Regression Models - Maximum Likelihood Estimation - Least Squares – Bias Variance Decomposition - Linear Models for Classification - Linear Discriminant Analysis - Probabilistic Generative Models - Probabilistic Discriminative Models

NEURAL NETWORKS AND DECISION TREES: Feed-forward Networks - Network Training - Delta Rule- Gradient Descent Error Backpropagation - Regularization in Neural Networks - Decision Tree Learning- Representation - Inductive Bias- Issues

KERNEL AND GRAPHICAL METHODS: Constructing Kernels - Radial Basis Function Networks - Maximum Margin Classifiers - SVM- Bayes Theorem - Naive Bayes - Bayesian Networks

UNSUPERVISED AND REINFORCEMENT LEARNING: Measures of Similarity and Dissimilarity - Clustering - Partitioning methods - KMeans - Hierarchical Methods - Reinforcement Learning - Reinforcement Learning Tasks - Q-learning

TEXT BOOKS

1. Tom Mitchell , "Machine Learning", McGraw Hill, 2017.
2. Christopher M Bishop , "Pattern Recognition and Machine Learning Learning", Springer, 2011.

REFERENCES

1. EthemAlpaydin , "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2015.
2. Trevor Hastie, Robert Tibshirani, Jerome friedman , "The Elements of Statistical learning", 2nd Edition, Springer,2017
3. Kevin Murphy , "Machine Learning - A Probabilistic Perspective", MIT Press, 2012.
4. Yaser S. Abu-Mostafa , "Learning from Data", AML, 2017.

23IZ602 GRAPH THEORY

INTRODUCTION: Review on Definition and Basic Terminologies of Graphs – Representations of Graphs – Walks in Graphs and Digraphs- Subgraphs-Vertex Degrees - Path and Cycles - Regular and Bipartite Graphs- Representations of graphs – adjacency and incidence lists – adjacency and incidence matrices -Graph Traversals-Applications: Four Cubes Problem- SocialNetworks.

EULERIAN AND HAMILTONIAN GRAPHS: Exploring and Travelling – Eulerian Graphs – Konigsberg bridge problem - Hamiltonian Graphs – Applications: Dominoes – Chinese Postman Problem - Travelling salesman problem

PATHS AND CONNECTIVITY: Connected Graphs and Digraphs-Menger's Theorem for Graphs-Applications: Reliable Telecommunication Networks. Network flows and applications- Flows and cuts in Networks, Maximum-flow problem, flows and connectivity– applications

VERTEX-COLORING: Vertex-coloring - chromatic number of a graph, vertex coloring algorithms – sequential vertex coloring, largest degree first algorithm, applications - scheduling problem, fast register allocation for computer programming.

MATCHING AND FACTORS: Matching, Perfect matching, Tutte's 1-factor theorem, weighted Bipartite matching, Hall's theorem

TEXTBOOKS:

1. Jonathan L. Gross and Jay Yellen, Graph Theory and its Applications, CRC Press, New York, 2016.
2. Douglas B West, Graph Theory, Prentice Hall, New Delhi, 2017.

REFERENCES:

1. Bondy J.A. and Murty U.S.R., Graph Theory, Springer, London, 2016.
2. Narsingh Deo, Graph Theory with Applications to Engineering And Computer Science, Prentice Hall ,New Delhi 2017.
3. Joan M Aldous and Robin J Wilson, "Graphs and Applications- An Introductory Approach,Springer-Verlag", New York, 2014.
4. Reinhard Diestel, "Graph Theory", Springer-Verlag, Berlin Heidelberg, 2012.

23IZ603 EMBEDDED SYSTEMS

INTRODUCTION: Fundamental Components of Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Development Environment

MEMORY AND INTERRUPTS: Types of Memory - Memory Access Procedure - Memory Management techniques - Memory Testing - Common Memory problems - Interrupts - Interrupt Service Routines

COMMUNICATION INTERFACES AND PROTOCOLS: Interfacing Buses - Serial Interfaces - RS232/UART - UART Programming - RS422/RS485 - I2C Interface - SPI Interface - I2C/SPI Programming - USB

REAL TIME OPERATING SYSTEMS: Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol -Priority Ceiling Protocol - Commercial RTOS

HOST and TARGET TESTING: Validation - Host and Target Testing - Debugging tool **- CASE STUDY** - Development of Automatic Vending Machine - Protocol converter - Development of a navigation

TEXT BOOKS:

1. Arnold S Berger, “Embedded Systems Design - An Introduction to Processes, Tools andTechniques”, Elsevier, New Delhi, 2011
2. Prasad K V K K, “Embedded/Real-Time Systems: Concepts, Design and Programming - The Ultimate Reference”, Himal Impressions, New Delhi, 2003

REFERENCES:

1. Raj Kamal, "Embedded Systems - Architecture, Programming and Design", 3rd Edition, Tata McGraw Hill, 2017
2. Rajib Mall, “Real-Time Systems: Theory and Practice”, First Edition, Pearson, 2009
3. Sriram V Iyer and Pankaj Gupta, “Embedded Real-time Systems Programming”, TataMcGraw-Hill Publishing Company Limited, New Delhi, 2006.

23IZ610 MACHINE LEARNING LABORATORY

LIST OF EXPERIMENTS:

1. Data Preparation for Machine Learning
2. Candidate elimination Algorithm
3. Implement Linear regression for data fitting
4. Implement Perceptron for binary Classification
5. Implement Kmeans algorithm
6. Comparing Regression Models(OLS, ridge, lasso) for a real world dataset
7. Comparing Classification Algorithms(decision tree, SVM, Naïve Bayes etc) for a real world dataset
8. Comparing Hierarchical Clustering Methods for a real world dataset
9. Reinforcement Learning

REFERENCES

1. 1EthemAlpaydin , "Introduction to Machine Learning", 4thEdition, PHI Learning, 2020.
2. Willi Richert, Luis Pedro Coelho, Building Machine Learning Systems with Python, Packt Publishing, 2018.
3. AurelienGeron, Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems, O’Reilly, 2019.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 2017
5. Richard O. Duda, Peter E. Hard, David G. Stork, “Pattern Recognition”, 2nd Edition, Wiley, 2020

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23IZ611INNOVATION PRACTICES

This course involves preparing students to think innovatively and present possible solutions to identified industry/academic problem or issue

BENG INNOVATIVE TEXTILES

BENG INNOVATIVE TEXTILES

S.No	Course Code	Course Title	Hours / Week				Maximum Marks		Total
			Lecture	Tutorial	Practical	Credits	CA	FE	
SEMESTER I									
1	23IT101	Calculus and its Applications	3	1	0	4	50	50	100
2	23IT102	Physics	3	0	0	3	50	50	100
3	23IT103	Chemistry	3	0	0	3	50	50	100
4	23IT104	Basics of Textile Engineering	3	0	0	3	50	50	100
5	23IT105	English Language Proficiency	3	1	0	4	50	50	100
6	23IT110	Engineering Practices	0	0	2	1	50	50	100
7	23IT111	Basic Sciences Laboratory	0	0	4	2	50	50	100
8	23IG065	German Language A1	12			4		100	100
SEMESTER 2									
1	23IT201	Matrix Theory and Numerical Methods	3	1	0	4	50	50	100
2	23IT202	Material Science	3	0	0	3	50	50	100
3	23IT203	Polymer and Fibre Chemistry	3	0	0	3	50	50	100
4	23IT204	Theory of Machines	3	2	0	5	50	50	100
5	23IT205	Basics of Electrical and ElectronicsEngineering	3	0	0	3	50	50	100
6	23IT210	Foundations of Problem Solving	0	0	2	0	50	50	100
7	23IT211	Engineering Graphics	0	0	4	2	50	50	100
8	23IT212	Electrical and Electronics Engineering Laboratory	0	0	4	2	50	50	100
9	23IG066	German Language A2	12			4		100	100
SEMESTER 3									
1	23IT301	Probability and Statistical Methods	3	2	0	5	50	50	100
2	23IT302	Engineering Economics	3	1	0	4	50	50	100
3	23IT303	Measurements and Instrumentation	3	0	0	3	50	50	100
4	23IT304	Spun Yarn Technology I	3	0	0	3	50	50	100
5	23IT305	Weaving Technology I	3	0	0	3	50	50	100
6	23IT310	Spun Yarn Technology Laboratory I	0	0	4	2	50	50	100
7	23IT311	Weaving Technology Laboratory	0	0	4	2	50	50	100
8	23IT313	Building Communication Skills	0	0	2	1	50	50	100
9	23IG067	German Language B1	12	0	0	4	-	100	100
SEMESTER 4									
1	23IT401	Fibre physics	4	0	0	4	50	50	100
2	23IT402	Spun Yarn Technology II	3	0	0	3	50	50	100
3	23IT403	Weaving Technology II	3	0	0	3	50	50	100
4	23IT404	Knitting Technology	3	0	0	3	50	50	100
5	23IT405	Technology of Nonwoven Fabrics	3	0	0	3	50	50	100
6	23IT410	Spun Yarn Technology Laboratory II	0	0	4	2	50	50	100
7	23IT411	Weaving and Knitting Technology Laboratory	0	0	4	2	50	50	100
8	23IT412	Python Programming Laboratory	0	0	4	2	50	50	100
9	23IG068	German Language B2	12	0	0	4	-	100	100

SEMESTER I

23IT101 CALCULUS AND ITS APPLICATIONS

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables.

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems.

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits.

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes' theorem.

TEXT BOOKS

1. J. Hass, C. Heil, Maurice D.W "'Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES

1. H. Anton, I. Bivens, S. Davis, "Calculus", John Wiley and Sons, USA, 2016.
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D.G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23IT102 PHYSICS

MECHANICAL PROPERTIES: Review of vector quantities. Newton's third law and Free Body diagrams. Rigid body dynamics: Centre of mass. Moment of inertia. Torque, angular momentum and angular acceleration. Work power and energy. Conservation of momentum. Friction and wear-Static and dynamic friction, limiting friction, Rolling friction. Coefficient of static friction, coefficient of dynamic friction. Lubrication and lubricants. Surface wear due to friction. Role of friction in textiles. Surface treatments for reducing friction. Surface treatments for increasing friction.

PROPERTIES OF LIQUIDS AND FLUIDS: Surface tension: molecular forces-intermolecular range. Excess pressure, capillarity. Viscosity -viscous force-coefficient of viscosity. Equation of continuity. Adhesion, cohesion, wettability**.** Fluid Motion- Newtonian and non-Newtonian fluids - Kinematics of Moving Fluids: Poiseuille's Equation for flow of a Liquid through a capillary tube. Properties of absorbent textiles for industrial applications

GEOMETRICAL OPTICS: Image formation using lenses and mirrors. Spherical and chromatic aberration. Methods of reducing aberrations. Aspherical components, aperture control, multiple elements. Adaptive optics. Definition of depth of field. Optical instruments for imaging and inspection of textiles and fibres. Factors affecting magnification and image quality

PHYSICAL OPTICS: Principle of Interferometry. Interferometric techniques for measurement of small thicknesses. Applications to measurement of fibre thickness and uniformity. Polarised light - appearance of transparent materials in polarised light- fibre colour due to birefringence. Polarised light microscopes for inspection of textiles and fibres. Use of Bertrand lens and conoscopy. Spectral distribution: emission, transmission reflection and absorption spectra. Textile colour, colour changing fabrics.

THERMAL PHYSICS: Review of thermal properties: Specific heat capacity, thermal capacity and coefficient of linear thermal expansion. Methods of measurement of thermal expansion. Differential equation of one-dimensional heat flow. Searle's apparatus and Lee's disc apparatus for determination of thermal conductivity. Thermal Insulation. Convection and radiation. Heat dissipation. Properties of woven and non-woven textiles for thermal functions.

TEXT BOOKS:

1. Richard Wolfson, "Essential university Physics" Vols 1 and 2. Pearson Education, Singapore, 2021.
2. Arthur Beiser, "Applied Physics", Tata McGraw-Hill Publishing Co. Ltd, India, 7th Edition, 2017.

REFERENCES:

1. Gaur R K and Gupta S L, "Engineering Physics", Dhanpat Rai and Sons, India, 2017.
2. Hitendra K Malik, Ajay Kumar Singh, "Engineering Physics", Tata McGraw-Hill Publishing Co. Ltd, India, 2nd Edition, 2017.
3. Paul M. Fishbane . Stephen, Gasiorowicz, Stephen T. Thornton, "Physics for Scientists and Engineers" Extended Version3rd Edition, 2014.
4. Raymond A. Serway, John W. Jewett "Physics for Scientists and Engineers", Cengage Learning., 2017.

23IT103 CHEMISTRY

CHEMICAL BONDING: Types of chemical bonds –ionic, covalent, polar covalent bonds- polar and non-polar molecules. Hydrogen bonding –types and their consequences, Vander Waals forces –origin and significance. Significant organic functional groups in textile fibres- cotton wool, silk, polyester and nylon. Influence of bonding on the properties of textiles- stretchability, dyeability,absorbency, crystallinity and strength- cotton wool, silk and polyester.

SURFACE CHEMISTRY : Adsorption -Freundlich and Langmuir isotherms. Catalysis- homogenous and heterogenous catalysis, kinetics of enzyme catalysis–Michaelis-Menton equation. Surface active agents -types, orientation of surfactants on solid and liquid interfaces, adsorbed mono layers- applications, Critical micelle concentration. Applications of adsorption –detergency, water repellency, wetting -contact angle, foaming, emulsifiers-zeta potential, hydrophile- lipophile balance, deemulsification, defoamers.

WATER CHEMISTRY: Water quality parameters-determination of hardness (EDTA method), alkalinity, TDS, BOD, COD, chloride, sulphate, estimation of iron by colorimetry. Boiler troubles and remedies – internal conditioning. Water treatment methods – zeolite, demineralization, electrodialysis and reverse osmosis. Solution chemistry - Solubility product, common ion effect-influence on ionization of weak electrolytes. Ionisation of water, pH scale and buffer solutions.

DYES: Theory of colour and constitution–chromophore and auxochromes. Optical brightening agents. Nomenclature of dyes - commercial naming, colour index. Classification of dyes based on chemical structure and application.Chemistry of dye Intermediates: nitration,halogenations, sulphonation, Friedel- Crafts reaction, hydrolysis, oxidation, reduction and diazotization. Intermediates from benzene, naphthalene and anthracene. Synthesis of metanil yellow, congored, malachite green, alizarin and indigo.

MISCELLANEOUS MATERIALS : Oils and fats - chemical constitution, general chemical characteristics –drying, rancidification, hydrolysis, hydrogenation, hydrogenolysis. Chemical analysis – acid, saponification, iodine values. Soaps and detergents. **Lubricants** : Mechanism of lubrication, properties of lubricating oil -viscosity, viscosity index, flash and fire points, oiliness, cloud and pour points, aniline point, steam emulsion number, oxidation stability. Additives for lubricants. Greases –types and uses. Solid lubricants. **Adhesives -** types, adhesive action- physical and chemical factors, development of strength, applications in textiles.

TEXT BOOKS:

1. Puri B. R. Sharma L. R. and Pathania M. S., “Principles of Physical Chemistry”, Vishal Publishing & Co., 2010.
2. Jain P. C. and Monica Jain., “Engineering Chemistry”, Dhanpat Rai Publishing Company, 2013.

REFERENCES:

1. Shaw D. J., “Introduction to Colloids and Surface Chemistry “, Butterworth -Heinemann Ltd.,1998.
2. Chatwal G. R., “Synthetic Organic Chemistry”, Himalaya Publishing House, 2001.
3. Shashi Chawla, “A Text book of Engineering Chemistry”, Dhanpat Rai & Co, 2005.

23IT104 BASICS OF TEXTILE ENGINEERING

TEXTILES: Apparels, Home Textiles and Technical textiles. Materials, Structure and properties based on end uses. Fabric type – Woven, Knitted and Nonwovens. Process flow chart

YARN: Classification of yarns – staple spun, continuous filament, textured yarn, fancy, composite, hybrid and plied. Structure and properties based on end uses. Process flow chart. Yarn Numbering systems.

FIBRES: Classification of textile fibers. Extraction, structure, properties and end uses of natural fibers – Cotton, Wool, Silk, Jute, Flax, Hemp Coir, Sisal and Banana.

MANUFACTURED FIBRES: Classification. Raw material, spinning process, process flow chart, structure , properties and end uses of Viscose, Polyester, Nylon, Acrylic, Polypropylene.

FIBRE IDENTIFICATION AND CURRENT TEXTILE TRENDS: Identification of textile fibres – Feeling Test, Burning test, Microscopic test, Staining Test. Chemical test and Density measurement. Research and development of textile machineries and products.

TEXT BOOKS:

1. Mathews Kolanjikombil, “The Substrates - Fibres, Yarn and Fabric”, Woodhead publishing India, 2018.
2. Sreenivasamurthy H. V., “Introduction to Textile Fibres”, The Textile Association India, Mumbai, 1998.

REFERENCES:

1. Bernard P. Corbman, “Textiles : Fibre to Fabric”, McGraw Hill Book Co., Singapore, 1983.
2. Mishra S. P., “A Text Book of Fibre Science and Technology,” New Age International (P) Ltd., New Delhi, 2000.
3. Marjory L. Joseph, “Essentials of Textiles”, CBS College Publishing, New York, 1984.
4. Oxtoby E., “Spun Yarn Technology”, Butterworths, London, 2002.

23IT105 ENGLISH LANGUAGE PROFICIENCY

VOCABULARY: Etymology-prefixes and suffixes–synonyms–antonyms–guessing meanings from context–word formation-single-word substitutes-different forms of a word–phrasal verbs–collocations.

LISTENING AND SPEAKING: Understanding listening – listening techniques - introducing oneself and others –seeking and sharing information– description-conversation skills–extempore speaking– speech practice in varied formal contexts.

GRAMMAR: Wh-questions–Yes/no questions–parts of speech–articles–prepositions–gerunds–conjunctions-degrees of comparison–tenses– modal verbs– adverbs - direct and indirect questions.

READING: Reading strategies: skimming and scanning, predicting–reading comprehension: techniques –practice reading.

WRITING: Discourse markers – dialogue writing - completing sentences – jumbled sentences –paragraph writing –writing compare & contrast paragraphs – Letter writing.

TEXTBOOKS:

1. Shoba K.N.and Lourdes Joavani Rayen,"Communicative English", Cambridge University press,Cambridge,2021.
2. Raymond Murphy,"Intermediate English Grammar", Cambridge University Press, New Delhi,2020.

REFERENCES:

1. Raymond Murphy, "English Grammar in Use", Cambridge University Press, New Delhi, 2020.
2. Sudharshana N P and Savitha C, "English for Engineers", Cambridge University Press, New York, 2018.
3. Anne Laws, "Writing Skills", Orient Black Swan, Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, "Essential English Grammar", Cambridge University Press, New Delhi, 2019.

23IT110 ENGINEERING PRACTICES

1. Welding - metal arc welding tools and Equipment, exercises by arc welding and tig welding processes.
2. Fitting - tools, operations, exercises make "T"-joint and "L" joint, types of joints.
3. Carpentry- tools, carpentry process, carpentry exercises, types of joints.
4. Plumbing-exercises-external thread cutting and joining.
5. Sheet metal work& soldering - tools, operations, exercises make a rectangular tray in galvanized iron sheet.

REFERENCE:

1. Laboratory manual prepared by department of mechanical engineering, 2023

231T111 BASIC SCIENCE LABORATORY

Physics (Any eight experiments)

Determination of Young's Modulus of a wooden bar – Cantilever method

Determination of coefficient of viscosity of water – Poiseuille's method

Determination of surface tension of water – Capillary rise method

Determination of Surface tension – Drop weight method

Determination of thermal conductivity of bad conductor using Lee's Disc method

Determination of Specific Heat of solids – Calorimeter

Determination of fibre thickness – air wedge method

Determination of wavelength of mercury spectrum using transmission grating

Determine the charge of an electron by Millikan's oil drop method.

Determine the wavelength of the laser source by Michelson Interferometer.

Demonstration:

Determine the excitation potential of Argon using the Franck Hertz method.

Determine the number of turns & radius of the coil and magnetic field of 'Helmholtz' coil using Biot-Savart's Law – apparatus

Find the Hall voltage, Hall coefficient, mobility & charge density of the given 'Ge' crystal using Hall apparatus.

Determine e/m (charge to mass ratio) of the electron by Thomson's method.

Determine the Planck's constant using Photo Electric method.

Determine the thickness of the film by Mach Zehnder Interferometer.

Find the finesse and free spectral region of the Etalon.

Analyze the mercury spectrum and find wavelength using polynomial equation.

Determine the refractive index of given specimen using Brewster's angle apparatus.

REFERENCES:

1. Department of Physics," Physics laboratory observation", 2023.
2. Jerry D Wilson; Cecilia A Hernandez Hall, "Physics laboratory experiments", Boston, MA : Cengage Learning, 2016.

CHEMISTRY (Any eight experiments)

1. Estimation of hardness of water by EDTA method.
2. Determination of pH, alkalinity and COD of water sample.
3. Study of viscosity of lubricating oil using Redwood viscometer.
4. Determination of Flash and Fire points & Cloud and Pour points of a lubricating oil.
5. Determination of acid value, saponification value and iodine value of a vegetable oil.
6. Determination of CMC of a surfactant by conductometry.
7. Estimation of strength of commercial acid and purity of washing soda.
8. Estimation of strength of hydrogen peroxide solution.
9. Estimation of available chlorine in the hypochlorite solution.
10. Removal of dye from textile effluent using adsorbents.

REFERENCE:

1. Laboratory manual prepared by department, 2023

SEMESTER II

23IT201 MATRIX THEORY AND NUMERICAL METHODS

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors of a real matrix – characteristic equation, properties - diagonalization - quadratic forms, reduction to canonical form by orthogonal reduction- Errors and approximations in numerical methods, power method for dominant eigenvalue.

LINEAR ALGEBRIAC SYSTEM OF EQUATIONS AND NONLINEAR EQUATIONS: System of linear equations – Gauss elimination method, Crouts method, Gauss Seidal iterative method, Roots of equations - false-position method, Newton - Raphson method, Graeffe's root squaring method.

INTERPOLATION, DIFFERENTIATION AND INTEGRATION: Newton's forward and backward interpolating polynomials, Lagrange and Newton's divided difference interpolating polynomials. Numerical differentiation, numerical integration - Newton-Cotes formulae, Trapezoidal rule, Simpson's 1/3 rule.

ORDINARY DIFFERENTIAL EQUATIONS: Taylor-series method, Euler method, 4^{th} order Runge-Kutta method, multi-step method – Milne's method.

PARTIAL DIFFERENTIAL EQUATIONS: Finite difference: elliptic equations – Laplace equation, Poisson equation – Liebmann method, parabolic equations – heat conduction equation – Crank Nicolson's method, hyperbolic equations – vibrating string

TEXT BOOKS:

1. David C Lay, Judi J. McDonald, Steven R. Lay "Linear Algebra and its Applications", Pearson Education, New Delhi, 2021.
2. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2021.

REFERENCES:

1. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, New Delhi, 2017.
2. Rizwan B, "Introduction to Numerical Analysis Using MATLAB", Infinity Science Press, Hingham, 2010.
3. Richard L B and Douglas J F, "Numerical Analysis", Thomas Learning, NewYork, 2017.
4. Howard Anton, Chris Rorres, Anton Haul "Elementary Linear Algebra", Wiley India, New Delhi, 2019.

23IT202 MATERIAL SCIENCE

CRYSTAL STRUCTURE: Solids :- Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Types of Bonds. Ionic Bond. Covalent Bond. Van der Waals Bond. Diffraction of X-rays by Crystals. Bragg's Law. Powder diffraction patterns Determination of crystallinity in textile fibres- Principle of rotating crystal method.

MECHANICAL PROPERTIES AND VISOELASTIC BEHAVIOUR OF MATERIALS: Concepts of **s**tress and strain, Hooke's law, three moduli of elasticity and relation among them, Poison's ratio, factors affecting elastic modulus and tensile strength, Moment, Couple, Torque – twisting Couple on a wire, expression for Torque per unit twist – Torsional test and Deformation, bending of beams, bending moment, theory of thin cantilever,determination of young's modulus by cantilever method, twisting of a cylinder ,determination of rigidity modulus by torsional pendulum. Elastic and plastic deformation.

PHYSICAL PROPERTIES OF TEXTILE MATERIALS: Structure-function relationships- role of atomic arrangements and bonding in fibre properties-Anisotropy of physical properties - mechanical strength, BOPP. coefficient of friction. Electrical properties and static electricity- textiles for anti-static applications. Hierarchical structures- dry adhesives. self-adhesive non-woven textiles. Atomic structure of oil/water absorbent or repellent fibres. Surface energy and fibre diameter. Factors affecting mechanical strength of fibres.

TEXTILES FOR INDUSTRIAL APPLICATIONS: Sabine's formula for reverberation time. Reverberation time and auditory comfort. Absorption coefficient, Open Window Units. measurement of absorption coefficients- Impedance tube method, Anechoic chamber method. Materials for modifying surface absorption. Effect of porosity and sound energy dissipation. Metallised textiles-Faraday cages. Retroreflective fabrics for safety applications

SMART TEXTILE AND ADVANCED MATERIALS: Definition - function of matrix and reinforcement in composites -classification of composites based on reinforcement-Glass fibre, aramid fiber carbon fibre. Preparation and properties - Law of mixtures. Applications Dielectric and semiconducting properties of fibres. smart textiles. Bio- mimetic materials. Metamaterials. Nanomaterials.

TEXT BOOKS:

1. William D Callister Jr, "Materials Science and Engineering - An Introduction", John Wiley and Sons Inc , New York, 2018..
2. Raghavan V, "Materials Science and Engineering", Prentice Hall of India, New Delhi, 2015.

REFERENCES:

1. Morton W E Hearle, J W S, "Physical Properties of Textile Fibres," CRC Press, Taylor & Francis, USA, 2008
2. D.S.Kumar, "Mechanical Measurements and Control" S.Chand &Co, New Delhi 2015..
3. Holman J P, "Experimental Methods of Engineering", McGraw Hill, New Delhi, 2016.
4. Gaur R K and Gupta S L "Engineering Physics", Dhanpat Rai and sons, New Delhi, 2016.

23IT203 POLYMER AND FIBRE CHEMISTRY

INTRODUCTION TO POLYMERS: Classification, polymerization reactions- chain, step and ring opening mechanism, degree of polymerization, molecular weight of polymers – polydispersity, number average and weight average molecular weights. Determination of molecular weight by gel permeation chromatography. Polymerisation methods: Addition polymerisation -bulk, solution, suspension and emulsion techniques. Condensation polymerisation - melt, solution and interfacial techniques.

PROPERTIES OF POLYMER: Amorphous and crystalline states–degree of crystallinity –factors affecting crystallizability. Influence of chemical structure on properties – electrical, solubility, mechanical, thermal - Glass transition temperature – factors affecting Tg, determination of Tg by DSC and thermal stability by TGA, Requisite for polymers to form fibres, elastomers and plastics. Polymer reactions - Hydrolysis – acidolysis – aminolysis –hydrogenation – cyclization – crosslinking –grafting. Degradations – chemical, thermal, mechanical and photo degradations.

METHODS TO MODIFY POLYMER PROPERTIES- polymer processing additives - plasticizers, thermal stabilizers, foaming agents, antistatic agents. Protective addives - antioxidants, UV stabilizer. Functional additives- flame retardant, antimicrobial. Polymer blends and alloys.
COMPOSITES- classification, constituents, role of interphase, Fibre reinforced composites- carbon, glass and aramid fibres. Properties and applications.

FIBRES: **NATURAL FIBRES-**Chemical composition, structure and properties of cotton, silk and wool. **REGENERATED FIBRE**: viscose rayon-manufacture. **SYNTHETIC FIBRES**-Manufacture, structure, properties of PET, nylon 6,6, polypropylene, polyethylene, segmented polyurethane.

SURFACE MODIFICATION TECHNIQUES FOR TEXTILE MATERIALS: Surface grafting of textiles- methods, application. Metallisation - Electroless plating of copper on polyester, Chemical vapour deposition, Nano finishing - nanoparticles, synthesis of silver nanoparticle, Sol- gel technique-imparting oil repellency. Surface modification of textiles for composite- modification of aramid fibre for composites.

TEXT BOOKS:

1. Gowarikar V. R., Viswanathan N. V. and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd, 2011.
2. Mishra S.P., "A Textbook of Fibre Science and Technology", New Age International (P) Ltd, 2005.

REFERENCES:

1. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India Pvt. Ltd, 2003.
2. J. M. G. Cowie and Valeria Arrighi, " Polymers: Chemistry and Physics of modern Materials", CRC Press, 2007.
3. Q. Wei, "Surface modification of textiles", Woodhead Publishing Ltd, 2009.

23IT204 THEORY OF MACHINES

STATICS OF RIGID BODIES AND FRICTION: Forces – systems of forces - concurrent and non-concurrent forces in plane - resultant - problems involving the equilibrium. Friction - Pivot and collar friction – Uniform pressure, wear assumptions, torque power loss. Theory of lubrication – Types of bearings and selection of bearings.

BASICS OF MECHANISMS AND ITS KINEMATICS: Definitions and basic concepts of link, pair, chain, mechanism, Machine and structure – degrees of freedom, inversions, applications of mechanisms, Velocity and acceleration analysis for four-bar and slider-crank mechanisms, KLEIN"S constructions for single slider-crank mechanism.

FORCE ANALYSIS: Static force analysis - Determination of torque in four bar and single slider crank mechanisms using graphical approach, Introduction to Inertia force analysis and D Alembert's principle.

FLYWHEEL: Torque Vs crank angle diagram – excess energy to be stored in a flywheel, fluctuation of speed within a cycle. Co-efficient of fluctuations of speed, flywheel weight required for a loom.

BALANCING : Principle of balancing – balancing of rotating masses in the same plane and several planes, dynamic balancing of carding cylinder, spindles, tin roller and split pulleys. Basics of vibration – measurements, reduction techniques.

TEXT BOOKS:

1. Shrigley J. E. and Vicker J. J., "Theory of Machines and Mechanisms", Mc Graw Hill, New Delhi, 2005.
2. Ratan S. S., "Theory of Machines", Tata Mc Graw Hill Pulisher, New Delhi, 2005.

REFERENCES:

1. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics - Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2011.
2. Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics & Dynamics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2011.
3. Ballaney P. L., "Theory of Machines", Khanna Publishers, New Delhi, 2002.
4. Thomas bevan, "Theory of machines", CBS Publishers, New Delhi, 2000.

23IT205 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRIC CIRCUITS: Ohm's law, Kirchhoff's Laws, solving simple DC Circuits-single phase AC circuit fundamentals-Power, Power factor-solving simple AC circuits- Introduction to three-phase AC circuits.

ELECTRICAL MACHINES: DC MOTORS: Principle of Operation-types-torque equation - speed-torque characteristics-speed control of DC motors-Electric Braking AC MACHINES: Single phase Transformers - Construction and working principle, 3 phase Induction Motor-construction–Principle of operation- types-torque equation-speed -torque characteristics-1 phase Induction Motor-Principle of operation-types Industrial Applications.

ELECTRONIC DEVICES : Operation of PN junction diodes, VI characteristics, zener diode, BJT, types-CB, CE, CC configurations, input and output characteristics, JFET - working principle and characteristics - Comparison of BJT and FET. MOSFET-types, principle of operation and characteristics, Opto Electronic Devices - Introduction, types, photo conductive cells, photo diode, phototransistor, Light emitting diode-Principles and Applications.

ELECTRONIC CIRCUITS : (Qualitative analysis only) Half wave and full wave rectifier, capacitive filters, zener voltage regulator, RC- coupled amplifier, frequency response. LINEAR INTEGRATED CIRCUITS: Operational amplifier, Ideal op-amp characteristics, Inverting and Non-inverting amplifier, Op-amp applications : Adder, Subtractor, integrator, differentiator.

DIGITAL ELECTRONICS : Number systems-representation of signed numbers: 1's complement and 2's complement, logic gates, Half, full adder/subtractor, Flip flops, RS,JK,JK Master slave, D and T type, counters and shift registers.

TEXT BOOKS:

1. Mehta V K and Rohit Mehta, "Principles of Electrical Engineering and Electronics", S Chand and Co. New Delhi, 3rd edition, 2014.
2. Muthusubramanian R, and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, 2012.

REFERENCES:

1. Bhattacharya S K, "Basic Electrical and Electronics Engineering", Pearson, 2012.
2. Rajput R K, "Basic Electrical and Electronics Engineering", University Science Press, 2nd Edition, 2012.
3. Gupta B R and Singhal Vandana, "Electrical and Electronics Engineering", S. Chand and Co., 2010.
4. Theraja B L, "Fundamentals of Electrical and Electronics Engineering", S. Chand and Co., 2006.

23IT210 FOUNDATIONS OF PROBLEM SOLVING

PROBLEM SOLVING:

1. Speed Mathematics (SAW, Oz, Mirror methods)
2. Speed Mathematics (High5, Minion, Butterfly methods)
3. Speed Mathematics (Inception, Goldeneye methods)
4. Thinking with Numbers
5. Problem Solving with Visual information
6. Words Puzzles
7. Resume Writing Essentials

REFERENCE:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.

23IT211 ENGINEERING GRAPHICS

INTRODUCTION:
1. Lettering practice
2. Dimensioning practice (as per BIS)
3. Geometric constructions

THEORY OF PROJECTION:
1. Projection of points and lines
2. Projection of planes
3. Projection of solids

DEVELOPMENT OF SURFACES
1. Development of lateral surfaces of regular solids
2. Projection of truncated solids and simple engineering sheet metal components

ORTHOGRAPHIC PROJECTIONS
1. Orthographic projection of simple engineering components – missing view exercises
2. Orthographic projections of textile machinery parts
3. 3D - Modeling of simple engineering components using CAD software

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International Publishers, New Delhi, Fifteenth Multi color edition 2018.
2. P.I Varghese., "Engineering Graphics", McGraw Hill Education India Pvt. Ltd., New Delhi, 2013

REFERENCES:

1. K C John, "Engineering Graphics for Degree", PHI Publishers India Pvt. Ltd. 2009
2. Natarajan K. V., "Engineering Drawing and Graphics", M/s Dhanalakshmi N, Chennai, 2007.
3. Bureau of Indian Standards, "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, New Delhi, 2004.

23IT212 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

1. Verification of Ohm's law and Kirchoff's laws.
2. Mechanical Characteristics of DC Shunt and Compound Motor
3. Load test on Three phase Induction Motor
4. Study of Half wave and Full wave rectifiers with and without filters
5. Applications of Operational Amplifier: Adder, Subtractor, Integrator and Differentiator
6. Study of logic gates and implementation of binary adder / subtractor
7. Characteristics of temperature sensors (thermocouple/ thermistor)
8. Study of optoelectronic devices (LDR, photodiode, phototransistor)
9. Study of PLC and Basic programming methods
10. Measurement of linear displacement using LVDT and measurement of strain using strain gauge

REFERENCE:

1. Laboratory Manual Prepared by the Department of Electrical and Electronics Engineering, 2023.

SEMESTER III

23IT301 PROBABILITY AND STATISTICAL METHODS

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axiomatic approach to probability, Baye's theorem, discrete random variables, probability mass functions, cumulative distribution functions, mean and variance, discrete uniform, binomial, Poisson and geometric distributions.
CONTINUOUS RANDOM VARIABLES: Continuous random variables, probability density functions, cumulative distribution functions, mean and variance, uniform, exponential, Weibull and normal distributions.

JOINT PROBABILITY DISTRIBUTIONS: Two dimensional discrete and continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation and linear regression.

STATISTICAL INFERENCE: Point estimation – maximum likelihood estimation - interval estimation – hypotheses concerning means – large, small samples and matched pairs - hypotheses concerning variances – hypotheses concerning proportions, chi square test for goodness of fit and independence of attributes, test for randomness and rank-sum test – Wilcoxon test.

ANALYSIS OF VARIANCE AND STATISTICAL QUALITY CONTROL: Analysis of variance - completely randomized designs, randomized block designs, Latin Square design - process capability - control charts for measurements – $\bar{X}$, R charts - control charts for attributes - p, np, c charts.

TEXT BOOKS

1. Douglas C. Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers”, Wiley India, New Delhi, 2018.
2. Richard A. Johnson, “Miller & Freund's Probability and Statistics for Engineers”, Pearson education, New Delhi, 2017.

REFERENCES

1. Ronald E. W, Raymond H. M, Sharon L. M and Keying Ye, “Probability & Statistics for Engineers & Scientists, Pearson Education, New Delhi, 2016.
2. Robert V. H, Elliot T and Dale Z, “Probability and Statistical Inference”, Pearson Education, New Delhi, 2021.
3. Jay L. Devore, “Probability and Statistics for Engineering and the Sciences”, Cengage Learning**,** New Delhi 2020.
4. Sheldon M Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic press, USA, 2020.

23IT302 ENGINEERING ECONOMICS

Fundamentals of Economic Analysis: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency.

Cost and Inventory Control: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages- Depreciation Methods – Problems in Straight Line and Diminishing Balance Method.

Pricing, Revenue and Value Engineering: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering.

Project Management: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis.

Economic Growth and Development: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy.

TEXT BOOKS:

3. Panneerselvam. R., “Engineering Economics”, PHI Learning Private Limited, 2012.
4. Metha P.L, “Managerial Economics – Analysis, Problems and Cases”, Sultan Chand & Sons, 2016.

REFERENCES:

5. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, “Principles of Engineering Economics with Applications, Cambridge University Press, 2018.
6. Varshney, R.L and K.L. Maheshwari, “Managerial Economics”, Sultan Chand & Sons, 2014.
7. McEachern and Indira., “Macro ECON”, Cengage India Private Limited, 2017.
8. Shalini Goyal Bhalla, “Circular Economy (Re) Emerging Movement”, Invincible Publishers, 2020.

23IT303 MEASUREMENTS AND INSTRUMENTATION

INSTRUMENTATION PRINCIPLES: Generalized configuration and functional elements of measuring system - Null and deflection methods-Static characteristics: error, accuracy, precision, resolution, Hysteresis, modeling and error reduction.

TRANSDUCERS AND MEASUREMENT OF NON ELECTRICAL VARIABLES: Transducer-Classifications, Principle of operation of Resistance potentiometer, strain gauge, Linear Variable Differential transformer - Inductive Transducer - Capacitance and Piezo-electric transducers, Measurement of thickness, temperature measurement using resistance thermometers, thermocouples and thermistors.

ELECTRONIC AND TEXTILE INSTRUMENTS: Digital voltmeter-Digital multimeter- Digital storage oscilloscope. X-Y recorder, digital data acquisition systems - Magnetic tape recorders, High volume fibre tester- Evenness tester - Single yarn strength tester, hairiness meter.

CONTROL SYSTEM COMPONENTS: Basics of control system – Control system examples - Principle of operation of Stepper motors - Hydraulic valves - Pneumatic switches, proximity switches and flapper valves - Hydraulic and Pneumatic automation in textile machines

PROGRAMMABLE LOGIC CONTROLLERS (PLC): Block diagram – programming methods – programs – applications - material handling system. Data acquisition system for spinning preparatory, ring spinning - rotor spinning.

TEXT BOOKS:

1. Sawhney A K, "A course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons, New Delhi, 2015.
2. Doebelin E O, “Measurement System : Application and Design", Mc.Graw Hill Pub., New York, 2017.

REFERENCES:

1. Rangan C S, Sharma G R, Mani V S, „Instrumentation Devices and Systems", Tata McGraw Hill, New Delhi, 2001.
2. U A Bakshi S C Goyal,” Principle of control systems”, Technical Publication, Pune, seventh edition, 2008.
3. Frank D Petruzella,” Programmable Logic Controllers”, fourth edition Published by McGraw-Hill, New York, 2011.
4. Berkstresser G A Grady P and Buchanan D R, “Automation in the Textile Industry from Fibres to Apparel”, the Textile Institute, Manchester, 1995.

23IT304 SPUN YARN TECHNOLOGY I

GINNING AND BLOWROOM: Classification of spinning –short and long staple. Objectives, Machines, ginning defects. Fibre characteristics for yarn production. Blowroom - Objectives, Principles of opening, cleaning, mixing and blending of fibres. Influence of process parameters on opening and cleaning. Blow room machinery and operating elements. Automatic Waste Evacuation systems (AWES), auxillary blow room machines. Effectiveness of opening and cleaning systems. Automation and recent development. Calculations.

CARDING: Principles of carding. revolving flat card, roller and clearer card, card clothing. Machine elements and operations in card. Sliver formation, carding theory. Automation and recent developments. Calculations.

DRAWFRAME: Objectives, principles and methods of roller drafting. Machine elements and operations. Autolevellers. Automation and recent developments. Calculations.

COMBER : Preparation for combing, lap formers. Comber - Objectives, Machine elements and operations, Factors influencing noil extraction. Automation and recent developments. Calculations.

SPEEDFRAME:. Objectives, Machine elements and operations, principle and mechanism of builder motion in speed frame. Automation and recent developments. Calculations.

TEXT BOOKS:

1. Werner Klein, "The Rieter Manual of Spinning, Volume.2 – Blowroom & Carding", Rieter Machine Works Limited, Switzerland, 2008
2. Werner Klein, "The Rieter Manual of Spinning, Volume.3 – Spinning Preparation", Rieter Machine Works Limited, Switzerland, 2008.

REFERENCES:

1. Werner Klein , "The Rieter Manual of Spinning, Volume.1 – Technology of Short staple Spinning", Rieter Machine Works Limited, Switzerland, 2008.
2. Lawrence C.A, "Fundamental of spun yarn technology", CRC Press, New York, 2002.
3. Oxtoby E, "Spun Yarn Technology", Butterworths, London, 2002.
4. Peter R Lord, "Hand book of Yarn Production Technology Science and economics", Wood head publishing Ltd, New York, 2003.

23IT305 WEAVING TECHNOLOGY I

WINDING: Winding - objectives, random and precision winders, elements and functions - unwinding accelerator, tension device, yarn clearer, splicer, waxing, anti-patterning, drum type, link coner, automation. Package types, faults - causes and remedies, Calculations. Winding synthetic and blended yarns, winding for coloration. Pirn winding – objectives, elements and functions.

WARPING, SIZING AND DRAWING-IN: Warping - objectives, direct and section warping, elements and functions – creel, stop motion, tension device, warper reed, automation. Section warping – section building and traverse, leasing. Sizing - objectives, size recipe, elements and functions – creel, sow box, drying zone, yarn splitting, automation. Single end sizing, Calculations. Sizing of filament yarns, energy conservation in sizing. Beam gaiting, tyeing-in.

PROCESS CONTROL IN WARPING AND SIZING: Controls – temperature, level, moisture, stretch. Size pick up and end breaks. process control in warping and sizing – control of end breaks, hard waste and beam defects, combined dyeing and sizing, dead loss in sizing.

PRIMARY MOTIONS IN SHUTTLE WEAVING: Loom types, timing diagram. Shedding – tappet, dobby and jacquard. Shed geometry, shed types, reversing motions. Picking – overpick and underpick, shuttle flight and timing, shuttle checking. Beat-up – sley kinematics and eccentricity.

SECONDARY AND AUXILLARY MOTIONS: Take up, let off, warp stop, weft stop, warp protector, weft feelers and pirn change motions, drop box motion. Production and efficiency calculations.

TEXT BOOKS:

1. P.K.Banerjee, "Principles of Fabric Formation", CRC Press, New Delhi, 2014.
2. Talukdar M.K., Sriramulu P.K. and Ajgaonkar D.B., "Weaving: Machines, Mechanisms, Management", Mahajan Publishers, Ahmedabad, 1998.

REFERENCES:

1. Lord P.R. and Mohamed M.H., "Weaving: Conversion of Yarn to Fabric", Merrow, New Delhi, 1992,.
2. Marks R. and Robinson T.C., "Principles of Weaving", The Textile Institute, Manchester, 1989.
3. Booth J.E., "Textile Mathematics Volume 3", The Textile Institute, Manchester, 1977.
4. Mukesh Kumar Singh, " Industrial Practices in Weaving Preparatory", WPI Publishers, UK, 2014.

23IT310 SPUN YARN TECHNOLOGY LABORATORY I

1. Determination of beater speed and intensity of beating of bladed beater and fibre rupture of any one cleaning machine and study their influence on the quality of yarn.
2. Determination of the cleaning efficiency and openness of tufts and study their influence on the quality of yarn.
3. Determination of speed of the various rotating elements and understanding its working mechanism & functions of blending machines.
4. Running of carding machine and Determination of speed of the various rotating elements and understanding its functions.
5. Analysis of various setting points in carding machine and its effect on sliver quality.
6. Measurement of PPSI of different clothing profiles and study on the types of card wire clothing.
7. Determination of transfer coefficient and cleaning efficiency of a card and its influence on the production and quality.
8. Running of draw frame machine and study on drafting waves and determination of total draft and its distribution in draw frame drafting system.
9. Determination of CV% of input and output sliver with respect to law of doubling and drafting.
10. Carry out the analysis of roller setting, measurement of top roller pressure and roller eccentricity in draw frame.

REFERENCE:

1. Spinning Laboratory Manual prepared by Department of Textile Technology, 2023.

23IT311 WEAVING TECHNOLOGY LABORATORY

1. Determination of Winding parameters in Random / Precision Winding Machine.
2. Determination of Shed Depth in Tappet Shedding Motion.
3. Creation of Dobby design and fabric production in Dobby loom.
4. Creation of Jacquard design and preparation of Punched Card.
5. Determination of Picking angle, Picking Velocity, Picking force and Power in Underpick loom.
6. Determination of Sley Eccentricity in shuttle loom.
7. Dismantling and assembly of Take-up Motion and calculation of loom dividend.
8. Determination of Rate of Let-off at various Beam Diameters in positive and negative let-off systems.
9. Study of Weft feelers, Weft and Warp Stop Motions.
10. Preparation of Pattern Card in Drop box loom.
11. Preparation of Special fabrics in handloom.
12. Understanding of Loom requirements from the given Fabric Sample.

REFERENCE:

1. Weaving Laboratory Manual prepared by Department of Textile Technology. 2023

23IT313 BUILDING COMMUNICATION SKILLS

BUILDING COMMUNICATION SKILLS:

1. Introduction to Workplace Communication
2. Profile Building for Internships
3. English in the Workplace (Grammar & Vocabulary)
4. Professional Communication (Speaking & Writing)
5. Workplace Communication Tools
6. Career Exploration
7. Resume Update

REFERENCES:

1. P.C.Wren and H.Martin, "High school English grammar & composition ", S Chand Publishing, New Delhi, 2017.
2. Norman Lewis, "Word Power Made Easy", Goyal Publisher, New Delhi, 2011.

SEMESTER IV

23IT401 FIBRE PHYSICS

FIBRE STRUCTURE: Requirements of fibre forming polymers, Analysis of fibre structure models – fringed micelle, fringed fibrillar and lamellar. Characterization of fibres structure. Crystallinity and orientation. Morphological and chemical structure -Cotton, wool, silk, viscose rayon, acetate rayon, polyamides, polyester, acrylic fibres. Elucidation of fibre structure.

MOISTURE PROPERTIES: Humidity, moisture regain and content. Relation between regain and relative humidity for various textile fibres. Equilibrium absorption of moisture- Hygroscopic nature and moisture absorption behavior of textile fibres. Effect of temperature, hydrophilic groups, crystalline and noncrystalline regions on moisture regain. Conditioning of Fibres.

THERMAL PROPERTIES AND THERMO-MECHANICAL RESPONSES: Theories of thermoplastic and non- thermoplastic fibres, First order transition, second-order transition, Specific heat - thermal conductivity. Analysis of DSC and TGA. Heat-setting of fibres.

OPTICAL AND ELECTRICAL PROPERTIES: Refractive index and birefringence - absorption, dichroism, reflection and lustre of fibres. Electrical Properties: Factors influencing electrical properties of fibres, Static Electricity Problems and elimination in textile processes.
MECHANICAL PROPERTIES: Tensile strength, Load-Elongation and Stress-Strain Curves. Modulus, Elongation, Elastic Recovery, Work of Rupture, Work Factor. Effect of parameters on mechanical properties, Mechanical conditioning, Torsional and flexural rigidity of fibres. Creep and stress relaxation. Frictional Properties: General theory and its applications to fibres, Directional Frictional Effect of wool.

TEXT BOOKS:
1. Morton W E, and Hearle J W S , "Physical Properties of Textile Fibres", 4th Edition, Wood head Publishing Limited, UK, 2008.
2. Eichhorn S J, Hearle J W S, Jaffe M and Kikutani T, Handbook of textile fibre structure, Wood head Publishing, UK, 2009.

REFERENCES:
1. Marcel Dekar.H B. , "Handbook of Fibre Science & Technology", Textile Institute, Manchester, UK, 1998.
2. Mukhopadhyay , "Advances in Fibre Science", Textile Institute, Manchester, UK, 2000.
3. Gupta V.B and Kothari, V.K, "Manufactured Fibre Technology", Springer science, Netherlands, 1997.
4.. Hearle J W S, High-Performance Fibres, Wood head Publishing, UK, 2001.

23IT402 SPUN YARN TECHNOLOGY II

RING SPINNING I: Objectives, principle of yarn formation, machine elements and operations in ring spinning. Design aspects of various elements in ring frame. Builder motion.
RING SPINNINGII: Condensed spinning- Principle, methods of yarn production and comparison of yarn properties with ring spun yarn. Spinning Geometry. Calculations. Automation and developments
OPEN-END SPINNING : Principle - Rotor Spinning –mechanism of yarn formation, raw material selection, design features of important elements and yarn quality. Automation and developments. Calculations. Friction spinning – mechanism of yarn formation, raw material selection and process parameters. Developments.

OTHER SPINNING SYSTEMS : Air-jet and vortex spinning: Principle of yarn production, raw material selection, process parameters and yarn properties. Principles of Self twist, Wrap, Core and Twist less spinning. Comparison of yarn structure and yarn properties of different spinning systems.

YARN PLYING : Objectives and principles of plying of yarns; methods for plying - ring doubling, two for-one and three for one twisting. Selection of twist level for plying. Calculations. Fancy Yarns- Types and production methods. Applications.

TEXT BOOKS:
1. Herbert Stalder, The Rieter Manual of Spinning, Vol.4 – Ring spinning, Rieter Machine Works Limited, Switzerland ,2014.
2. Heinz Ernst, The Rieter Manual of Spinning, Vol.5 – Rotor spinning, Rieter Machine Works Limited, Switzerland,2014.

REFERENCES:
1. Herbert Stalder, The Rieter Manual of Spinning, Vol.6 – Alternative spinning systems, Rieter Machine Works Limited, Switzerland, 2014.
2. Mahendra Gowda, R V New Spinning systems, NCUTE, New Delhi, 2004.
3. Oxtoby E, “Spun Yarn Technology”, Butterworth Publications, London, 1987.
4. Lawrence, C A, Advances in yarn spinning technology, The Textile Institute, Woodhead Publishing Limited,UK, 2010

23IT403 WEAVING TECHNOLOGY II

FEATURES OF SHUTTLELESS LOOMS : Shedding, Beat-Up, Take-Up, Let-Off, Selvedge motion, yarn feeders and accumulators, Batching Motion. Production and efficiency Calculations.
PROJECTILE WEAVING: Projectile loom - Weft insertion sequence. Torsion bar picking mechanism, Projectile Circulation, Projectile Types and Dimensions, Projectile Guides, Projectile Brake.

RAPIER WEAVING : Technological Developments, Classification, principles of Rapier – Rigid / Flexible, Single / Double. Tip / Loop transfer principles, weft insertion sequence, rapier drives.

JET WEAVING : Principles of Airjet weft insertion. Air and yarn quality requirements. Water jet Looms: Technological Developments, Principles, characteristic features of water-jet looms. Comparison of various weft insertion Systems.
MULTIPHASE WEAVING: Circular and flat multiphase looms. Shed formation, filling insertion, beatup. 3D Weaving - multi-layer weaving, loom requirements. Narrow weaving, Braiding – types, classification of braids, braid geometry, applications.

TEXT BOOKS:
1. Talukdar M.K., Sriramulu P.K. and Ajgaonkar D.B., "Weaving: Machines, Mechanisms, Management", Mahajan Publishers, Ahmedabad, 1998.
2. Sabit Adanur, "Handbook of Weaving", Technomic Publishing Co. Inc., New Delhi, 2001.

REFERENCES:
1. Vangheluwe L., "Air- Jet Weft Insertion", Textile progress, Vol. 29, No. 4, Textile Institute Publication, UK, 1999.
2. Valeriy V. Choogin, Palitha Bandara and Elena V. Chepelyuk, "Mechanisms of Flat Weaving Technology", Wood Head Publishing,UK, 2013.
3. Prabir Kumar Banerjee, "Principles of Fabric Formation" CRC Press, New Delhi, 2014.
4. Marks R. and Robinson T.C., "Principles of Weaving", The Textile Institute, Manchester, 1989.

23IT404 KNITTING TECHNOLOGY

BASICS OF WEFT KNITTING: Comparison of woven, knitted and bonded fabrics. Reasons for the growth of the knitting industry. Uses of weft knitted fabrics. Yarn quality requirements for knitting. Knitting classification- Weft knit and warp knit. General definitions and elements of knitted loop structure. Types of knitting needles- Bearded, Latch and Compound Needle.

WEFT KNIT MACHINES AND FABRIC STRUCTURES: Basic weft knitted structures and their production - plain, rib, interlock and purl. Mechanical elements and operations. Fundamentals of formation of knit, tuck and float stitches. Notations. Double knit structures and specialty structures. Flat Knitting: Types, Mechanical elements and operations, Weft knit structures using flat bed.

WEFT KNITTED FABRIC GEOMETRY: Faults in circular knitting, their causes – avoidance. Production calculation in weft knitting, weft knitted fabric geometry: Loop length, stitch density, tightness fabric, areal density and optimum knitting conditions. Advancements in weft knitting: Auto stripper, roving to knitting, jacquard knitting, loop transfer, racking.

WARP KNITTING AND STRUCTURAL ELEMENTS: Basic principles and loop elements- open loop, closed loop. Mechanical elements and operations of Tricot, raschel, simplex and 2 needle bar raschel machines. Knitting cycle, lapping diagrams and notations. Guide bars movement, chain links and threading. Double needle bar patterning.

GEOMETRY AND APPLICATIONS OF WARP KNITTED FABRICS: Specialty structures of warp knitting, Production calculation. Warp knit fabric geometry. Applications of warp knit fabrics: Medical textiles, filtration, protective textiles and other areas of technical textiles.

TEXT BOOKS:
1. Anbumani N, "Knitting-Fundamentals, Machines, Structures and Developments", New Age International (P) Ltd., New Delhi, 2007.
2. Raz E, "Warp Knitting Technology", Coloumbine Press, Buxton, 1992.

REFERENCES:
1. Spencer D J, "Knitting Technology", Third Edition, Textile Institute Publication, Manchester, UK, 2001.
2. Brackenbury.T, "Knitted Clothing Technology", Blackwell Science, London, 1992.
3. Wilkens C, "Warp knit machine elements" Blackwell Science, London, 1997.
4. Aigaonkar D B, "Knitting Technology", Universal Publication Corpn. Bombay,1998.

23IT405 TECHNOLOGY OF NONWOVEN FABRICS

RAW MATERIAL AND APPLICATIONS: Nonwoven process, raw materials – web formation – web bonding. Classification of nonwovens. Applications of nonwovens in Apparels ,Hygiene products, home textiles and technical textiles applications. Raw materials preparation for the production of nonwovens, binders-requirements, properties.

WEB FORMATION :. Staple fiber and continuous filament webs. Web formation - Classification, Dry lay process, Wet lay method. Extrusion nonwovens - spun bond and meltblown. Web drafting.

WEB BONDING : Mechanical bonding - Needle punching, Stitch bonding, Spun lacing. Chemical bonding. Thermal bonding. Process variables and their effect on nonwoven properties.

FINISHING OF NONWOVENS : Mechanical finishing – shrinking, compacting and creping, calendering, pressing, perforating, slitting, breaking, splitting, suede finishing, shearing, raising, singeing and sewing. Chemical finishing - washing, dyeing, printing, finishing, softening, special effects, coating, laminating, flocking.

TESTING AND CHARACTERISTICS OF NONWOVENS : Testing of raw materials for nonwovens, testing of nonwovens, test processes related to end-use. Identification of nonwovens. Nonwoven fabric structure-property relations.

TEXT BOOKS:

1. Wilhelm Albrecht, "Nonwoven Fabrics", Wiley – VCH, Verlag Gmbh and Company, Germany, 2003.
2. Russel S, "Handbook of Nonwovens", Textile Institute Publication, UK, 2004.

REFERENCES:

1. Krcma R, "Manual of Nonwovens", Textile Trade Press, USA, 1993.
2. Irsak O, "Nonwoven Textiles", Textile Institute,, UK, 1999.
3. Mrstina V and Feigl F, "Needle Punching Technology", Elsevier Science Publishers, India, 1990.

23IT410 SPUN YARN TECHNOLOGY LABORATORY II

1. Running of comber machine, understanding its working mechanism & functions of different combing elements and determination of draft and production.
2. Determination of the Fractionating efficiency of comber and estimation of noil extraction (between head and overall) in a comber machine.
3. Construction details of nipper assembly and detaching roller drives and determination of timings of various components with respect to index wheel.
4. Sample development in speed frame machine, understanding its working mechanism & functions of drafting elements and determination of draft and production.
5. Study of flyers in speed frame &speed frame builder motion and determination of false twist, flyer speed & bobbin speed.
6. Running of ring frame machine, production of samples and change the process parameters like DCW, TCW, roller setting and spacer and analyze the effect of process parameters on the quality of the yarn produced.
7. Examination of construction and working of a ring frame builder motion and determination of winding: binding coil ratio.
8. Analysis of spinning geometry in existing ring frame and determination of winding angle variation during winding of ring cop.
9. Running of rotor spinning machine and understanding its working mechanism & functions of various spinning elements and determination of draft and production.
10. Sample development in TFO and Fancy doubler machine, understanding its working mechanism & analysis of TPI and fancy yarn structure (Knop yarn).

REFERENCE:

1. Textile Laboratory Manual prepared by Department of Textile Technology, 2023.

23IT411 WEAVING AND KNITTING TECHNOLOGY LABORATORY

1. Production of toweling fabrics in Terry Loom.
2. Design and development of sample in Electronic Jacquard.
3. Design and development of sample in Electronic Dobby.
4. Observation of various operations in function panel and running of Rapier Loom.
5. Observation of various operations in function panel and running of Airjet loom.
6. Production of Tapes in Narrow width loom and study of braiding machine.
7. Working of Single Jersey knitting machine and development of sample using various process parameters.
8. Working of Double Jersey knitting machine and development of sample using various process parameters.
9. Working of flat knitting machine and development of sample using various process parameters.
10. Working of Socks knitting machine and development of sample using various process parameters.
11. Sample production and analysis using Test Knitting machine and development of fabrics using various process parameters.
12. Preparation of report on Maintenance and Troubleshooting activities in Rapier & Air jet looms.

REFERENCES:

1. Textile Laboratory Manual prepared by Department of Textile Technology. 2023.

23IT412 PYTHON PROGRAMMING LABORATORY

LIST OF EXPERIMENTS:

1. Problem solving related to the following topics:
2. Computational thinking using flowcharts and Pseudocode
3. Programs related to simple data types: integers, float, complex, Boolean in the shell
4. Input/output and conditional statements in scripts
5. Different operators and conversion functions
6. Loops: for and while
7. String datatype: Creation, Operations, Methods
8. List datatype: Creation, Operations, Methods
9. Tuple data type: Creation, Operations, Methods
10. Set and frozensetdatatypes: Creation, Operations, Methods
11. Dictionary datatype: Creation, Operations, Methods
12. Functions: definitions , parameter passing, returning datatypes
13. Lambda and recursive functions
14. Creating modules and packages
15. Using numpy and matplotlib packages
16. Handling exceptions
17. File handling

Note: Problem sheets will be given during the course

REFERENCES:

1. Mark Summerfield. “Programming in Python 3: A Complete introduction to the Python Language”, Addison-Wesley Professional, 2009.
2. ReemaThareja ,”Python Programming : Using Problem Solving Approach”, Oxford university Press 2017
3. Wesley J Chun, “Core Python Applications Programming”, Prentice Hall, 2012.
4. Martin C. Brown, “PYTHON: The Complete Reference”, McGraw-Hill, 2018.

BE/BS MECHANICAL ENGINEERING

BE/BS MECHANICAL ENGINEERING

S.No	Course Code	Course Title	Hours / Week				Maximum Marks		Total
			Lecture	Tutorial	Practical	Credits	CA	FE	
SEMESTER I									
1	23IM101	Calculus and its Applications	3	1	0	4	50	50	100
2	23IM102	Physics	3	0	0	3	50	50	100
3	23IM103	Chemistry of Engineering Materials	3	0	0	3	50	50	100
4	23IM104	Basics of Electrical and Electronics Engineering	3	0	0	3	50	50	100
5	23IM105	English Language Proficiency	3	1	0	4	50	50	100
6	23IM110	Basic Sciences Laboratory	0	0	4	2	50	50	100
7	23IM111	Engineering Graphics	0	0	4	2	50	50	100
8	23IM112	2D CAD Laboratory	0	0	4	2	50	50	100
9	23IG065	German Language A1	12			4		100	100
SEMESTER 2									
1	23IM201	Complex Variables and Transforms	3	1	0	4	50	50	100
2	23IM202	Engineering Mechanics	3	1	0	4	50	50	100
3	23IM203	Manufacturing Processes I	3	0	0	3	50	50	100
4	23IM204	Fluid Mechanics	3	1	0	4	50	50	100
5	23IM205	Industrial Metallurgy	3	0	0	3	50	50	100
6	23IM206	Professional Skills					50	50	100
7	23IM210	Electrical and Electronics Engineering Laboratory	0	0	2	1	50	50	100
8	23IM211	Engineering Practices Laboratory	0	0	2	1	50	50	100
9	23IH073	Organizational Behaviour	3	0	3	3	50	50	100
10	23IG066	German Language A2	12	0	0	4		100	100
SEMESTER 3									
1	23IM301	Computational Mathematics	3	1	0	4	50	50	100
2	23IM302	Engineering Economics	3	1	0	4	50	50	100
3	23IM303	Mechanics of Materials	3	0	0	3	50	50	100
4	23IM304	Kinematics of Machinery	3	1	0	4	50	50	100
5	23IM305	Engineering Thermodynamics	3	1	0	4	50	50	100
6	23IM310	Metallurgy and Mechanics of Materials Laboratory	0	0	4	2	50	50	100
7	23IM311	Manufacturing Processes Laboratory	0	0	4	2	50	50	100
8	23IH074	TOEFL/ IELTS Training	6	0	9	2	50	50	100
9	23IG067	German Language B1	12	0	0	4	-	100	100
SEMESTER 4									
1	23IM401	Probability and Statistics	2	1	0	3	50	50	100
2	23IM402	Manufacturing Processes II	3	0	0	3	50	50	100
3	23IM403	Dynamics of Machinery	3	1	0	4	50	50	100
4	23IM404	Thermal Engineering I	3	0	0	3	50	50	100
5	23IM405	Hydraulics and Pneumatics					50	50	100

6	23IM410	Machine Drawing	0	0	4	2	50	50	100
7	23IM411	Python Programming Laboratory	0	0	4	2	50	50	100
8	23IG068	German Language B2.1	12	0	0	4		100	100
SEMESTER 5									
1	23IM501	Design of Machine Elements	3	1	0	4	50	50	100
2	23IM502	Thermal Engineering II	3	1	0	4	50	50	100
3	23IM503	Operations Research	3	0	0	3	50	50	100
4	23IM504	Turbomachinery	3	1	0	4	50	50	100
5	23IM505	Metrology and Instrumentation	3	0	0	3	50	50	100
6	23IM510	Fluid Mechanics and Machinery Laboratory	0	0	4	2	50	50	100
7	23IM511	Thermal Engineering Laboratory	0	0	4	2	50	50	100
9	23IG069	German Language B2.2	12	0	0	4		100	100
SEMESTER 6									
1	23IM601	Mechanical System Design	3	1	0	4	50	50	100
2	23IM602	Heat and Mass Transfer	3	1	0	4	50	50	100
3	23IM603	Design for Manufacture and Assembly	3	1	0	4	50	50	100
4	23IM604	Tool Design					50	50	100
5	23IM605	Internet of Things for Mechanical Applications	3	0	0	3	50	50	100
6	23IM610	Heat Transfer Laboratory	0	0	4	2	50	50	100
7	23IM611	Dynamics and Metrology Laboratory	0	0	4	2	50	50	100
8	23IM612	Innovation Practices	0	0	2	1	50	50	100
9	23IM613	MAT Laboratory							
10	23IG070	German Language C1	12	0	0	4		100	100

SEMESTER – I

23IM101 CALCULUS AND ITS APPLICATIONS

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables.

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems.

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits.

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes' theorem.

TEXT BOOKS

1. J. Hass, C. Heil, Maurice D.W "'Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES

1. H. Anton, I. Bivens, S. Davis, "Calculus", John Wiley and Sons, USA, 2016.
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23IM102 PHYSICS

STATICS OF PARTICLES: Introduction to Newtonian mechanics - vector mechanics;Forces on a particle, parallelogram law, resolution of a force, rectangular components of a force; Resultant of several concurrent forces: Equilibrium of a particle, free-body diagrams, forces in space - equilibrium of a particle in space.

KINEMATICS OF PARTICLES: Introduction to dynamics**;** Rectilinear motion of particles: Analytical and graphical solutions to problems, motion of several particles; Curvilinear motion of particles: projectile motion, rotary motion and rolling motion.

KINETICS OF PARTICLES - NEWTON'S SECOND LAW AND FRICTION: Rectilinear and rotary motion: Newton's second law, D'Alembert'sprinciple, dependent motion of several particles; Friction: concepts of friction, problems involving dry friction; Wedges, square-threaded screws, journal bearings - axle friction, thrust bearings - disk friction, wheel friction - rolling resistance, belt friction.

KINETICS OF PARTICLES – ENERGY METHODS: Work-energy and power**:** Work of a force, Conservative and non- conservative forces, kinetic energy, principle of work and energy, potential energy, conservation of energy, power and efficiency; Solving problems using the concepts of friction wherever applicable.

KINETICS OF PARTICLES – MOMENTUM METHODS: Concept of conservation of momentum, co-efficient of restitution, Impulse-momentum principle, Impact – direct central impact, oblique central impact, problems involving impulse and momentum.

TEXT BOOKS:

1. Ferdinand P. Beer, E. Russell Johnston, David F.Mazurek, Philip J. Cornwell, Sanjeev Sanghi, Brian P.Self "Vector Mechanics for Engineers Statics and Dynamics", McGraw Hill Education (India) Private Ltd., New Delhi, 2019, 12th edition
2. Nelson. A "Engineering Mechanics -Statics and Dynamics", Tata McGraw Hill Education (India) Private Ltd., New Delhi, 2017, 1st edition

REFERENCES:

1. Rajasekaran S, Sankarasubramanian G "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2015
2. R.C. Hibbler "Engineering Mechanics -Statics and Dynamics", Pearson, 2022, 15th Edition
3. James L.Meriam, L. Glenn Kraige, J.N. Bolton, "Engineering Mechanics, Statics, Wiley India Private Limited, 2018

23IM103 CHEMISTRY OF ENGINEERING MATERIALS

FUELS AND COMBUSTION : Petroleum - refining, cracking and polymerisation- petrol and diesel knocking-octane and cetane rating of fuels-reforming of gasoline. Liquefaction of coal- Bergius process. Alternate fuels-methanol, ethanol, CNG, biodiesel. Calorific value -determination by Bomb calorimeter-calculation of heat of combustion. Calorific intensity- calculation of theoretical flame temperature. Combustion of fuels- theoretical air calculations for solid and gaseous fuels. Emission tests, catalytic convertors-principles, Euro and Bharath emission standards. Propellants-requisites-examples. Explosives –Lead azides-applications.

BATTERIES and FUEL CELLS: Electrode potential, Nernst equation. Performance characteristics of batteries.Construction, reactions, characteristics of Zn-Carbon, lithium primary cells. Lead - acid battery and lithium-ion secondary batteries. Supercapacitors – EDLC – fundamentals, electrode materials, electrolytes, pseudocapacitors. Fuel cell-working principles of proton exchange membrane and direct methanol fuel cells. Speciality batteries for satellites and torpedoes.

CORROSION AND PROTECTIVE COATINGS : Forms of corrosion- uniform, pitting, crevice, intergranular and stress corrosion. Corrosion protection by design, anodic and cathodic protection, corrosion inhibitors - mention of types and applications. Protective coatings - Anodizing, electroplating of Cu, Ni and Cr. Galvanizing and Tinning. Paints-constituents and functions. Electrophoretic painting, superhydrophobic and self healing coatings.

POLYMERS AND COMPOSITES : Polymers: Classification, degree of polymerization molecular weight - Mn and Mw. Structure related to thermal and mechanical properties of polymers. Degradation of polymers-Thermal and mechanical, Additives- protective additives-thermal stabilizers, UV stabilizers, Antioxidants, functional additives-metal deactivators, flame retardants, vulcanization. **Composites:** classification, role of matrix and reinforcements, polymer matrix-thermoplastic and thermoset, reinforcements – glass, carbon, aramids, nanomaterials.

MISCELLANEOUS MATERIALS : Lubricants-classification- properties, mechanisms of lubrication- additives and improvers. Solid lubricants (graphite and MoS2). Abrasives: Natural abrasives (diamond and corundum)-synthetic abrasives (silicon carbide and boron carbide). Refractories- characteristics – classification –alumina, magnesite and zirconia bricks- applications. Adhesives-pressure sensitive, epoxy, acrylic and plastics based. Boiler feed water- requisites -estimation of hardness- demineralization process.

TEXT BOOKS:

1. Shikha Agarwal, “Engineering Chemistry: Fundamentals and Applications” Cambridge University Press, 2015.
2. Shashi Chawla, “A Text Book of Engineering Chemistry”, Dhanpat Rai & Co, 2005.

REFERENCES:

1. Samir S., “Fuels and Combustion”, India Universities Press, 2009.
2. Vladimir S. Bagotsky, Alexander M. Skundin, Yurij VM. Volfkovich., “Electrochemical power sources : Batteries, fuel cells, and supercapacitors”, John Wiley & Sons, Inc.,2015.
3. Gowarikar V. R., Viswanathan N.V. and JayadevSreedhar, “Polymer Science”, New Age International (P) Ltd., 2011.

23IM104 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

INTRODUCTION TO AC AND DC CIRCUITS: Charge and Current, Voltage, Energy and Power - Sinusoidal Voltage and Current - Average value - RMS value - Power factor - Phasor representation. - Circuit elements and symbols - Ohm’s law - Kirchhoff’s law - Mesh and Nodal analysis - Thevenin’s theorem - Norton’s theorem - Superposition theorem - Maximum Power transfer theorem.

DC MACHINES: Types of DC motors, Construction and Principle of operation: Shunt motor - Series motor - Compound motor, Speed-torque characteristics, Starting, Speed Control, Braking.

AC AND SPECIAL MACHINES: Types of AC motors - Signal phase induction motor - Three phase induction motor - Synchronous motor – Starting – single phase transformers: Construction, EMF equation- variable reluctance stepper motor- brushless DC motor-servo motors.

ELECTRONIC DEVICES: PN junction diode - Zener diode - LED – BJT: Biasing, Amplifier and switch, Frequency response characteristics – MOSFET: Types, Biasing, Current-voltage characteristics, Amplifier, High frequency model, Junction Field- Effect Transistor (JFET) - Comparison of BJT and FET - Optocouplers - SCR- TRIAC - DIAC.

ELECTRONIC CIRCUITS: Half wave and full wave rectifiers: analysis, ripple factor, filtering – Clippers and Clampers – Zener voltage regulator- series voltage regulators – RC coupled amplifier - RC phase shift oscillator

TEXT BOOKS:

1. William Hayt, Jack Kemmerly, Jaime Phillips, Steven Durbin “Engineering Circuit Analysis” , Tata McGraw Hill, New Delhi, 2019.
2. D. P. Kothari, I. J. Nagrath “Basic Electrical and Electronics Engineering”, Tata McGraw Hill, New Delhi, 2014.

REFERENCES:

1. Charles Alexander, Mathew Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, New Delhi, 2021.
2. Mittle V N, Aravind Mittal, “Basics of Electrical Engineering”, Tata Mc Graw Hill, New Delhi, 2017.
3. Warsame Hassan Ali, Samir Ibrahim Abood, Matthew N. O. Sadiku “Fundamentals of Electric Machines” , CRC press,New York, 2019.
4. Robert l. Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson, New Delhi, 2013.

23IM105 ENGLISH LANGUAGE PROFICIENCY

VOCABULARY: Etymology-prefixes and suffixes–synonyms–antonyms–guessing meanings from context–word formation- single-word substitutes-different forms of a word–phrasal verbs–collocations.

LISTENING AND SPEAKING: Understanding listening – listening techniques - introducing oneself and others –seeking and sharing information– description-conversation skills–extempore speaking– speech practice in varied formal contexts.
GRAMMAR: Wh-questions–Yes/no questions–parts of speech–articles–prepositions–gerunds–conjunctions-degrees of comparison–tenses– modal verbs– adverbs - direct and indirect questions.

READING: Reading strategies: skimming and scanning, predicting–reading comprehension: techniques – practice reading.

WRITING: Discourse markers – dialogue writing - completing sentences – jumbled sentences –paragraph writing –writing compare & contrast paragraphs – Letter writing.

TEXTBOOKS:

1. Shoba K.N.and Lourdes Joavani Rayen,“Communicative English”, Cambridge University press,Cambridge,2021.
2. Raymond Murphy,“Intermediate English Grammar”, Cambridge University Press, New Delhi,2020.

REFERENCES:

1. Raymond Murphy, “English Grammar in Use”, Cambridge University Press, New Delhi, 2020.
2. Sudharshana N P and Savitha C, “English for Engineers”, Cambridge University Press, New York, 2018.
3. Anne Laws, "Writing Skills", Orient Black Swan, Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, “Essential English Grammar”, Cambridge University Press, New Delhi, 2019.

23IM110 BASIC SCIENCES LABORATORY

Physics (Any eight experiments)

1. Determination of Young’s Modulus of a wooden bar – Cantilever method
2. Determination of rigidity modulus of a given material using Torsion pendulum
3. Determination of thermal conductivity of bad conductor using Lee’s Disc method
4. Determination of fibre thickness – air wedge method
5. Determination of wavelength of mercury spectrum using transmission grating
6. Measurement of vibration frequency of electrically maintained tuning fork using Melde’s apparatus
7. Determination of Hysteresis loss of a ferromagnetic material
8. Determination of thermal conductivity of a metallic material using Wiedemann – Franz law
9. Determine e/m (charge to mass ratio) of the electron by Thomson’s method.
10. Find the Hall voltage , Hall coefficient, mobility & charge density of the given ‘Ge’ crystal using Hall apparatus.

Demonstration:

1. Determine the excitation potential of Argon using the Franck Hertz method.
2. Determine the number of turns & radius of the coil and magnetic field of ‘Helmholtz’ coil using Biot-Savart’s Law – apparatus
3. Determine the charge of an electron by Millikan’s oil drop method.
4. Determine the Planck’s constant using Photo Electric method.
5. Determine the wavelength of the laser source by Michelson Interferometer.
6. Determine the thickness of the film by Mach Zehnder Interferometer.
7. Find the finesse and free spectral region of the Etalon.
8. Analyze the mercury spectrum and find wavelength using polynomial equation.
9. Determine the refractive index of given specimen using Brewster’s angle apparatus.

REFERENCES:

1. Department of Physics,” Physics laboratory observation”, 2022.
2. Jerry D Wilson; Cecilia A Hernandez Hall, “Physics laboratory experiments”, Boston, MA : Cengage Learning, 2016.

CHEMISTRY (ANY EIGHT EXPERIMENTS) :

1. Proximate analysis of coal.
2. Study of a galvanic cell.
3. Examination of different forms of corrosion using Ferroxyl indicator and determination of corrosion rateby current measurement.
4. Anodizing of aluminium and determination of thickness of anodized film
5. Electroplating of nickel /copper and determination of coulombic efficiency
6. Determination of molecular weight of polymer by Ostwald Viscometer.

7. Potentiometric estimation of ferrous ion in an effluent.
8. Determination of kinematic viscosity of lubricating a oil using Redwood viscometer.
9. Determination of flash point and fire points of lubricating oils. 10.Determination of hardness, TDS, pH and conductivity of a water sample.

Text books:
1. Laboratory Manual prepared by Physics department
2. Laboratory Manual prepared by Chemistry department

23IM111 ENGINEERING GRAPHICS

INTRODUCTION:
1) Lettering practice
2) Dimensioning practice as per BIS conventions
3) Types of projection and concepts of orthographic projection

ORTHOGRAPHIC PROJECTION:
1) Projection of points and lines
2) Projection of planes
3) Projection of solids

SECTIONS AND DEVELOPMENT:
1) Sectional views of regular solids
2) Development of lateral surfaces of regular solids
3) Projection of truncated solids and simple engineering sheet metal components

PICTORIAL PROJECTIONS:
1) Isometric view of simple engineering components
2) Conversion of isometric views to orthographic views
3) Perspective projection using visual ray method

GEOMETRIC MODELING USING CAD SOFTWARE:
1) Modeling of simple engineering components
2) Extraction of 2D views from 3D models

REFERENCES:

1. Venugopal K, Prabhu Raja V "Engineering Graphics", New Age International Publishers, 16th edition, 2021.
2. John K.C "Engineering Graphics for Degree", PHI Learning Private Limited, 2009.
3. Bureau of Indian Standards "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, 2003.
4. Shaw M.B, Rana B.C "Engineering Drawing", Pearson Education India, 2009.

23IM112 2D CAD LABORATORY

Introduction to AutoCAD: History, Exploring GUI Workspaces, Co-ordinate systems, File Management: New, Qnew, Open, Save, save as, Close, Exit, Drawing settings: Units, Limits

Drafting settings: Ortho, Polar, Grid, Snap, Polar Tracking, Object snap, Dynamic Inputs, Quick Properties, Selection Cycling, Drawing Tools: Line, Circle, Arc, Ellipse, Polygon, Rectangle, Point, Multiline, Spline

Modify Tools: Erase, Oops, Undo, Redo, Explode, Move, Copy, Rotate, Mirror, Array, Align, Scale, Stretch, Lengthen, Trim, Extend, Break, Join, Chamfer, Fillet, Divide, Measure, Point Style, Mlstyle, Mledit, Pedit, Splinedit, Edit Array, Grip Editing, Hatching Objects: Hatch, Gradient, Hatchedit

Display Control: Zoom, Pan, Redraw, Regen, Clean Screen, Steering wheels, Object Properties: Color, Linetype, Ltscale, Line weight, Match Properties, Transparency, List

Dimension - Linear, Aligned, Radius, Diameter, Center Mark, Angle, Arc length, Continuous, Baseline, Tolerance, Dimension Space, Dimension Break, Jogged radius, Ordinate dimensions, Centre Mark, Centreline, Dimension Style, Dimension Edit, Annotation Tools: Leader, Qleader, Mleader, Mleader style, Add leader, Align Leaderlines, Collect Leader, Text, Style, Mtext, Scaletext, Spell, Table, Tablestyle, Tabledit

Parametric Modeling Geometric Constraint, Dimensional Constraint, Design Centre, Tool Palette, Introduction to plotting, Layout, Viewports, Mview, Page setup, Plot Styles, Plot

REFERENCES:

1. Engineering graphics with Auto CAD 2018. Choudary/Anuradha Publishers.

SEMESTER – II

23IM201 COMPLEX VARIABLES AND TRANSFORMS

COMPLEX DIFFERENTIATION: Derivative, analytic function, Cauchy-Riemann equations, Laplace's equation, linear fractional transformations.

COMPLEX INTEGRATION: Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only).

LAPLACE TRANSFORMS: Laplace transform, linearity, first shifting theorem, transforms of derivatives and integrals, unit step function, second shifting theorem, Dirac's delta function, periodic functions, differentiation and integration of transforms, solving ODEs with constant coefficients and initial value problems.

FOURIER ANALYSIS: Fourier series – arbitrary period, even and odd functions, half range expansions. Fourier transforms, Fourier cosine and sine transforms.

PARTIAL DIFFERENTIAL EQUATIONS: Basic concepts of PDEs, wave equation, heat equation, steady state two- dimensional heat problems, solution by Fourier series.

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.
2. Dennis G. Z, "Advanced Engineering Mathematics", Jones and Bartlett Pvt Ltd, New Delhi, 2017.

REFERENCES

1. Dennis G. Z and Patrick D S, "A first course in Complex Analysis with applications", Jones and Bartlett Pvt Ltd, New Delhi, 2015.
2. Wylie C R and Barret L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2018.
4. Dean G. D, "Advanced Engineering Mathematics with MATLAB", CRC Press, USA, 2017.

23IM202 ENGINEERING MECHANICS

STATICS OF RIGID BODIES: Equivalent systems of forces acting on a rigid body in 2D space: Transmissibility, moment of a force, Varignon's theorem, moment of a couple, resolution of a given force, reduction of a system of forces; Equilibrium of a rigid body in 2D space - reactions at supports and connections; Analysis of structures: Simple trusses - method of joints, method of sections, joints under special loading conditions, analysis of frames and machines.

APPLICATIONS OF FRICTION: Clutches: Role of clutches, overview of positive and gradually engaged clutches, friction clutches - single plate, multiple plate, cone and centrifugal clutches; Brakes: Role of brakes, Single shoe, double shoe and band brakes - self-locking, self-energizing and de-energizing actions; Overview of disc brakes and internally expanding shoe brakes.

CENTROIDS, CENTRES OF GRAVITY AND MOMENTS OF INERTIA: Centroids of areas and lines, Centroids of composite areas, moment of inertia of plane figures, polar moment of inertia, radius of gyration, Moments of inertia of mass – thin plates, composite bodies.

KINEMATICS OF RIGID BODIES - PLANE MOTION: Kinematics of rigid bodies: Plane motion, translation and rotation; General plane motion: Absolute velocity, relative velocity, instantaneous centre of rotation, absolute acceleration, relative acceleration.

KINETICS OF RIGID BODIES - PLANE MOTION: Equations of motion of a rigid body - angular momentum, D'Alembert's principle; Principle of work and energy for a rigid body, work of forces acting on a rigid body, kinetic energy of a rigid body in plane motion, conservation of energy; Impulse-momentum principle for the plane motion of a rigid body; Overview of Lagrange's equations of motion.

TEXT BOOKS:

1. Ferdinand P. Beer, E. Russell Johnston, David F.Mazurek, Philip J. Cornwell, Sanjeev Sanghi, Brian P.Self "Vector Mechanics for Engineers Statics and Dynamics", McGraw Hill Education (India) Private Ltd., New Delhi, 12th edition, 2019.
2. Nelson. A "Engineering Mechanics -Statics and Dynamics", Tata McGraw Hill Education (India) Private Ltd., New Delhi, 1st Edition, 2017.

REFERENCES:

1. Rajasekaran S, Sankarasubramanian G, "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2006.
2. James L.Meriam, L. Glenn Kraige, J.N. Bolton, "Engineering Mechanics - Statics, Wiley India Private Limited, 2017.
3. James L.Meriam, L. Glenn Kraige, J.N. Bolton, "Engineering Mechanics - Dynamics, Wiley India Private Limited, 2018.
4. Rattan S S, "Theory of Machines", Tata McGraw Hill Publishers, New Delhi, 4th edition, 2017.

23IM203 MANUFACTURING PROCESSES I

METAL CASTING: Casting process: Terminology, green sand molding, investment casting, die casting, patterns, molds, and cores; solidification and cooling; riser and gating systems; casting defects.

JOINING PROCESSES: Gas welding: flame types, equipment; Electric Arc Welding (EAW), Gas Metal Arc Welding (GMAW), Gas Tungsten Arc Welding (GTAW); Resistance welding - Spot, seam, projection and flash; Welding defects; Laser beam and friction-stir welding; Principles of brazing, soldering and adhesive bonding.

SHEET METAL PROCESSES: Principle of shearing, punch-die clearance; Sheet metal operations: blanking, punching, bending, drawing, spinning; Blanking force calculation; Die-set: simple, progressive, compound; Press: open back inclinable press, hydraulic press; Deep drawing and bending processes.

BULK DEFORMATION PROCESSES: Plastic deformation, hot and cold working; Rolling - Rolling mills, defects in rolled parts; Drawing - Wire and rod drawing; Forging - Open and closeddie forging, forging hammers, rotary swaging;Extrusion - directand indirect extrusion.

POWDER METALLURGY AND PLASTIC PROCESSING: Production of metal powder: Atomization, crushing; Blending; Compacting: Die pressing, isostaticpressing; Sintering; Plastic processing: Injection, blow molding.

ADDITIVE MANUFACTURING: Fundamentals of additive manufacturing (AM); AM technologies: Stereolithography, fused deposition modeling, selective laser sintering and overview of metal additive manufacturing.

TEXTBOOKS:

1. Rao P N "Manufacturing Technology", Tata McGraw Hill Education Private Limited., New Delhi, 2013.
2. Serope Kalpakjian and Stephen Schmid "Manufacturing, Engineering and Technology", Pearson Education., 2018.

REFERENCES:

1. Mikell P Groover "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Wiley., 2015,
2. Arora R P "Manufacturing Technology", Macmillan India Limited., New Delhi, 2011
3. Ian Gibson, David Rosen Brent Stucker, “Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing” Springer Second edition, 2015
4. Amitabhaghosh and Ashok kumarmallik “Manufacturing Science”, East-west press pvt ltd, 2010

23IM204 FLUID MECHANICS

FLUID STATICS AND KINEMATICS: Properties of fluids, concept of gauge and absolute pressure, measurement of pressure using manometers; Types of flow - laminar, turbulent, steady, unsteady, uniform and non-uniform flows; Flow visualization : Stream, streak and path lines; Lagrangian and Eulerian descriptions of fluid motion.

DIFFERENTIAL ANALYSIS OF FLUID FLOW: Irrotational and rotational flows, vorticity, stream function, potential function, continuity equation - derivation and applications to one dimensional flow, differential momentum equation, impact of jets - force on fixed and moving vanes; Navier Stokes equation, Euler's equation and Bernoulli's energy equation, applications of energy equations.

FLOW THROUGH PIPES: Hagen Poiseuille equation: Velocity profile, power calculation; Laminar flow between parallel plates:Couette flow; Pipes in series and parallel, Darcy-Weisbach equation, use of Moody diagram; Minor losses: Sudden expansion, contraction and losses in pipe fittings.

FLOW MEASUREMENTS: Orifice meter, mouthpiece, venturimeter, flow nozzle, pitot tube, multi-hole probe, anemometer, rotameter, hotwire anemometer, displacement meter, vortex flow meter, selection of flow meters.

DIMENSIONAL ANALYSIS AND BOUNDARY LAYER THEORY: Buckingham Pi theorem, Reynolds, Froude and Mach numbers and their applications in model testing; Boundary layer theory, development of boundary layer, drag on a flat plate, boundary layer separation and its control, streamlined and bluff bodies, flow around circular bodies and airfoil, calculation of lift and drag.

TEXT BOOKS:

1. Munson B R, Young D F, Okiishi T H and Huebsch W W , "Fundamentals of Fluid Mechanics", 9th Edition, John Wiley & Sons, USA, 2021.
2. Yunus A Cengel and John M Cimbala , "Fluid Mechanics", 4th Edition, McGraw Hill Education, USA, 2019.

REFERENCES:

1. Kumar D S , "Fluid Mechanics and Fluid Power Engineering", 2nd Edition, Kataria S K and Sons, India, 2016.
2. Frank M White , "Fluid mechanics", 8th Edition, McGraw-Hill Education, USA, 2016.
3. Victor Streeter E, Benjamin Wylie K, Bedford W , "Fluid Mechanics", 9th Edition, McGraw Hill Higher Education, USA, 2010.
4. Subramanya K , "Fluid Mechanics and Hydraulic Machines", 2nd Edition, McGraw Hill Education, India, 2018.

23IM205 INDUSTRIAL METALLURGY

MATERIAL CLASSIFICATION AND CRYSTAL STRUCTURES : Classification of materials, functional classification of materials; **Crystal structures** : Fundamental concepts, unit cells, metallic crystal structures, density computations, crystallographic points, directions, and planes; Imperfections in crystal structures: Point defects, dislocations, Schmid's Law, surface defects, bulk or volume defects.

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS : Solid solutions: substitutional and interstitial solutions, Hume-Rothery rules; Phases, Gibbs phase rule; Binary phase diagrams: Isomorphous systems, eutectic systems, eutectoid and peritectic reactions, Iron- Iron carbide diagram, development of microstructures.

HEAT TREATMENT AND STRENGTHENING METHODS : Annealing: Full annealing, stress relief annealing, recrystallization annealing, spheroidizing; Normalizing, hardening and tempering of steel; Concept of TTT and CCT diagrams, hardenability - Jominy end quench test, austempering and martempering; Surface hardening techniques: Carburizing, nitriding, cyaniding, carbonitriding, flame and induction hardening; Strengthening of metals and alloys: Cold working/strain hardening, solid solution strengthening, dispersion hardening, precipitation hardening and grain size strengthening.

MECHANICAL PROPERTIES AND NDT OF MATERIALS : Mechanism of plastic deformation, deformation by slip, critical resolved shear stress, deformation by twinning; Types of fracture; Tensile testing: Stress-strain curve; Hardness tests (Brinell, Vickers and Rockwell); Impact test :Izod and Charpy, fracture toughness tests; Fatigue: Types, mechanism, S-N curves; Creep: Mechanisms, stages, creep curve; Fatigue and creep tests; ASTM standards for different mechanical tests; Introduction to NDT techniques: LPT, MPT, UT and RT.

FERROUS AND NON-FERROUS ALLOYS : Cast iron: Compositions, types, properties, applications, effect of alloying elements in steels; Plain carbon steels, stainless steels and tool steels: Types, properties, applications and heat treatment; Copper and aluminum alloys: Types, properties, microstructure and applications

TEXT BOOKS:

1. William D. Callister Jr., David G. Rethwisch, "Callister's Materials Science and Engineering", John Wiley & Sons, 2020
2. Sydney H Avner,"Introduction to Physical Metallurgy", McGraw-Hill BookCompany, 2017

REFERENCES:

1. Kenneth G Budinski and Michael K Budinski, "Engineering Materials", 4th Edition, Prentice-Hall of India Private Limited, 2013.
2. Raghavan V, "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd, 2018.
3. Dieter G E, "Mechanical Metallurgy", McGraw-Hill Book Company, 2018.
4. Donald R Askeland, Pradeep P Fulay, Wendelin J Wright, "The Science and Engineering of Materials", Thomson brooks, 2011.

23IM206 PROFESSIONAL SKILLS

UNIT I A: HISTORICAL PERSPECTIVE OF MANUFACTURING ENGINEERING : Industrial revolution, purpose and evolution of production engineering, materials in manufacturing, conscious design & manufacturing, economics - time and cost analysis, recent technologies - digital manufacturing, case studies.

UNIT I B: TRAINING IN CAD PACKAGE : Solid modeling and assembly practice, Extraction of 2D view from 3D modeling, Coloring and shading of 3D models.

UNIT II: SEMINAR PRESENTATION AND TECHNICAL REPORT WRITING

WRITING COHERENT PROJECT REPORT : Overview structure of reports, gathering informations - synopsis / abstract - title – headings – table of contents – list of figures – list of tables – list of appendices – chapters – structured paragraphs – inferences, conclusions – figures – tables – flow charts – complete design (headers and footers).-Plagiarism. Each student will be required to submit a technical report based on the guidelines provided by the department.

PROJECT PRESENTATION : Each student will be required to make one technical presentation for a minimum 15 minutes duration in this course. Individual topics will be assigned to the students by the department.

PROFESSIONAL COMMUNICATION –ORAL SKILLS : Principles of group communication, interviewing, and making presentations- group discussions, role plays, mock interviews- talking about some visual information- giving and receiving instructions.

23IM210 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

LIST OF EXPERIMENTS:

1. Verification of Ohm's law and Kirchoff's laws.
2. Measurement of power and power factor in single phase RLC Circuit
3. Mechanical Characteristics of DC Shunt Motor
4. Load test on Three phase Induction Motor
5. Electric Braking of Three Phase Inductor Motor (Dynamic Braking / Plugging)
6. Study of Halfwave and Fullwave rectifiers with and without filters
7. Study of logic gates and implementation of binary adder/subtractor
8. Characteristics of temperature sensors (thermocouple/ RTD)
9. Study of optoelectronic devices (LDR, photodiode,phototransistor)
10. Measurement of linear displacement using LVDT and measurement of strain using strain gauge

REFERENCE:

1. EEE Department , "Electrical and Electronics Engineering Laboratory Manual", EEE Department, PSGCT, Coimbatore, 2023.

23IM211 ENGINEERING PRACTICES LABORATORY

ENGINEERING PRACTICES:

1. Foundry: Study of the tool; Preparation of green sand mould using different types of patterns.
2. Welding: Study of arc welding tools and equipment; Exercises: Preparation of joints using arc and TIG welding.
3. Fitting: Study of tools and joining methods; Exercises: Preparation of “L” and “V” Joints.
4. Carpentry: Study of wood working tools. Exercises: Preparation of “L” and “V” Joints.
5. Plumbing: Study of tools and operations; Exercises: External thread cutting and preparation of PVC pipe joints.
6. Sheet metal work and Soldering: Study of tools and operations; Exercise: Preparation of a rectangular tray.

REFERENCES:

1. Department of Mechanical Engineering, "Manufacturing Processes Laboratory Manual", PSG College of Technology, 2019.
2. Chapman WAJ , "Workshop Technology - Part I", 4th Edition, CBS Publications, New Delhi, 2007.

23IH073 ORGANIZATIONAL BEHAVIOR

Introduction to OB: Meaning & Importance of OB – Historical Development & Contributing Disciplines

Personality – Personality determinants & attributes, Emotional Intelligence and Wor k Values
Employment relationship and the psychological contract

Motivation - Basic Concepts, Motivation Theories, Problems in Motivation

Leadership - Theories of leadership, Leadership styles and effectiveness

Group Dynamics: Types of Groups, Group Norms and Cohesiveness: Group Roles.

Organizational Culture - Elements, Culture and Performance, merging organizational cultures, changing and strengthening culture.

Organizational Change - Forces for change force field analysis model Organization Development

Work Stress - Causes and consequences – Stress coping strategies

Case studies

REFERENCES:

1. Mc Shane Von Glinow and Radha Sharma, “Organisational Behaviour”, Tata Mc Graw Hill, 4th Edition, 2008
2. Stephen P Robbins, “Organisational Behaviour”, Prentice Hall (India) Pvt. Ltd., New Delhi, 13 th Edition, 2009
3. Kreitner Robert, Kinicki , Angelo, “Organsiational Behaviour”, Irwin Inc., Illinois, 2 nd Edition, 2006
4. Hellriegel, “Organsiational Behaviour” Thomson Learning, 1st edition, 2005
5. Ivancevich, “Organsiational Behaviour” Tata Mc Graw Hill, 7th Edition, 2006.

SEMESTER – III

23IM301 COMPUTATIONAL MATHEMATICS

SYSTEM OF LINEAR EQUATIONS, EIGENVALUES AND EIGENVECTORS: Approximations and errors. System of linear equations **-** Naïve Gauss elimination method, Cholesky method, Gauss–Seidel method. Eigenvalues and eigenvectors - Jacobi method, Applications - analysis of statically determinate truss, spring-mass systems.

NON LINEAR EQUATIONS: False-position method, Newton-Raphson method, Graeffe's root squaring method, Applications - Openchannel flow model, vibration analysis.

INTERPOLATION, DIFFERENTIATION AND INTEGRATION: Interpolation **-**Newton's forward and backward, Lagrange, cubic-spline, approximation - Bezier curves, Numerical differentiation, Numerical integration - Newton-Cotes formulae, Trapezoidal rule, Simpson's1/3rd rule, Gaussian Quadrature, Applications – temperature gradient, velocity and pressure distribution, relation between stress and strain.

ORDINARY DIFFERENTIAL EQUATIONS: Taylor-series method, Euler method, 4th order Runge-Kutta method, Milne's method. Finite element method – Rayleigh Ritz method, Galerkin method, Applications - swinging pendulum, heat flow models.

PARTIAL DIFFERENTIAL EQUATIONS: Finite difference method: elliptic equations - Laplace equation, Poisson equation **–** Liebmann method, deflection of a plate, steady state heat conduction, parabolic equations – Crank Nicolson's method, transient heat conduction, hyperbolic equations – vibrating string. .

TEXT BOOKS

1. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2021.
2. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, New Delhi, 2017.

REFERENCES

1. Richard L B and Douglas J F, "Numerical Analysis", Thomas Learning, New York, 2017.
2. G. Miller, "Numerical Analysis for Engineers and Scientists", Cambridge University Press, UK, 2014.
3. Amos G and Vish S, "Numerical Methods for Engineers and Scientists", Wiley India, New Delhi 2014.
4. Tai-Ran, "Applied Numerical Analysis", Wiley India, 2018.

23IM302 ENGINEERING ECONOMICS

Fundamentals of Economic Analysis: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency

Cost and Inventory Control: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages-Depreciation Methods – Problems in Straight Line and Diminishing Balance Method.

Pricing, Revenue and Value Engineering: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering.

Project Management: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis.

Economic Growth and Development: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy.

Text Books

1. Panneerselvam. R., "Engineering Economics", PHI Learning Private Limited, 2012.
2. Metha P.L, "Managerial Economics – Analysis, Problems and Cases", Sultan Chand & Sons, 2016.

References

1. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, "Principles of Engineering Economics with Applications, Cambridge University Press, 2018.
2. Varshney, R.L and K.L. Maheshwari, "Managerial Economics", Sultan Chand & Sons, 2014.
3. McEachern and Indira., "Macro ECON", Cengage India Private Limited, 2017.
4. Shalini Goyal Bhalla, "Circular Economy (Re) Emerging Movement", Invincible Publishers, 2020.

23IM303 MECHANICS OF MATERIALS

CONCEPTS OF STRESS AND STRAIN: Stresses and strains, types;Axial and shear stresses and strains: Elastic limit, Hooke's law, lateral strain, Poisson's ratio, volumetric strain, elastic constants, factor of safety; Stepped bars, uniformly varying sections, stresses in composite bar due to axial force and temperature; Strain energy due to axial force: Stresses due to gradual load, sudden load and impact loads.

SHEAR FORCE AND BENDING MOMENT: Relationship between load, shear force and bending moment; Shear force and bending moment diagrams: Cantilever, simply supported and overhanging beams under concentrated load, uniformly distributed load, uniformly varying load, concentrated moments, maximum bending moment and point of contraflexure.

BENDING STRESS AND DEFLECTION OF DETERMINATE BEAMS: Theory of simple bending: Assumptions and derivation, section modulus, bending stresses in symmetrical and unsymmetrical sections; Shear stresses in beams; Deflection of beams: Double integration method, Macaulay's method and moment area method; Euler's theory of columns.

TORSION: Theory of torsion: Assumptions and derivation, polar modulus; Stresses in solid and hollow circular shafts, power transmission, design for strength and stiffness; Stresses and deflection in close coiled helical spring, springs in seriesandparallel.

THIN CYLINDERS, PRINCIPAL STRESSES AND STRAINS: Stresses in thin cylindrical and spherical shells subjected to internal pressure; State of stress at a point: Normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method.

TEXT BOOKS:

1. James M Gere, "Mechanics of Materials", Cengage Learning, Inc, 7thedition, 2008.
2. Beer, Johnston and Dewolf, "Mechanics of Materials", Tata McGraw-Hill Education, 7th edition, 2012.

REFERENCES:

1. S S Rattan, "Strength of Materials", McGraw-Hill Education (India) Pvt. Ltd., 3rd edition, 2017.
2. Don H Morris, William F Riley and Leroy D Sturges, "Mechanics of Materials", John Wiley and Sons Inc., 6th edition, 2007.
3. Russell C Hibbler, "Mechanics of Materials", Pearson, 10thedition, 2016.
4. Popov E P, "Engineering Mechanics of Soilds", Prentice-Hall, 2ndedition, 1999.

23IM304 KINEMATICS OF MACHINERY

BASICS AND SYNTHESIS OF MECHANISMS: Terminology-rigid link, kinematic pairs, kinematic chain, mechanism, degree of freedom; Kinematic inversions-four bar chain, single slider and double slider chains; Indices of merit; Synthesis: Type, number and dimensional synthesis, function generation-two, three position synthesis of slider crank and four bar mechanisms using graphical method, analytical synthesis-Freudenstein's equation, precision positions, structural error, Chebyshev's spacing, defects in mechanisms.

KINEMATIC ANALYSIS: Displacement, velocity and acceleration analysis of simple mechanisms-graphical method, instantaneous centre method; Kinematic analysis of four bar linkages-loop closure equation;Computer aided kinematic analysis of mechanisms.

GEARS AND GEAR TRAINS: Fundamentals of gears, gear nomenclature, law of gearing, tooth forms, contact ratio, interference and undercutting; Gear trains-velocity ratio of simple, compound and epicyclic gear trains, holding torque.

KINEMATICS OF CAM: Cam nomenclature, classifications, follower displacement and derivatives-uniform velocity, simple harmonic and cycloidal motions, and, uniform acceleration and retardation motion; Layout of cam profiles for different types of followers-knife edged, roller, flat faced followers; Pressure angle and jump speed.

GYROSCOPIC COUPLE AND SPATIAL MECHANISMS: Gyroscopic couple and its effect on aircraft, ship, two and four wheeled automobiles; Spatial mechanisms – introduction, series and parallel manipulator, mobility, topological arrangements, DH parameters.

TEXT BOOKS:

1. John J. Uicker Jr., Gordon R. Pennock, Joseph E. Shigley, "Theory of Machines and Mechanisms", Oxford University Press, New Delhi, 5th edition, 2017.
2. Rattan S S, "Theory of Machines", Tata McGraw -Hill Publishers, New Delhi, 4th edition, 2017.

REFERENCES:

1. Robert L. Norton, "Design of Machinery", McGraw Hill Higher Education, 6th edition, 2020.
2. David H Myszka, "Machines and Mechanisms", Pearson, 4th edition, 2015.
3. Kenneth J. Waldron, Gary L. Kinzel, Sunil K. Agrawal, "Kinematics, Dynamics, and Design of Machinery", Wiley, 3rd edition 2016.
4. Kevin Russell, Qiong Shen, Raj S. Sodhi, "Kinematics and Dynamics of Mechanical Systems", CRC Press, 2nd edition, 2019.

23IM305 ENGINEERING THERMODYNAMICS

FIRST LAW OF THERMODYNAMICS : system, properties, zeroth law of thermodynamics and application, thermodynamic state and equilibrium, process and cycle, work, heat and other forms of energy; First law of thermodynamics, application to open and closed systems, general energy equation and applications.

PROPERTIES OF PURE SUBSTANCES : Ideal gas properties, equations of state, properties of mixtures, compressibility, pure substances, P-V-T surfaces, phase change processes, vapor pressure, properties of steam, use of property tables, T-S diagrams, Mollier chart, Rankine cycle.

SECOND LAW OF THERMODYNAMICS : Kelvin-Planck and Clausius statements, heat engines and heat pump, reversibility, Carnot cycle, Carnot theorem, thermodynamic temperature scale; Third law of thermodynamics, types of irreversibility; first and second law efficiencies.

ENTROPY : Clausius theorem, property of entropy, Clausius inequality, entropy and its applications, microscopic interpretation of entropy, maximum work obtainable from finite heat reservoirs, entropy generation in open and closed systems, isentropic work in a steady flow open system.

AVAILABILITY AND IRREVERSIBILITY : Availability, available energy referred to a cycle, maximum work in a reversible process, reversible work-open and closed systems; Availability and irreversibility; Thermodynamic relations, Maxwell's equations, Joule Kelvin effect, Clausius-Clapeyron equation, conditions of thermodynamic equilibrium and stability.

TEXT BOOKS:

1. Sonntag R E, Borgnakke C, Van WylenG.J , "Fundamentals of Engineering Thermodynamics", 9th Edition, John Wiley & Sons, USA, 2017.
2. Nag P K , "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill, India, 2017.

REFERENCES:

1. Yunus A Cengel, Boles M A , "Thermodynamics: An Engineering Approach", 8th Edition, Tata McGraw Hill, USA, 2017.
2. Michael Moran J, Howard Shapiro N, Daisie Boettner D, Margaret Bailey D, "Fundamentals of Engineering Thermodynamics", 8th Edition, John Wiley & Sons, USA, 2014.
3. Onkar Singh , "Engineering Thermodynamics", 1st Edition, New Age International, India, 2007.
4. Holman J P , "Thermodynamics", 3rd Edition, Tata McGraw Hill, USA, 2003.

23IM310 METALLURGY AND MECHANICS OF MATERIALS LABORATORY

METALLURGY LABORATORY:

1. Study of metallurgical microscope and practice of metallographic sample preparation
2. Determination of graphite type and size in grey cast iron, nodularity in SG iron and inclusion rating in steels
3. Microstructure of grey cast iron, SG iron, mild steel, stainless steel
4. Microstructure of hardened steel, Al-Si alloy, brass
5. Fractography analysis using scanning electron microscopy

MECHANICS OF MATERIALS LABORATORY:

1. Tension test on metals: Stress-strain characteristics
2. Hardness test on metals: Brinell, Vicker and Rockwell hardness tests
3. Impact test on metals: Charpy impact test
4. Torsion test on shafts: Torque and angle of twist characteristics
5. Tension and compression tests on helical springs: Load deformation characteristics and stiffness
6. Deflection test on beams
7. Study of fatigue test on metals
8. Study of cupping test on sheet metal

REFERENCES:

1. Department of Metallurgical Engineering, "Materials Science Laboratory Manual", PSG College of Technology, 2022.
2. Department of Mechanical Engineering, "Mechanics of Materials Laboratory Manual", PSG College of Technology, 2022.

23IM311 MANUFACTURING PROCESSES LABORATORY

CYCLE - 1 (LATHE):

1. Study of Lathe: Specifications, constructional details, mechanisms, operations, cutting tools and work holding devices.
2. Machining a shaft by involving facing, chamfering and step turning operations.
3. Taper turning a shaft to produce components like taper pin and taper shank.
4. Machining a shaft by involving facing, drilling and boring operations to produce components like cylindrical bush.
5. Machining shaft involving step turning and knurling.
6. Step turning and circlip groove machining and external thread cutting operations.

CYCLE - 2 (SPECIAL MACHINES):

1. Drilling holes on a component using a radial drilling machine and cutting force measurement using a drill tool dynamometer
2. Machining a key way cutting by using slottingmachine
3. Milling a die pocket using a vertical millingmachine
4. Machining spur gears using gear hobbingmachine
5. Grinding Process: A rectangular mild steel block using a surfacegrinder
6. Machining a profile using an electrical discharge machine(EDM)

Study Exercise: Study of additive manufacturing process

REFERENCES:

1. Department of Mechanical Engineering, "Manufacturing Processes Laboratory Manual", PSG College of Technology,2019.
2. ChapmanWAJ,"WorkshopTechnology-PartII",4th Edition,CBSPublications,New Delhi,2007.

SEMESTER – IV

23IM401 PROBABILITY AND STATISTICS

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axiomatic approach to probability, Baye's theorem, discrete random variables, probability mass functions, cumulative distribution functions, mean and variance, binomial, Poisson and geometric distributions.

CONTINUOUS RANDOM VARIABLES: Continuous random variables, probability density functions, cumulative distribution functions, mean and variance, uniform, exponential, and normal distributions.

JOINT PROBABILITY DISTRIBUTIONS: Two dimensional discrete and continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation.

STATISTICAL INFERENCE: Point estimation - interval estimation – hypotheses concerning means – large, small samples and matched pairs – hypotheses concerning proportions, chi square test for goodness of fit.

VARIANCE TESTS AND ANALYSIS OF VARIANCE: Hypotheses concerning variances - analysis of variance - completely randomized design, randomized block design.

TEXT BOOKS

1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018.
2. Richard A. Johnson, "Miller & Freund's Probability and Statistics for Engineers", Pearson education, New Delhi, 2017.

REFERENCES

1. Ronald E. W, Raymond H. M, Sharon L. M and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson Education, New Delhi, 2016.
2. Robert V. H, Elliot T and Dale Z, "Probability and Statistical Inference", Pearson Education, New Delhi, 2021.
3. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning**,** Delhi 2020.
4. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic press, USA, 2020.

23IM402 MANUFACTURING PROCESSES II

THEORY OF METAL CUTTING AND CUTTING TOOL TECHNOLOGY: Introduction: Material removal processes; Metal cutting fundamentals: Theory of chip formation, types of chips, orthogonal cutting and oblique cutting; Nomenclature of single-point cutting tools; Mechanics of metal cutting: Machining forces and Merchant's Circle Diagram (MCD) – simple calculations, cutting tool materials, tool wear, tool life, cutting fluids; Overview of high-speed machining.

CENTRE LATHE AND CNC LATHES: Centre lathe, constructional features, various operations, machining time calculation; Fundamentals of NC technology, Computer Numerical Control: CNC turning center - Constructional features, part programming techniques, applications.

MACHINING OF PRISMATIC COMPONENTS : Shaper, Milling: up milling, down milling, milling cutters, operations; Constructional features of CNC machining centers; Drilling: Column and radial drilling machines, reaming, tapping andboring; Broaching machines: Push, pull broaching processes.

ABRASIVE PROCESSES AND GEAR MACHINING: Abrasive processes: Grinding wheel designation and selection; Types of grinding processes: Cylindrical grinding, surface grinding, centreless grinding; Honing, lapping; Gear machining methods: Gear hobbing, gear shaping and gear grinding.

NONTRADITIONAL MACHINING: Mechanical energy processes: abrasive water jet machining, ultrasonic machining; Thermal Energy Processes: electric discharge machining (EDM), laser beam machining (LBM).

TEXTBOOKS:
1. Rao P N, "Manufacturing Technology-Vol.2", 4th Edition, McGraw-Hill Education, USA, 2018.
2. Milton C Shaw, "Metal Cutting Principles", 2nd Edition, Oxford University Press, USA, 2012.

REFERENCES:
1. Serope Kalpakjian and Stephen Schmid, "Manufacturing, Engineering and Technology", 7th Edition, Pearson Education, USA, 2018.
2. Mikell P Groover, "Principles of Modern Manufacturing", 5th Edition, Wiley & Sons Pvt. Ltd, India, 2013.
3. Radhakrishanan P, "Computer Numerical Control Machining and Computer-Aided Manufacturing", 1st Edition, New Age International Publishers, India, 2018.
4. Peter Scallan, "Process Planning" The Design/Manufacture Interface, 1st Edition, Elsevier, 2003

23IM403 DYNAMICS OF MACHINERY

STATIC FORCE ANALYSIS OF MECHANISM: Free body diagram: Conditions of equilibrium, two, three and four force members, effect of friction in rolling and sliding pairs.

DYNAMIC FORCE ANALYSIS OF MECHANISM: Inertia force and D'Alembert's principle, dynamic force analysis of mechanisms; Turning moment diagram: Fluctuation of energy and speed, mass of flywheel required for IC engines and mechanical presses.

BALANCING: Balancing of rotating masses - masses in single plane and several planes; Balancing of reciprocating masses - primary and secondary forces and couples, balancing of in-line multi-cylinder engines, balancing of V and radial engines - direct and reverse crank technique; Balancing machines - field balancing.

FREE VIBRATION: Basic features of vibratory systems: Elements, single degree of freedom system; Undamped free vibration - equation of motion, natural frequency; Damped free vibration - damping ratio, logarithmic decrement; Transverse vibration - Dunkerley's method, critical speed of shaft.

FREE TORSIONAL VIBRATION AND FORCED VIBRATION: Torsional vibration: Two and three rotor systems, geared systems; Response to periodic force: Forcing by unbalance, support motion, force and amplitude transmissibility, vibration isolation; Vibration measurement and analysis: General considerations, vibration measurement, vibration pickups, signature analysis, preparation of Campbell diagram for rotating equipment, ISO severity code.

TEXT BOOKS:
1. Shigley J E,Uicker J J, "Theory of Machines and Mechanisms", Oxford University Press, 5th edition, 2016.
2. Rattan S S, "Theory of Machines", McGraw Hill Education, 5th edition, 2019.

REFERENCES:
1. Singiresu S. Rao, "Mechanical Vibrations", Pearson India, 6th edition, 2018.
2. Ghosh,Mallick, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 3rd edition, 2008.
3. Graham Kelly.S, "Fundamentals of Mechanical Vibrations", McGraw-Hill Corporation, 2ndedition, 2000.
4. William L. Cleghorn, Nikolai Dechev, "Mechanics of Machines" Oxford University Press, 2nd edition, 2014.

23IM404 THERMAL ENGINEERING I

AIR STANDARD CYCLES AND IC ENGINES : Air standard assumptions,; Carnot, Otto, Diesel and Dual cycles, comparison of Otto, Diesel, and Dual cycles; Classification and comparison of engines, working principle of Wankel engine, four stroke and two stroke engines, petrol and diesel engines with P-V and T-S diagrams, valve and port timing diagrams.

ENGINE AUXILIARY SYSTEMS: Working principles and types of carburetors, ignition systems, fuel pumps and injectors, MPFI, CRDI, lubricating and cooling systems; Super and turbocharging.

PERFORMANCE OF IC ENGINES : Engine testing: Constant speed and variable speed tests, indicated power, brake power, frictional power - Willan's line and Morse test, volumetric efficiency, heat balance test;.

BOILERS: Requirements of boiler; Types: Water tube, fire tube, fluidized bed boilers; Boiler draught; Boiler performance: Direct and indirect heat balance.

COMPRESSORS : Classification, working principle of reciprocating compressors, equations for shaft work and efficiencies, effect of clearance on volumetric efficiency, multi-stage compression, inter-cooler and optimum intermediate pressure in a two stage compressor; Rotary compressor: Roots-type blower, sliding vane and screw compressors - working principle and performance.

TEXT BOOKS:
1. John B. Heywood , "Internal Combustion Engine Fundamentals", 2nd Edition, McGraw-Hill Education, USA, 2018.
2. Ganesan V , "Internal Combustion Engine", 4th Edition, McGraw Hill Publishers, India, 2012.

REFERENCES:
1. Allan T Kirkpatrick, Colin R Ferguson , "Internal Combustion Engines: Applied Thermosciences", 3rd Edition, Wiley, India, 2015.
2. Kothandaraman C P, DomkundwarS , "Thermodynamics and Thermal Engineering", 3rd Edition, Dhanpat Rai and Sons, India, 2013.
3. Rudramoorthy R , "Thermal Engineering", 3rd Edition, Tata McGraw Hill Publishers Co. Ltd, India, 2017.
4. Willard W Pulkrabek, "Engineering Fundamentals of the Internal Combustion Engine", 2nd Edition, Pearson Education, USA, 2003.

23IM405 HYDRAULICS AND PNEUMATICS

INTRODUCTION: Introduction to fluid power, properties - hydraulic fluids, air. Selection of hydraulicfluids, comparison between hydraulics and pneumatics.

ACTUATORS AND CONTROL VALVES: Actuators-types & constructional details, Pressure, flowand direction control valves – types & constructional details, seals

HYDRAULIC SYSTEM DESIGN: Sizing of hydraulic system- power pack, conduits, actuators,valves, accumulators. Heat generation and estimation of losses.

TYPICAL INDUSTRIAL APPLICATION OF HYDRAULIC SYSTEMS:decelerationcircuit, regenerative circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits.

PNEUMATIC SYSTEM DESIGN: Design of sequential multi actuator circuits Cascade method, Step counter method and Karnaugh Veitch Map method. Integration of start selection, start restriction, emergency stop modules with multi actuator systems.

TYPICAL INDUSTRIAL APPLICATIONS OF PNEUMATIC SYSTEMS: Metal working, handling, clamping, counter and timer circuits.

PROGRAMMABLE LOGIC CONTROLLERS: Construction, typical specification, programmingmethods andapplications.

ADVANCED TOPICS IN FLUID POWER ENGINEERING: Servo & Proportional valves- types and Hydropneumatics applications

TEXT BOOKS:

1. Anthony Esposito, " Fluid Power with Application", Pearson Education (Singapore) Pte.Ltd,Delhi, India, 2003.
2. Srinivasan R, "Hydraulic and Pneumatic Controls", McGraw –Hill education(India) Pvt Ltd, 2010

REFERENCES:

1. Majumdar, S.R., "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw- Hill., NewDelhi, 2003.
2. Werner Deppert and Kurt Stoll, "Pneumatic Controls : An Introduction to Principles", Vogel-Druck Wurzburg, Germany, 1975.
3. Peter Rohner, "Fluid Power Logic Circuit Design – Analysis, Design Method and WorkedExamples", The Macmillan Press Ltd., UK, 1979.

23IM410 MACHINE DRAWING

INTRODUCTION AND CONVENTIONS : Introduction to machine drawing;Types of sections, sectional views of engineering components; Code of practice for engineering drawing; Conventional representation of features: Drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways; Conventional representation of standard parts: Bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges.

ASSEMBLY CONCEPTS: Assembly requirements, bill of materials; Methods of assembly-bolts, nuts, studs, screws and pins; Methods of axial and radial retention of parts of an assembly; Assembly of parts with emphasis on assembly sequence and appropriate fits.

FITS AND TOLERANCES: Limits, fits and tolerances; Need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances; Geometric tolerance: uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings; Surface finish symbols - methods of indicating thesurface roughness; Blue print reading exercises; Preparation of production drawing.

ASSEMBLY DRAWING PRACTICE: Drawing practice of typical subassemblies: Sleeve and cotter joint, flange coupling, plummer block, stuffing box, gear box, foot step bearing, screw jack.

ASSEMBLY USING SOLID MODELING : Modeling and assembly using a modeling software-extracting views and sections; Drawing of assemblies: Machine vice, stop valve, drill jig, tail stock; Creation of bill of materials, calculation of mass and section properties, interference check between solids.

REFERENCES:

1. BIS, "SP:46-2003 – Engineering Drawing Practice for Schools and Colleges", New Delhi, 2003.
2. John K C, "Text book of Machine Drawing", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. Gopalakrishna K R, "Machine Drawing", Subhas Stores, Bangalore, 22nd edition 2013.
4. Narayana K L, Kannaiah P, Venkata Reddy K, "Machine Drawing", New Age International Publishers, New Delhi, 3rd edition 2006.

23IM411 PYTHON PROGRAMMING LABORATORY

LIST OF EXPERIMENTS:

Problem solving related to the following topics:

1. Computational thinking using flowcharts and Pseudocode
2. Programs related to simple data types: integers, float, complex, Boolean in the shell
3. Input/output and conditional statements in scripts
4. Different operators and conversion functions
5. Loops: for and while
6. String datatype: Creation, Operations, Methods
7. List datatype: Creation, Operations, Methods
8. Tuple data type: Creation, Operations, Methods
9. Set and frozenset datatypes: Creation, Operations, Methods
10. Dictionary datatype: Creation, Operations, Methods
11. Functions: definitions , parameter passing, returning datatypes
12. Lambda and recursive functions
13. Creating modules and packages
14. Using numpy and matplotlib packages
15. Handling exceptions
16. File handling

Note: Problem sheets will be given during the course

REFERENCES

1. Mark Summerfield. "Programming in Python 3: A Complete introduction to the Python Language", Addison-Wesley Professional, 2009.
2. Reema Thareja ,"Python Programming : Using Problem Solving Approach", Oxford university Press 2017
3. Wesley J Chun, "Core Python Applications Programming", Prentice Hall, 2012.
4. Martin C. Brown, "PYTHON: The Complete Reference", McGraw-Hill, 2018.

Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India.

STATE GOVERNMENT AND FEDERALISM: Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States

JUDICIARY: Supreme Court, High Court; District Court and Lower Courts - Functions and Powers – Judges – Qualifications and Powers - Judicial Review.

TEXT BOOKS:

1. Subash C. Kashyap, "Our Political System", National Book Trust, 2011.
2. Praveenkumar Mellalli, E., "Constitution of India, Professional Ethics and Human Rights", Sage Publications India Pvt. Ltd., 2015.

REFERENCES:

1. Briji Kishore Sharma, "Introduction to the Constitution of India", Prentice Hall of India, 2010.
2. Basu D.D., "Introduction to the Constitution of India", Prentice Hall of India, 2016.
3. Jain. M. C., "The Constitution of India", Law House, New Delhi, 2001.
4. Shukla. V. N., "Constitution of India", Eastern Book Company Ltd., New Delhi, 2011.

SEMESTER - V

23IM501 DESIGN OF MACHINE ELEMENTS

STATIC AND VARIABLE LOADING: Machine design: Definition, design process, machine element design, standards and codes in design, review of types of stress including buckling stress, contact stress and impact stress; Design for static loading: Modes of failure, factor of safety, eccentric loading, theories of failure, problems; Design for variable loading: Stress concentration, fatigue failure, endurance limit, design equations -Soderberg, Goodman and Gerber equations, combined stresses; Overview of fracture mechanics.

SHAFTS, KEYS AND COUPLINGS: Design of shafts: Forces on shafts due to gears, belts and chains, design for strength and rigidity – lateral stiffness, torsional rigidity, critical speed; Design of keys; Overview of couplings and coupling design.

SPRINGS: Helical springs: Stresses and deflection in round wire helical springs accounting for variable loading, concentric springs; Design of leaf springs-stress and deflection equation, nipping; Overview of the designofhelical and leaf springsin automobile suspension system.

RIVETED, BOLTED AND WELDED JOINTS: Riveted joints: Modes of failure, strength and efficiency, design of riveted joints – axial loading and eccentric loading, Lozenge joints; Bolted joints: Design of eccentrically loaded bolted joints; Overview of elastic analysis; Welded joints: Types, design of welded joints for different types of loading, unsymmetrical sections.

BEARINGS: Rolling contact bearings: Types, method of assembly, load ratings, bearing failure, preloading, selection of deep groove ball bearings and roller bearings; Bearing mounting for machine tool spindles and axles of automobiles; Overview of hybrid bearings; Sliding contact bearings: Theory of lubrication, hydrodynamic bearings, Sommerfeld number, design of hydrodynamic bearings.

TEXT BOOKS:

1. Richard G Budynas, J Keith Nisbett, "Shigley's Mechanical Engineering Design",McGraw Hill Publishers Co. Ltd, 11th edition 2020.
2. Bandari V.B , "Design of Machine Elements", Tata McGraw Hill Publishers Co. Ltd,5th edition, 2020.

REFERENCES:

1. Robert L Norton , "Machine Design - An integrated approach", Pearson publishers, 5th edition, 2014.
2. Jacobson B O, Bernard J Hamrock, Steven R Schmid, "Fundamentals of Machine Elements", McGraw Hill, 3rd edition, 2013.
3. M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram, and C. V. Venkatesh, Design of Machine Elements, Pearson Education, 8th edition, 2019.
4. Faculty of Mechanical Engineering, PSG College of Technology, "PSG Design Data Book", Kalaikathir Achagam, 2020.

23IM502 THERMAL ENGINEERING II

REFRIGERATION : Reverse Carnot and Brayton cycles, air refrigeration, vapour compression refrigeration, use of T- s and P-h diagrams, sub-cooling, superheating, performance calculations and applications, working principle of vapour absorption refrigeration, adsorption cooling, evaporative cooling and steam jet refrigeration, refrigerants and properties.

AIR CONDITIONING : Atmospheric air, properties, psychrometry chart, psychrometric processes, air- conditioning processes, requirements for comfort and industrial air-conditioning, summer and winter air conditioning systems, by-pass factor, apparatus dew point, sensible heat factor, cooling load calculation; Working principle of window type, split, package and centralized AC systems.

COMPRESSIBLE FLOW : Thermodynamic concepts, conservation equations, stagnation state properties, pressure waves in gases, effect of compressibility, differential equations for one dimensional flow, isentropic flow with area variations and calculation of parameter variations; Fanno and Rayleigh flows, analysis of parameter variations.
NORMAL AND OBLIQUE SHOCKS : Development of normal shock wave, Prandtl - Meyer relation, property calculations; Concept of oblique shock wave, Shocks in convergent and divergent nozzles.

JET PROPULSION : Turbo propeller and turbo jet: Thrust, fuel power, thrust power, propulsive power, efficiencies; Rocket propulsion, solid and liquid propellants, ram and scram jets.

TEXT BOOKS:

1. Sarao A S,"Thermal Engineering", Satyaprakashan Publishers,2016.
2. Munson B R, Young D F, OkiishiT H, HuebschW W , "Fundamentals of Fluid Mechanics", John Wiley & Sons, 2013.

REFERENCES:

1. Arora C P , "Refrigeration and Airconditioning", Tata McGraw Hill,2017.
2. Rudramoorthy R,"Thermal Engineering",Tata McGraw Hill Publishers Co .Ltd, 2010.
3. William E Carscallen, Oosthuizen P H ,"Compressible Fluid Flow", CRC Press, 2014.
4. Rajput R K, "Thermal Engineering", Laxmi Publications (P) Limited, 2018.

23IM503 OPERATIONS RESEARCH

CONCEPTS OF OPERATIONS RESEARCH AND LINEAR PROGRAMMING TECHNIQUES: Operations research and decision making, types of mathematical models and their construction; Formulation of linear programming problem, applications and limitations: Graphical method, Simplex method, Big–M method, Two–phase method; Dual problems.

TRANSPORTATION PROBLEMS: Least cost method, North West corner rule, Vogel"s approximation method, Modified distribution method optimization models, degeneracy in transportation model, unbalanced and maximization models.

ASSIGNMENT MODELS, SCHEDULING AND INVENTORY CONTROL: Assignment models: Hungarian algorithm, unbalanced assignment problems, maximization case in assignment problems, traveling salesman problem; Sequencing and scheduling problems: m×2, m×3, m×n and 2×n problems; Inventory control: Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, inventory models with probability, lead time, demand, multi item deterministic model.

PROJECT MANAGEMENT BY CPM AND PERT: Constructing project network, network computations in CPM and PERT, cost crashing, resource leveling.

GAME THEORY, QUEUING MODELS AND REPLACEMENT MODELS: Game theory: Theory of games, competitive games, rules for game theory, mixed strategies, two person zero sum game, n person zero sum game, graphical method, and linear programming in game theory; Queuing models: The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns; Replacement models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy.

TEXT BOOKS:
1. Mikell P Groover, “Automation, Production Systems and Computer-Integrated Manufacturing”, Pearson, 2016.
2. Devdas Shetty and Richard A Kolk, “Mechatronics System Design”, PWS Publishing Company, 2010.

REFERENCES:
1. Frederick S. Hillier, Geralld J. Lieberman, Bodhibrata Nag and Preetam Basu, "Introduction to Operations Research", 11th Edition, McGraw-Hill, 2021.
2. Hamdy A. Taha, “Operations Research: An Introduction”, 10th Edition, Pearson Education Pvt. Ltd., 2019
3. Kanthi Swarup, Gupta P K, Manmohan, "Operations Research", Sultan Chand and Sons, New Delhi, 2014.
4. Dharani Venkatakrishnan. S, "Operations Research", 5th Edition, Keerthi Publication House, Coimbatore, 1996.

23IM504 TURBOMACHINERY

TURBINES : Energy transfer between fluid and rotor, Euler's energy transfer equation, components of energy transfer, degree of reaction, effect of blade angle on degree of reaction and energy transfer; Types of turbines: Pelton, Francis, Kaplan and Propeller -principles of operation, velocity triangles, turbine design, regulationand performance; Cavitation, types of draft tubes, specific speed and its significance.

PUMPS : Types of pumps, differences between positive displacement pump and roto-dynamic pump, performance calculation, determination of main dimensions, minimum starting speed, cavitationin pumps, NPSH (netpositive suction head), efficiency and slip, selection of pumps.

TURBO-COMPRESSORS : Classification, radial flow type, work done by the impeller, isentropic efficiency, pressure and flow coefficients, characteristic curves, surging and choking; Axial flow type, airfoilanalysis, stalling, calculation of delivery pressure, isentropic and polytropic efficiencies, number of stages, selection of fans and compressors.

STEAM NOZZLES AND TURBINES : Types of steam nozzle, maximum mass flow rate and velocity of steam at exit, critical pressure ratio, meta stable flow in nozzle; Types of steam turbines, compounding of steam turbines, degree of reaction, estimation of efficiency.

GAS TURBINES : Brayton cycle, open cycle, closed cycle, methods of improving the efficiency of a simple cycle, inter-cooling, reheating and regeneration, multistage compression; Effect of operating variables on thermal efficiency, work ratio; Open cycle gas turbine and calculations.

TEXT BOOKS:
1. Dixon S L , "Fluid Mechanics and Thermodynamics of Turbomachinery", Butterworth-Heinemann, 2010.
2. Yahya S M , "Turbines, Compressors and Fans", Tata McGraw-Hill Education, 2017.

REFERENCES:
1. ValanArasuA , "Turbo Machines", Vikas Publishing House, 2013.
2. Seppo A Korpela , "Principles of Turbomachinery", John Wiley & Sons, 2011.
3. Venkanna B K , "Fundamentals of Turbomachinery", PHI Learning, 2009.
4. R. K. Turton , "Principles of Turbomachinery", Springer, 1994

23IM505 METROLOGY AND INSTRUMENTATION

BASICS OF MEASUREMENT SYSTEM AND DEVICES: Definition of metrology, accuracy, precision and sensitivity, Abbe‘s principle; Three stages of generalized measurement system, mechanical loading, factors considered in selection of instruments, commonly used terms, uncertainty, traceability, error analysisand classification, sources of error; Principle of interferometry, Michelson interferometer, NPL flatness interferometer,laser interferometer.

CALIBRATION OF INSTRUMENTS AND QUALITY STANDARDS: Calibration of measuring instruments, principles of calibration, calibration of vernier caliper, micrometer, feeler gauges, dial indicator, surface plate, slip gauges; Care of gauge blocks-general rules inmeasurement and preservation methods; ISO 9000 quality standards and ISO 14000 environmentalmanagementstandards.

COMPARATORS AND GEOMETRICAL MEASUREMENT: Comparators - mechanical, electrical, optical and pneumatic; Angular measurement: Bevel protractors, sine bar, tool maker’s microscope; Roundness measurement, limit gauge, design of plug gauge, Taylor‘s principle, three basic types of limit gauges; Components of surface texture: Roughness, lay, waviness, Ra and Rz, surface roughness measuring instrument; Computer controlled CMM.

MEASUREMENT OF SCREW THREAD AND SPUR GEAR TERMINOLOGY: ISO metric thread, measurement of major, minor and effective diameters; Gear terminology, spur gear measurement, checking of composite errors, base pitchmeasurement

INDUSTRIAL MEASUREMENTS : Position sensors: Potentiometer, LVDT; Proximity sensors- types; Vibration sensors - seismic instrument; Torque sensors; Strain gauges; Temperature sensors: Resistance temperature detector, thermistor, thermocouples, J&K type and thermopiles, optical pyrometer; Pressure sensor: Elastic transducers, pressure cell, bulk modulus pressure gauge; Low pressure measurement; Thermal conductivity gauge; Flow measurement: Turbine type meter, hotwire anemometer, magneticflowmeter.

TEXT BOOKS:

1. Raghavendra N V, Krishnamurthy L, “Engineering metrology and measurements”, Oxford university press, New Delhi, 2021.
2. Beckwith T G, Roy D, Marangoni, John H Lienhard V, "Mechanical Measurements", Pearson, India, 2019.

REFERENCES:

1. Alan S Morris, Reza Langari, "Measurement and Instrumentation: Theory and Application", Elsevier, India, 2013.
2. Jain R K, “Engineering Metrology”, Khanna publishers, New Delhi,2015.
3. Connie L Dotson, “Fundamentals of dimensional metrology”,Cengage learning, Chennai, 2019.
4. Brige Y Mukherjee, “Quality management system ISO 9000 & ISO 14000”, Manas publications, New Delhi, 2003.

23IM510 FLUID MECHANICS AND MACHINERY LABORATORY

LIST OF EXPERIMENTS:

1. Flow measurement using mouthpiece and orifice.
2. Calibration and comparison of instruments for measuring flow through pipes- orifice, venturimeter, water meter androtameter.
3. Calibration and comparison of open channel flow measuring instruments- V-Notch and Rectangular Notch
4. Measurement of force on vane due to impact of jet
5. Determination of lift coefficient using wind tunnel
6. Performance test on axial flow fan
7. Performance test on centrifugal blower
8. Performance test on reciprocating pump
9. Performance test on centrifugal pump
10. Performance test on impulse water turbine
11. Performance test on reaction water turbine

REFERENCES:

1. Department of Mechanical Engineering, "Fluid Machinery Laboratory Manual", PSG College of Technology, 2019.
2. Kumar D S, "Fluid Mechanics and Fluid Power Engineering", Kataria S K and Sons, 2016.

23IM511 THERMAL ENGINEERING LABORATORY

LIST OF EXPERIMENTS :

1. Valve timing diagram of a 4-stroke diesel engine
2. Port timing diagram of a 2-stroke petrol engine
3. Performance test on constant speed 4-stroke diesel engine
4. Variable speed test on multi-cylinder diesel engine
5. Heat balance test on 4-stroke diesel engine
6. Performance test on of petrol engine
7. Performance test on two stage reciprocating aircompressor
8. IC engine performance evaluation using PC interface module
9. Test on HVAC(heating, ventilation and air conditioning)system
10. Performance analysis of refrigeration system
11. Study on diesel fired steam powerplant

REFERENCES:

1. Department of Mechanical Engineering,"Thermal Engineering Laboratory Manual", PSG College of Technology, 2019.
2. Ganesan V,"Internal Combustion Engines",Tata McGraw Hill, 2013.

SEMESTER - VI

23IM601 MECHANICAL SYSTEM DESIGN

IC ENGINE: Systems concept,Overview of mechanical systems that include power generation and power transmission systems; Review of design considerations for system components subjected to static and dynamic loads; Design of IC engine comprising cylinder, piston, connecting rod, crankshaft, flywheel, valves and valve springs.

SPUR/HELICAL GEAR REDUCERS AND GEARBOX DESIGN: Design of spur and helical gears: Materials, modes of failure, non-metallic gears; Speed reducers: Design of single stage spur/helical gear reducers for various applications – force analysis, shaft design and bearing selection; Gear box design for automotive transmission.

BEVEL/WORM GEAR REDUCERS: Overview of bevel gear design; Design of worm gears: Materials, thermal considerations; Design of bevel gear reducer and worm gear reducer for various applications – force analysis, shaft design and bearing selection; Applications like speedometer, steering gear box, etc.

FRICTION DRIVES/BRAKES: Design of belt drives using basic equations, Design of flat and V- belt drives based on manufacturer’s data, Design of chain drive; Overview of timing belt and silent chain; Design of automobile clutch - design of friction plate assembly, declutching linkage; Design of power screws – force analysis and design for various applications; Design of automotive braking systems.

MATERIAL HANDLING SYSTEMS: Material handling systems: Design principles, power requirement, wire ropes, sheaves, point hooks, wheels and rails for trolley; Design of EOT crane – Lifting mechanism, trolley and cross-beam sub-systems involving frame, electric motor, reduction gearbox, band brake and other elements; Design of belt conveyor system – capacity of conveyor, rubber covered and fabric ply belts, pulleys, idlers, tension-take up systems.

TEXT BOOKS:

1. Patil S.P., "Mechanical System Design", Jaico Publishing House, 2nd edition, 2008.
2. Anup Goel, "Mechanical System Design", Technical Publications, 1st edition, 2020.

REFERENCES:

1. BandariV.B,"Design of Machine Elements", Tata McGraw Hill Publishers Co. Ltd, New Delhi, 5th edition, 2020.
2. Richard G Budynas, J Keith Nisbett, "Shigley's Mechanical Engineering Design", McGraw Hill Publishers Co.Ltd., 11th edition, 2020.
3. Robert L Norton, "Machine Design - An Integrated Approach", Pearson Education, 6th edition, 2020.
4. Faculty of Mechanical Engineering, PSG College of Technology, "PSG Design Data Book", Kalaikathir Achagam, 2020.

23IM602 HEAT AND MASS TRANSFER

STEADY STATE HEAT CONDUCTION : Concepts of heat and mass transfer, three-dimensional heat conduction equations in various co-ordinate systems, steady state one dimensional heat conduction equation, thermal analogy for complex system analysis, variable thermal conductivity, heat transfer with heat generation in different shapes.

UNSTEADY STATE HEAT CONDUCTION : Lumped parameter systems, infinite solids, and semi- infinite solids, numerical and graphical methods.

CONVECTION HEAT TRANSFER : Differential analysis of hydrodynamic and thermal boundary layers; Forced and free convection, external and internal flow, laminar and turbulent flow, convective mass transfer, non-dimensional analysis.

RADIATION AND PHASE CHANGE HEAT TRANSFER : Emissive power, grey body, irradiation, radiosity, Radiation heat transfer between surfaces, shape factor, radiation shield, gas radiation; Boiling heat transfer: bubble growth, freezing and melting; Condensation: Film wise condensation and drop wise condensation.

APPLICATIONS OF HEAT TRANSFER : Heat transfer enhancement techniques in various applications; Fins: Types of fins, effectiveness and efficiency of fins; Heat exchangers: Types, tube and shell arrangements, single and multi-pass types, parallel flow, counter flow, cross flow and compact heat exchangers, LMTD and effectiveness method (NTU).

TEXT BOOKS:

1. Theodore L. Bergman, Adrienne S Lavine, Frank P. Incropera, David P. DeWitt , "Fundamentals of Heat and MassTransfer", Wiley India Private Limited, 2017.
2. Yunus A Cengel , "Heat Transfer: A Practical Approach", Tata McGraw Hill Inc., 2017.

REFERENCES:

1. John H Lienhardd, John H Lienhard , "Heat Transfer Text Book", Phlogiston Press, 2017.
2. Kothandaraman C P , "Fundamentals of Heat and Mass Transfer", New Age International (P) Limited, 2014.
3. Nag P K , "Heat and Mass Transfer", McGraw Hill Education, 2011.
4. Ramesh K Shah, Dusan P Sekulic , "Fundamentals of Heat Exchanger Design", John Wiley & Sons, 2003.

23IM603 DESIGN FOR MANUFACTURE AND ASSEMBLY

PROCESS CAPABILITY ANALYSIS AND GEOMETRIC TOLERANCES: DFM approach: DFM/DFA guidelines, DFA index; Process capability metrics: Cp, Cpk. feature tolerances, surface finish, review of relationship between attainable tolerance grades and different machining processes; Geometric tolerances: form, orientation, runout, and profile tolerances.

TOLERANCE ANALYSIS AND SELECTIVE ASSEMBLY: Cumulative effect of tolerances: Sure fit law, normal law, and truncated normal law; Interchangeable and selective assembly: Deciding the number of groups, Model-I where group tolerances of mating parts are equal, Model-II where total and group tolerances of shaft are equal, number of shafts/holes in each group, control of axial play - secondary machining operations, laminated shims.

DATUM SYSTEMS: Degrees of freedom, grouped datum systems, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, tongue and slot pairs, computation of translational and rotational accuracy, geometric analysis and applications; Datum features - functional and manufacturing; Component design - machining considerations, redesign for manufacture, examples.

TRUE POSITION TOLERANCING THEORY: Comparison between co-ordinate tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, composite tolerancing, examples.

FORM DESIGN OF CASTINGS, WELDMENTS AND TOLERANCE CHARTING: Redesign of castings based on parting line considerations, minimizing core requirements; Redesign of cast members using weldments, use of welding symbols – case studies; Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

TEXTBOOKS:

1. ASME Y 14.5M-2018, "Dimensioning and Tolerancing – Engineering Product Definition and Related Documentation Practices, The American Society of Mechanical Engineers, New York, 2019.
2. Spotts M F, "Dimensioning and Tolerancing for Quantity Production", Prentice Hall Inc, New Jersey, 1st edition, 1983.

REFERENCES:

1. Bryan R. Fischer , “Mechanical Tolerance Stackup and Analysis”, Taylor & Francis, 2004.
2. Oliver R Wade , "Tolerance Control in Design and Manufacturing", 1stedition, Industrial Press Inc, New York, 2008.
3. James G Bralla , "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1986.
4. Harry Peck , "Designing for Manufacture", Pitman Publications, London, 1st edition, 1983.

23IM604 TOOL DESIGN

CUTTING TOOLS: Materials-properties, classification, selection, insert and coated tools, tool wear, tool life. Recent developments in cutting tool technology.

SINGLE POINT TOOLS: Nomenclature, types and styles, design and manufacture of HSS and carbide insert type tools for turning, boring, shaping, planning and slotting operations. Design of form tools.Tools and holders for CNC applications.

MULTIPOINT CUTTERS: Nomenclature, classification and selection, construction methods, cutter setting, design and manufacture of drills, reamers, milling cutters, broaches, hobs and gear shaper cutters. Grinding-wheel specification and selection.

JIGS: Degrees of freedom, principles of location and clamping, principles of jig design, fool proofing,elements of jigs, classification of jigs, design of jigs for drilling and reaming.

FIXTURES: Principles of fixture design, locators and different types of clamps, elements of fixtures, provision for cutter setting, design of fixtures for milling, turning, boring and grinding operations. Fixtures for turning centers and machining centers.Modular fixturing-concepts and applications.

PRESS TOOLS: Design of sheet metal parts, Design and manufacture of die sets for sheet metal components-simple, compound and progressive dies for punching and blanking operations. Dies for drawing and bending operations.Selection of press tools.

DESIGN OF INJECTION MOULDING AND DIE CASTING DIES: Product and mould, thermal considerations, design of two plate mould, runner and gate design, mould cooling and ejection. Overview of shrinkage and warpage analysis.

LIMIT GAUGES: Design of plug, ring and snap gauges.

TEXT BOOKS:

1. Arshinov.V and Alekseev.G, "Metal cutting Theory and Cutting Tool Design", MIR Publishers,Moscow, 1976.
2. Donaldson.C and LeCain.C.H, "Tool Design", Tata McGraw Hill Publishing Company Limited,New Delhi, 2004.

REFERENCES:

1. ASTME, “Fundamentals of Tool Design”, Prentice Hall, INC, New Delhi, 1962.
2. Kempster, "Introduction to Jig and Tool Design", VIVA Books, New Delhi, 1998.
3. Cracknell.P.C and Dyson.R.W, “Handbook of Thermoplastics Injection Mould Design”, Chapmanand Hall, 1993.
4. Paquin.J.R and CrowleyJ R Paquin, “Die Design Fundamentals”, Industrial Press, NY, 2006.

23IM605 INTERNET OF THINGS FOR MECHANICAL APPLICATIONS

CONCEPTS OF IOT : IoT: Characteristics, applications, enablers; Comparison between IoT, M2M, and WoT; IoT interdependence; IoT network configurations - comparison between IPv4 and IPv6; IoT components, interoperability, IoT challenges; Comparison between Industrial IoT and IoT.

DATA COLLECTION : Sensing: Sensors, transducers, sensor resolution, types of sensors; Actuation: Actuator, types of actuators; Communication protocols: 802.15.4, ZigBee, 6lowpan, RFID, NFC, Bluetooth, Z-wave; Embedded systems - Arduino, Raspberry Pi.(10)

DATA PROCESSING AND DATA HANDLING : Data processing: MQTT, MQTT components and methods; Data handling: Big data, types of data, flow of data; Cloud computing: Recent trends, service models, managing data in cloud.

DATA ANALYTICS AND DATA SECURITY : Data analytics: Types, lifecycle- discovery, preparation, model planning, model building; Data collection; Streaming data analytics: Hadoop, Hive, Hbase; Data security: Data protection, challenges.

MECHANICAL APPLICATIONS : Manufacturing: Machine diagnostics and prognosis, robotics and autonomous vehicles and part tracing; Inventory and logistics: Route generation and scheduling, fleet tracking, shipment monitoring, remote vehicle diagnostics; Energy: Smart grids, waste management; Safety and security: Indoor air quality monitoring, noise level monitoring, smoke/gas detections, structural health monitoring.

TEXT BOOKS:

1. Alasdair Gilchrist , "Industry 4.0: The Industrial Internet of Things", 1st Edition, Apress, 2016.
2. Ulrich Sendler , "The Internet of Things: Industrie 4.0 Unleashed", 1st Edition, Springer, NewYork, 2019.

REFERENCES:

1. Sabina Jeschke, Christian Brecher, Houbing Song, Dana B. Rawat , "Industrial Internet ofThings: Cyber- manufacturing Systems", Springer, 2016.
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles , "Architecting the Internet of Things",Springer, New York, 2011.
3. Adrian McEwen, Hakim Cassimally , "Designing the Internet of Things", John Wiley and SonsLtd, UK, 2014.
4. Thomas Er, Dr. Zaigham Mahmood, Professor Ricardo Puttini , "Cloud Computing: Concepts,Technology & Architecture", PHI, 2013.

23IM610 HEAT TRANSFER LABORATORY

LIST OF EXPERIMENTS:

1. Determination of thermal conductivity using guarded hotplate apparatus
2. Study of unsteady state heat conduction
3. Determination of thermal conductivity of insulating powder
4. Heat Transfer analysis using pin-fin apparatus
5. Determination of natural convective heat transfer coefficient for a vertical cylinder
6. Determination of forced convective heat transfer coefficient for a hollow tube
7. Determination of Stefan-Boltzmann constant
8. Determination of emissivity of grey surface
9. Determination of effectiveness of parallel /counter flow heat exchanger
10. Determination of heat transfer coefficient in film and drop wise condensation

REFERENCES:

1. Department of Mechanical Engineering, "Thermal Engineering Laboratory Manual", PSG College of Technology, 2019.
2. Ganesan V,"Internal Combustion Engines", Tata McGraw Hill, 2013.

23IM611 DYNAMICS AND METROLOGY LABORATORY

DYNAMICS LABORATORY:

1. Static and dynamic balancing using dynamic balancing machine.
2. Preparation of cam displacement curve and determination of jump speed of a cam.
3. Determination of (i) natural frequencies of transverse and torsional vibrations and (ii) critical speed of a shaft.
4. Determination of pressure distribution in journal bearing.
5. Determination of mass moment of inertia of connecting rod and comparison with software results.
6. Study of (i) friction and wear measurement using Pin-on-Disc method and (ii) gyroscopic effect of a rotating disc.

METROLOGY LABORATORY:

1 Gear roll testing (i) Tooth to tooth composite error (ii) Tooth thickness measurement using gear tooth vernier caliper.
2 Measurement of screw thread and single point cutting tool parameters using optical profile projector and tool maker's microscope.
3 (i) Angular measurement using sine bar (ii) Internal taper measurement using two ball method.
4 (i) Measurement of component using height gauge (ii) study of height master.
5 Measurement of effective diameter of external parallel screw threads using floating carriage micrometer.
6 Study of Coordinate Measuring Machine (CMM) and surface roughness measurement.

REFERENCES:

1. Department of Mechanical Engineering, "Metrology Laboratory Manual", PSG College of Technology, 2021.
2. Department of Mechanical Engineering, "Dynamics Laboratory Manual", PSG College of Technology, 2021.

23IM612 INNOVATION PRACTICES

INNOVATION PRACTICES LABORATORY: Project-based laboratory that enables students to ideate, develop and test small application prototypes. Student teams can work with potential users in order to gain in-depth knowledge of how to design, manufacture and test a creative solution in the real world.

SYSTEMATIC PRODUCT DEVELOPMENT: The procedure involves idea generation, development of concept model, design optimization, prototype development and technical documentation.

AUGMENTATION OF PRODUCT INNOVATION PROCESS: An overview of 3D scanning, Design optimization, 3D printing, Concepts of IoT and Intellectual Property Rights will be provided.

REFERENCES:

1. Karl T Ulrich and Steven D Eppinger , "Product Design and Development", Tata McGraw Hill, New Delhi, 2017.
2. A. K. Chitale, R. C. Gupta , "Product Design and Manufacturing", 6th Edition, PHI Learning Pvt. Ltd, 2013.
3. Kevin Otto and Kristin Wood , "Product Design", 2nd Edition, Pearson, New Delhi, 2013.
4. Innovation Advisory Council , "Innovation Black Book on Exponential Technologies", Wiley India, New Delhi, 2019.

BE/BS MECHATRONICS / ROBOTICS AND AUTOMATION ENGINEERING

BE/BS MECHATRONICS / ROBOTICS AND AUTOMATION ENGINEERING

S.No	Course Code	Course Title	Hours / Week				Maximum Marks		Total
			Lecture	Tutorial	Practical	Credits	CA	FE	
SEMESTER I									
1	23IR101	Calculus and itsApplications	3	1	0	4	50	50	100
2	23IR102	Physics	3	0	0	3	50	50	100
3	23IR103	Applied Chemistry	3	0	0	3	50	50	100
4	23IR104	Engineering Mechanics	3	0	0	3	50	50	100
5	23IR105	English LanguageProficiency	2	1	0	3	50	50	100
6	23IR110	Engineering Graphics	0	0	4	2	50	50	100
7	23IR111	Basic Sciences Laboratory	0	0	4	2	50	50	100
8	23IR112	2D CAD Laboratory	0	0	4	2	50	50	100
9	23IG065	German Language A1	12	0	0	4	-	100	100
SEMESTER 2									
1	23IR201	Complex Variables andTransforms	3	1	0	4	50	50	100
2	23IR202	Basics of Electronics	4	0	0	4	50	50	100
3	23IR203	Electrical CircuitTheory	3	1	0	4	50	50	100
4	23IR204	Strength of Materials	3	1	0	4	50	50	100
5	23IR205	ManufacturingTechnology	3	0	0	3	50	50	100
6	23IR210	Electrical and Electronics Laboratory	0	0	4	2	50	50	100
7	23IH073	Organizational Behaviour	3	0	3	3	50	50	100
8	23IG066	German Language A2	12	0	0	4	-	100	100
SEMESTER 3									
1	23IR 301	Linear Algebra	3	1	0	4	50	50	100
2	23IR302	Electrical Machines and Power System	3	0	0	3	50	50	100
3	23IR303	Kinematics and Dynamics of Machinery	3	1	0	3	50	50	100
4	23IR304	Microprocessors and Microcontrollers	3	0	0	3	50	50	100
5	23IR305	Engineering Economics	3	1	0	4	50	50	100
6	23IR311	Mechanics and Electrical Machines Laboratory	0	0	4	2	50	50	100
7	23IR312	Microprocessors and Microcontrollers Laboratory	0	0	2	1	50	50	100
8	23IH074	TOEFL/ IELTS Training	6	0	9	2	50	50	100
9	23IG067	German Language B1	12	0	0	4	-	100	100
SEMESTER 4									
1	23IR401	Probability andStatistics	3	1	0	4	50	50	100
2	23IR402	Control Systems	3	1	0	4	50	50	100
3	23IR403	Basics of Robotics	4	0	0	4	50	50	100
4	23IR404	Object Oriented Programming	3	0	0	3	50	50	100

5	23IR405	Hydraulics and Pneumatics	3	0	0	3	50	50	100
6	23IR410	Python Programming Laboratory	0	0	4	2	50	50	100
7	23IR411	Hydraulics and Pneumatics Laboratory	0	0	2	1	50	50	100
8	23IR 412	Digital and Control System Laboratory	0	0	2	1	50	50	100
9	23IG068	German Language B2.1	12	0	0	4	-	100	100
SEMESTER 5									
1	23IR501	Dynamics and Control of Manipulators	3	1	0	4	50	50	100
2	23IR602	Design of Mechanical Transmission Systems	3	1	0	4	50	50	100
3	23IR503	PLC and SCADA	3	0	0	3	50	50	100
4	23IR504	Data Structures and Algorithms	2	2	0	4	50	50	100
5	23IR510	PLC and CAD Laboratory	0	0	4	2	50	50	100
6	23IR511	Robotics and Drives Laboratory	0	0	4	2	50	50	100
7	23IG069	German Language B2.2	12	0	0	4	-	100	100
SEMESTER 6									
1	23IR601	Power Electronics and Drives	4	0	0	4	50	50	100
2	23IR602	Machine Learning for Robotics	3	1	0	4	50	50	100
3	23IR603	Autonomous Wheeled Robots	3	1	0	4	50	50	100
4	23IR604	Sensors and VisionSystems	4	0	0	4	50	50	100
5	23IR610	Intelligent Robotics Laboratory	0	0	4	2	50	50	100
6	23IR611	Innovation Practices	0	0	2	1	50	50	100
7	23IG070	German Language C1	12	0	0	4	-	100	100

SEMESTER – 1

23IR101 CALCULUS AND ITS APPLICATIONS

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables.

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems.

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes' theorem.

TEXT BOOKS

1. J. Hass, C. Heil, Maurice D.W "'Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES

1. H. Anton, I. Bivens, S. Davis, "Calculus", John Wiley and Sons, USA, 2016.
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23IR102 PHYSICS

STATICS OF PARTICLES: Introduction to Newtonian mechanics - vector mechanics;Forces on a particle, parallelogram law, resolution of a force, rectangular components of a force; Resultant of several concurrent forces: Equilibrium of a particle, free-body diagrams, forces in space - equilibrium of a particle in space.

KINEMATICS OF PARTICLES: Introduction to dynamics**;** Rectilinear motion of particles: Analytical and graphical solutions to problems, motion of several particles; Curvilinear motion of particles: projectile motion, rotary motion and rolling motion.

KINETICS OF PARTICLES - NEWTON'S SECOND LAW AND FRICTION: Rectilinear and rotary motion: Newton's second law, D'Alembert'sprinciple, dependent motion of several particles; Friction: concepts of friction, problems involving dry friction; Wedges, square-threaded screws, journal bearings - axle friction, thrust bearings - disk friction, wheel friction - rolling resistance, belt friction.

KINETICS OF PARTICLES – ENERGY METHODS: Work-energy and power**:** Work of a force, Conservative and non- conservative forces, kinetic energy, principle of work and energy, potential energy, conservation of energy, power and efficiency; Solving problems using the concepts of friction wherever applicable.

KINETICS OF PARTICLES – MOMENTUM METHODS: Concept of conservation of momentum, co-efficient of restitution, Impulse-momentum principle, Impact – direct central impact, oblique central impact, problems involving impulse and momentum.

TEXT BOOKS:

1. Ferdinand P. Beer, E. Russell Johnston, David F.Mazurek, Philip J. Cornwell, Sanjeev Sanghi, Brian P.Self "Vector Mechanics for Engineers Statics and Dynamics", McGraw Hill Education (India) Private Ltd., New Delhi, 2019, 12th edition
2. Nelson. A "Engineering Mechanics -Statics and Dynamics", Tata McGraw Hill Education (India) Private Ltd., New Delhi, 2017, 1st edition

REFERENCES:

1. Rajasekaran S, Sankarasubramanian G "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2015
2. R.C. Hibbler "Engineering Mechanics -Statics and Dynamics", Pearson, 2022, 15th Edition
3. James L.Meriam, L. Glenn Kraige, J.N. Bolton, "Engineering Mechanics, Statics, Wiley India Private Limited, 2018

23IR103 APPLIED CHEMISTRY

FUELS AND COMBUSTION : Petroleum - refining, cracking and polymerisation- petrol and diesel knocking-octane and cetane rating of fuels-reforming of gasoline. Liquefaction of coal- Bergius process. Alternate fuels-methanol, ethanol, CNG, biodiesel. Calorific value -determination by Bomb calorimeter-calculation of heat of combustion. Calorific intensity- calculation of theoretical flame temperature. Combustion of fuels- theoretical air calculations for solid and gaseous fuels. Emission tests, catalytic convertors-principles, Euro and Bharath emission standards. Propellants-requisites-examples. Explosives –Lead azides-applications.

BATTERIES and FUEL CELLS: Electrode potential, Nernst equation. Performance characteristics of batteries.Construction, reactions, characteristics of Zn-Carbon, lithium primary cells. Lead - acid battery and lithium-ion secondary batteries. Supercapacitors – EDLC – fundamentals, electrode materials, electrolytes, pseudocapacitors. Fuel cell-working principles of proton exchange membrane and direct methanol fuel cells. Speciality batteries for satellites and torpedoes.

CORROSION AND PROTECTIVE COATINGS : Forms of corrosion- uniform, pitting, crevice, intergranular and stress corrosion. Corrosion protection by design, anodic and cathodic protection, corrosion inhibitors - mention of types and applications. Protective coatings - Anodizing, electroplating of Cu, Ni and Cr. Galvanizing and Tinning. Paints-constituents and functions. Electrophoretic painting, superhydrophobic and self healing coatings.

POLYMERS AND COMPOSITES : Polymers: Classification, degree of polymerization molecular weight - Mn and Mw. Structure related to thermal and mechanical properties of polymers. Degradation of polymers-Thermal and mechanical, Additives- protective additives-thermal stabilizers, UV stabilizers, Antioxidants, functional additives-metal deactivators, flame retardants, vulcanization. **Composites:** classification, role of matrix and reinforcements, polymer matrix-thermoplastic and thermoset, reinforcements – glass, carbon, aramids, nanomaterials.

MISCELLANEOUS MATERIALS : Lubricants-classification- properties, mechanisms of lubrication- additives and improvers. Solid lubricants (graphite and MoS_2). Abrasives: Natural abrasives (diamond and corundum)-synthetic abrasives (silicon carbide and boron carbide). Refractories- characteristics – classification –alumina, magnesite and zirconia bricks- applications. Adhesives-pressure sensitive, epoxy, acrylic and plastics based. Boiler feed water- requisites -estimation of hardness- demineralization process.

TEXT BOOKS:

1. Shikha Agarwal, “Engineering Chemistry: Fundamentals and Applications” Cambridge University Press, 2015.
2. Shashi Chawla, “A Text Book of Engineering Chemistry”, Dhanpat Rai & Co, 2005.

REFERENCES:

1. Samir S., “Fuels and Combustion”, India Universities Press, 2009.
2. Vladimir S. Bagotsky, Alexander M. Skundin, Yurij VM. Volfkovich., “Electrochemical power sources : Batteries, fuel cells,and supercapacitors”, John Wiley & Sons, Inc.,2015.
3. Gowarikar V. R., Viswanathan N.V. and JayadevSreedhar, “Polymer Science”, New Age International (P) Ltd., 2011

23IR104 ENGINEERING MECHANICS

STATICS OF PARTICLES & RIGID BODIES: Introduction – Units and dimensions – Laws of mechanics – Force - Characteristics - System of forces – Principle of transmissibility - Parallelogram and triangular Law of forces - Statics of particles in two dimensions – Resultant force – Statics of rigid bodies in two dimensions - Varignon’s theorem - Force couple system

EQUILIBRIUM OF PARTICLES & RIGID BODIES: Equilibrium and equilibrant – Conditions of equilibrium – Principles of equilibrium - Lami’s theorem - Free body diagram – Action and reaction - Equilibrium of rigid bodies in two dimensions –Types of supports – Types of loads - Support reactions of beams

PROPERTIES OF SURFACES AND SOLIDS: Centroid and centre of gravity – Centroid of plane and composite figures – Centre of gravity of solid figures - Area moment of inertia of plane and composite figures – Parallel axis theorem and perpendicular axis theorem - Mass moment of inertia – Comparison of mass moment of inertia and area moment of inertia

FRICTION: Frictional force – Role of frictional force – Types of friction – Limiting friction – Coefficient of friction and angle of friction - Laws of friction – Angle of repose – Cone of friction – Body on rough inclined plane – Simple contact friction: Screw friction and belt friction - Rolling resistance

DYNAMICS OF PARTICLES: Displacement, velocity, acceleration and their relationship – Rectilinear motion with uniform acceleration – Motion of a particle under gravity – Relative motion - Curvilinear motion - Newton’s laws of motion – Work energy equation - Impulse and momentum

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers: Statics and Dynamics”, 12th Edition, McGraw Hill Education, 2019.
2. Bhavikatti, S S, “Engineering Mechanics”, 7th edition, New Age International (P) Limited Publishers, 2019.

REFERENCES:

1. Hibbeller, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11th Edition, Pearson Education, 2009.
2. Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
3. Timoshenko S, Young D. H, Rao J. V, Sukumar Pati, “Engineering Mechanics”, 5th Edition, Tata McGraw-Hill Education, 2017.
4. Vela Murali, “Engineering Mechanics”, Oxford University Press, 2010.

23IR105 ENGLISH LANGUAGE PROFICIENCY

VOCABULARY: Etymology-prefixes and suffixes–synonyms–antonyms–guessing meanings from context–word formation- single-word substitutes-different forms of a word–phrasal verbs–collocations.

LISTENING AND SPEAKING: Understanding listening – listening techniques - introducing oneself and others –seeking and sharing information– description-conversation skills–extempore speaking– speech practice in varied formal contexts.
GRAMMAR: Wh-questions–Yes/no questions–parts of speech–articles–prepositions–gerunds–conjunctions-degrees of comparison–tenses– modal verbs– adverbs - direct and indirect questions.

READING: Reading strategies: skimming and scanning, predicting–reading comprehension: techniques – practice reading.

WRITING: Discourse markers – dialogue writing - completing sentences – jumbled sentences –paragraph writing –writing compare & contrast paragraphs – Letter writing.

TEXTBOOKS:

1. Shoba K.N.and Lourdes Joavani Rayen,“Communicative English”, Cambridge University press,Cambridge,2021.
2. Raymond Murphy,“Intermediate English Grammar”, Cambridge University Press, New Delhi,2020.

REFERENCES:

1. Raymond Murphy, “English Grammar in Use”, Cambridge University Press, New Delhi, 2020.
2. Sudharshana N P and Savitha C, “English for Engineers”, Cambridge University Press, New York, 2018.
3. Anne Laws, "Writing Skills", Orient Black Swan, Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, “Essential English Grammar”, Cambridge University Press, New Delhi, 2019.

23IM110 BASIC SCIENCES LABORATORY

Physics (Any eight experiments)

1. Determination of Young’s Modulus of a wooden bar – Cantilever method
2. Determination of rigidity modulus of a given material using Torsion pendulum
3. Determination of thermal conductivity of bad conductor using Lee’s Disc method
4. Determination of fibre thickness – air wedge method
5. Determination of wavelength of mercury spectrum using transmission grating
6. Measurement of vibration frequency of electrically maintained tuning fork using Melde’s apparatus
7. Determination of Hysteresis loss of a ferromagnetic material
8. Determination of thermal conductivity of a metallic material using Wiedemann – Franz law
9. Determine e/m (charge to mass ratio) of the electron by Thomson’s method.
10. Find the Hall voltage , Hall coefficient, mobility & charge density of the given ‘Ge’ crystal using Hall apparatus.

Demonstration:

1. Determine the excitation potential of Argon using the Franck Hertz method.
2. Determine the number of turns & radius of the coil and magnetic field of ‘Helmholtz’ coil using Biot-Savart’s Law – apparatus
3. Determine the charge of an electron by Millikan’s oil drop method.
4. Determine the Planck’s constant using Photo Electric method.
5. Determine the wavelength of the laser source by Michelson Interferometer.
6. Determine the thickness of the film by Mach Zehnder Interferometer.
7. Find the finesse and free spectral region of the Etalon.
8. Analyze the mercury spectrum and find wavelength using polynomial equation.
9. Determine the refractive index of given specimen using Brewster’s angle apparatus.

REFERENCES:

1. Department of Physics,” Physics laboratory observation”, 2022.
2. Jerry D Wilson; Cecilia A Hernandez Hall, “Physics laboratory experiments”, Boston, MA : Cengage Learning, 2016.

CHEMISTRY (ANY EIGHT EXPERIMENTS) :

1. Proximate analysis of coal.
2. Study of a galvanic cell.
3. Examination of different forms of corrosion using Ferroxyl indicator and determination of corrosion rate by current measurement.
4. Anodizing of aluminium and determination of thickness of anodized film
5. Electroplating of nickel /copper and determination of coulombic efficiency
6. Determination of molecular weight of polymer by Ostwald Viscometer.
7. Potentiometric estimation of ferrous ion in an effluent.
8. Determination of kinematic viscosity of lubricating a oil using Redwood viscometer.
9. Determination of flash point and fire points of lubricating oils. 10.Determination of hardness, TDS, pH and conductivity of a water sample.

Text books:

1. Laboratory Manual prepared by Physics department
2. Laboratory Manual prepared by Chemistry department

23IR110 ENGINEERING GRAPHICS

INTRODUCTION:

1. Lettering practice
2. Dimensioning practice as per BIS conventions
3. Types of projection and concepts of orthographic projection

ORTHOGRAPHIC PROJECTION:

1. Projection of points and lines
2. Projection of planes
3. Projection of solids

SECTIONS AND DEVELOPMENT:

1. Sectional views of regular solids
2. Development of lateral surfaces of regular solids
3. Projection of truncated solids and simple engineering sheet metal components

PICTORIAL PROJECTIONS:

1. Isometric view of simple engineering components
2. Conversion of isometric views to orthographic views
3. Perspective projection using visual ray method

GEOMETRIC MODELING USING CAD SOFTWARE:

1. Modeling of simple engineering components
2. Extraction of 2D views from 3D models

REFERENCES:

1. Venugopal K, Prabhu Raja V "Engineering Graphics", New Age International Publishers, 16th edition, 2021.
2. John K.C "Engineering Graphics for Degree", PHI Learning Private Limited, 2009.
3. Bureau of Indian Standards "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, 2003.
4. Shaw M.B, Rana B.C "Engineering Drawing", Pearson Education India, 2009

23IR112 2D CAD LABORATORY

Introduction to AutoCAD: History, Exploring GUI Workspaces, Co-ordinate systems, File Management: New, Qnew, Open, Save, save as, Close, Exit, Drawing settings: Units, Limits

Drafting settings: Ortho, Polar, Grid, Snap, Polar Tracking, Object snap, Dynamic Inputs, Quick Properties, Selection Cycling, Drawing Tools: Line, Circle, Arc, Ellipse, Polygon, Rectangle, Point, Multiline, Spline

Modify Tools: Erase, Oops, Undo, Redo, Explode, Move, Copy, Rotate, Mirror, Array, Align, Scale, Stretch, Lengthen, Trim, Extend, Break, Join, Chamfer, Fillet, Divide, Measure, Point Style, Mlstyle, Mledit, Pedit, Splinedit, Edit Array, Grip Editing, Hatching Objects: Hatch, Gradient, Hatchedit

Display Control: Zoom, Pan, Redraw, Regen, Clean Screen, Steering wheels, Object Properties: Color, Linetype, Ltscale, Line weight, Match Properties, Transparency, List

Dimension - Linear, Aligned, Radius, Diameter, Center Mark, Angle, Arc length, Continuous, Baseline, Tolerance, Dimension Space, Dimension Break, Jogged radius, Ordinate dimensions, Centre Mark, Centreline, Dimension Style, Dimension Edit, Annotation Tools: Leader, Qleader, Mleader, Mleader style, Add leader, Align Leaderlines, Collect Leader, Text, Style, Mtext, Scaletext, Spell, Table, Tablestyle, Tabledit

Parametric Modeling Geometric Constraint, Dimensional Constraint, Design Centre, Tool Palette, Introduction to plotting, Layout, Viewports, Mview, Page setup, Plot Styles, Plot

REFERENCES:

1. Engineering graphics with Auto CAD 2018. Choudary/Anuradha Publishers.

SEMESTER – 2

23IR201 COMPLEX VARIABLES AND TRANSFORMS

COMPLEX DIFFERENTIATION: Derivative, analytic function, Cauchy-Riemann equations, Laplace's equation, linear fractional transformations

COMPLEX INTEGRATION: Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only).

LAPLACE TRANSFORMS: Laplace transform, linearity, first shifting theorem, transforms of derivatives and integrals, unit step function, second shifting theorem, Dirac's delta function, periodic functions, differentiation and integration of transforms, solving ODEs with constant coefficients and initial value problems.

FOURIER ANALYSIS: Fourier series – arbitrary period, even and odd functions, half range expansions. Fourier transforms, Fourier cosine and sine transforms.

PARTIAL DIFFERENTIAL EQUATIONS: Basic concepts of PDEs, wave equation, heat equation, steady state two-dimensional heat problems, solution by Fourier series.

TEXT BOOKS

3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.
1. Dennis G. Z, "Advanced Engineering Mathematics", Jones and Bartlett Pvt Ltd, New Delhi, 2017.

REFERENCES

5. Dennis G. Z and Patrick D. S, "A first course in Complex Analysis with applications", Jones and Bartlett Pvt Ltd, New Delhi, 2015.
1. Wylie C R and Barret L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
2. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2018.
3. Dean G. D, "Advanced Engineering Mathematics with MATLAB", CRC Press, USA, 2017.

23IR202 BASICS OF ELECTRONICS

SEMICONDUCTOR PHYSICS AND DIODE THEORY: Intrinsic and Extrinsic semiconductors – Doping a semiconductor - Ideal diode - PN Junction Diode -Forward bias - Reverse Bias – Breakdown - Barrier potential and temperature – DC resistance of a diode – Applications of PN Junction Diode - Zener diode as a voltage regulator - Datasheet interpretation of diode

BIPOLAR JUNCTION TRANSISTOR: Unbiased and biased NPN and PNP transistor – Configurations of BJT - Transistor Currents - Base curve – Collector curve – Load line – Operating point - Transistor as switch – Emitter Bias - Voltage divider bias: Load line and Q-point - Datasheet interpretation of transistor

AMPLIFIERS AND OSCILLATORS: Introduction - Class A, Class B - Class C, Class D operation - Push-pull Emitter Follower - Theory of sinusoidal oscillation – Barkhausen Criteria– Wien-bridge oscillator - RC oscillator –Colpitts oscillator- LC oscillator

OPERATIONAL AMPLIFIER: The 741 Op-Amp – Inverting and Non-inverting Amplifier - Characteristics and applications of Op-Amp - Differential amplifier – Instrumentation amplifier - Current Boosters - Low pass filter - High pass filter – Band stop filter – All-pass filter - Comparators with zero reference, non-zero reference, hysteresis - Window comparator - Integrator - Differentiator – Waveform generation - Datasheet interpretation of Op-Amp

VOLTAGE REGULATORS: Fixed and adjustable three terminal regulators -555 Timer- Monostable and Astable operation of 555 timer - 555 timer applications - Phase-locked loop – Function generator ICs - Supply characteristics – Shunt regulator – Series Regulator –Current

TEXT BOOKS:

1. Albert Malvino, David J. Bates, Patrick E. Hoppe, "Electronic Principles", 9th Edition, Tata McGraw Hill, New Delhi, 2021.
2. Gayakwad A R, "Op-Amps and Linear Integrated circuits",4th Edition, Pearson Education, New Delhi, 2016.

REFERENCES:

1. Roy Choudhury, Shail Jain, "Linear Integrated Circuits", 6th Edition, New Age International Limited, 2021.
2. Millman J, Halkias C C, Satyabrata J, "Electronic Devices and Circuits", Tata McGraw Hill, New Delhi, 2013.
3. Boylestead L R, Nashelsky L, "Electronic Devices and Circuit Theory", Pearson Education India, New Delhi, 2015.
4. Anant Agarwal, Jeffrey H.Lang , "Foundations of Analog and Digital Electronic Circuits", 1st Edition, Morgan Kaufmann, 2005.

23IR203 ELECTRIC CIRCUIT THEORY

BASIC CIRCUIT CONCEPTS: Ohm's law - Resistors, Capacitors and Inductors - Series and Parallel Combination circuit - Sources - Introduction to Dependent Sources - Kirchhoff's Laws - Source Transformation - Magnetically coupled circuit - Illustration of dot conventions

NETWORK THEOREMS: Star Delta Transformation - Mesh Analysis - Nodal Analysis - Superposition theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem

SINGLE PHASE AC CIRCUITS: Introduction to Alternating Quantities - Average and RMS values - Phasor Representation of Alternating Quantities - Mathematical representation of Phasor - Behavior of Pure Resistor, Pure Inductor and Pure Capacitor in an AC circuit - Series RL circuit - Series RC circuit - Series RLC circuit – Parallel RC circuit - Parallel RL circuit - Real power, Reactive power, Apparent power - Series resonance and parallel resonance

THREE PHASE CIRCUIT ANALYSIS: Introduction - Advantages of Three Phase System - Interconnection of three phases Star and Delta connection - Voltage, Current and Power Relations in Balanced Star and Delta connected Load - Comparison between Star and Delta connection - Introduction to Three Phase circuit analysis with star and delta unbalanced loads - Measurement of Three Phase Power (10 + 3)

TRANSIENT ANALYSIS OF FIRST AND SECOND ORDER LINEAR CIRCUITS: Transient Concepts - Network equations, Initial conditions, Evaluation of RL and RC circuits - Transient and steady state response of RL and RC Circuits to various functions

TEXT BOOKS:

1. Ravish R Singh, "Electrical Networks", New Delhi: Tata McGraw Hill, 2017.
2. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, 2013.

REFERENCES:

1. Joseph A Edminister and Mahmood Nahvi, "Electric Circuits", Tata McGraw Hill, 2013.
2. Richad C Dorf and James A Svoboda, "Introduction to Electric Circuits", John Wiley and Sons Inc., 2013.
3. David A Bell, "Electric Circuits", PHI Pvt. Ltd, 2009.
4. William H. Hayt, Jr., Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 2013.

23IR204 STRENGTH OF MATERIALS

STRESSES AND STRAINS: Stress and strain due to axial force – Types of stresses and strains – Stress-strain curve for ferrous and non-ferrous materials - Material properties - Hooke's law - Factor of safety – Analysis of stepped bar, uniformly varying bar, composite bar – Thermal stresses – Thermal stresses in composite bar

CHANGES IN DIMENSIONS AND VOLUME: Longitudinal strain - Lateral strain - Poisson's ratio - Volumetric strain - Changes in dimensions and volume - Shear stress, shear strain - Relationship between elastic constants

PRINCIPAL STRESSES AND STRAINS: State of stress in two dimensions - Principal Stresses and principal planes - Stresses on inclined planes - Normal, tangential, and resultant stresses on a given plane - Maximum shear stress -Mohr's circle method

TORSION: Theory of torsion and assumptions - Torsion equation - Polar moment of inertia - Polar modulus - Stresses in solid and hollow circular shafts - Power transmitted by a shaft - Strength of shaft and torsional rigidity

BEAMS: Relationship between load, shear force and bending moment - Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, concentrated moments - Maximum bending moment and point of contra flexure - Theory of simple bending and assumptions - Bending equation – Area moment of inertia - Section modulus - Normal stresses due to flexure

TEXT BOOKS:

1. Punmia B C., Ashok Kumar Jain and Arun Kumar Jain, "Mechanics of Materials", Laxmi Publications, New Delhi, 2017.
2. Hibbeler R. C., "Mechanics of Materials", 10th Edition, Pearson Education, 2017.

REFERENCES:

1. Ramamrutham S and Narayan R., "Strength of Materials", Dhanpat Rai and Sons, New Delhi, 2018.
2. Egor P Popov, "Engineering Mechanics of Solids", 2nd Edition, Pearson Education, 2015.
3. Gere & Timoshenko, "Strength of Materials", 2nd Edition, CBS Publisher, 2006.
4. William F. Riley, Leroy D. Sturges, Don H. Morris, "Mechanics of Materials", 6th Edition, Wiley, 2010.

23IR205 MANUFACTURING TECHNOLOGY

METAL CASTING: Importance and Classification of manufacturing processes - Foundry –Patterns – Parting lines – Mould and core making – Melting: Types of furnaces - Casting - Principles and applications - Sand casting - Shell moulding - Investment casting – Pressure die casting – Centrifugal casting.

METAL FORMING AND WELDING: Forming - Construction, principles, process parameters and applications - Forging – Extrusion - Sheet metal forming - Injection moulding - Compression moulding – Welding - Construction, principles, process parameters and applications - Shielded Metal Arc Welding (SMAW) - Metal Inert Gas (MIG) Welding - Tungsten Inert Gas (TIG) Welding - Robotic Welding. **METAL CUTTING FOR CYLINDRICAL COMPONENTS:** Theory of metal cutting – Cutting tools - Types of lathes – Specifications - Lathe operations: Facing – Turning – Taper turning – Grooving – Boring – Drilling – Cutting off/Parting off – Threading – Knurling – Profiling - Work holding devices

METAL CUTTING FOR PRISMATIC COMPONENTS: Introduction to special machines – Construction, principles, process parameters and applications - Shaping machine - Slotting machine – Milling machine – Drilling machine – Boring machine - Grinding machine.

NON-CONVENTIONAL MACHINING PROCESSES: Principles - process parameters and applications - Electrical Discharge Machining (EDM) – Wire cut EDM – Laser beam machining – Plasma arc machining - Water jet machining - Electron beam machining.

TEXT BOOKS:

1. P. N. Rao, "Manufacturing Technology Vol I and II", Tata-McGraw-Hill Publishing Limited, 2018.
2. HMT, "Production Technology", McGraw-Hill Education, 2017.

REFERENCES:

1. Ghosh A, Mallik A.K, "Manufacturing Science", Affiliated East West Press Ltd., 2010.
2. Serope Kalpakjian, "Manufacturing Engineering and Technology", 8th Edition, Pearson India., 2020.
3. Hajra Choudhury, "Elements of Workshop Technology, Vol. I & II", Media Promotors Pvt. Ltd., 2010.
4. Radhakrishnan, "Manufacturing Technology I", SciTech Publications Pvt. Ltd., 2010.

23IR210 ELECTRICAL AND ELECTRONICS LABORATORY

1. Measurements and operations using CRO, DSO, Function Generator and RPS
2. Soldering, de-soldering and crimping practices
3. Experimental verifications using Resistors, Inductors and Capacitors: Series - Parallel combination of resistors

inductors and capacitors; Resistors use in Current limiting circuits, and Voltage division

4. Verification of Ohm's, Kirchhoff's laws, Thevenin's theorem and Norton's Theorem
5. Measurement of Power factor in RL and RC Circuit and Series & Parallel resonance circuits
6. AC and DC circuit analysis, Transient analysis of RL, RC and RLC circuit using PSPICE
7. Characteristics of PN Junction Diode, Zener Diode and BJT- CE configuration
8. Characteristics and linear Applications of Op-Amp: Inverting and Non-inverting amplifier; Slew rate and CMRR; Comparator,

Level Detector; Summing and Difference Amplifier

9. Generation of waveform using Op-Amp and Pulse Width Modulation: Square, Triangle, and Sine waveform
10. Performance characteristics of Voltage Regulator ICs: 7805, 7812, 723

REFERENCE:

2. Department of Robotics and Automation Engineering, "Electrical and ElectronicsLaboratory Manual" 2023.

23IH073 ORGANIZATIONAL BEHAVIOR

Introduction to OB: Meaning & Importance of OB – Historical Development & Contributing Disciplines

Personality – Personality determinants & attributes, Emotional Intelligence and Work Values Employment relationship and the psychological contract

Motivation - Basic Concepts, Motivation Theories, Problems in Motivation

Leadership - Theories of leadership, Leadership styles and effectiveness

Group Dynamics: Types of Groups, Group Norms and Cohesiveness: Group Roles.

Organizational Culture - Elements, Culture and Performance, merging organizational cultures, changing and strengthening culture.

Organizational Change - Forces for change force field analysis model Organization Development

Work Stress - Causes and consequences – Stress coping strategies

Case studies

REFERENCES:

1. Mc Shane Von Glinow and Radha Sharma, "Organisational Behaviour", Tata Mc Graw Hill, 4th Edition, 2008
2. Stephen P Robbins, "Organisational Behaviour", Prentice Hall (India) Pvt. Ltd., New Delhi, 13 th Edition, 2009
3. Kreitner Robert, Kinicki , Angelo, "Organsiational Behaviour", Irwin Inc., Illinois, 2 nd Edition, 2006
4. Hellriegel, "Organsiational Behaviour" Thomson Learning, 1st edition, 2005
5. Ivancevich, "Organsiational Behaviour" Tata Mc Graw Hill, 7th Edition, 2006.

SEMESTER – 3

23IR301 LINEAR ALGEBRA

VECTOR SPACES: General vector spaces - real vector spaces - Euclidean n-space - subspaces – linear independence-coordinates and basis - dimension – change of basis - row space, column space and null space – consistency of linear systems - rank and nullity

LINEAR TRANSFORMATIONS: General linear transformation - matrix transformations- geometry of linear operators on R^2-matrices for general linear transformations - similarity.

INNER PRODUCT SPACES: Inner products - angle and orthogonality in inner product spaces, Gram - Schmidt process:QR decomposition, best approximation: least squares - least squares fitting to data.

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors, diagonalization - orthogonal diagonalization - quadratic forms.

MATRIX DECOMPOSITION AND OPTIMIZATION: Spectral decomposition - singular value decomposition - reduced singular value decomposition - optimization using quadratic forms.

TEXT BOOKS

1. Howard Anton, Chris Rorres, Anton Haul "Elementary Linear Algebra", Wiley India, New Delhi, 2019.
2. David C Lay, Judi J. McDonald, Steven R. Lay "Linear Algebra and its Applications", Pearson Education, New Delhi, 2021.

REFERENCES

1. Gareth Williams, "Linear Algebra with Applications", Narosa Publishing House, New Delhi, 2017.
2. Gilbert Strang, "Linear Algebra and Learning from Data", Wellesley-Cambridge Press, USA, 2019.
3. Friedberg, Insel and Spence, "Linear Algebra", Pearson Education, USA, 2015.
4. Steven J Leon, "Linear Algebra with Applications", Pearson Education, USA, 2015.

23IR302 ELECTRICAL MACHINES AND POWER SYSTEMS

DC MACHINES : Electromechanical energy conversion - Rotating machines - Driving and opposing torque - Faradays law - Generator mode and Motor mode - Constructional details of DC Machines - EMF equation - Methods of excitation – Self and separately excited Shunt generator - Principle of operation of DC Motor – back emf and torque equation - Characteristics of DC series and shunt motors - Starting of DC Motors, Need for Starters - Speed control and Braking of DC motors (Voltage Control & Dynamic Braking Only) - Principle and types of PMDC motors

TRANSFORMERS: Constructional Details – Principle of Operation – EMF Equation – Transformation ratio - Transformer on no load – Parameters referred to HV/LV windings – Equivalent circuit - Dot Convention - Transformer on load- Regulation - Losses and efficiency - Load test - Three phase transformer connections - Introduction to Current and Potential Transformers and its classes - Applications of Transformer in Robotics and Automation

INDUCTION MOTORS: Construction – Types – Principle of operation of three phase induction motor - Speed Torque characteristics - Equivalent circuit - Starting and Speed control - Single-phase induction motors (only qualitative analysis) - Introduction to Linear induction motor - PMSIM – Applications

SYNCHRONOUS AND SPECIAL MACHINES: Construction of Synchronous machines - Types – Induced emf - Working principles of: Brushless alternators and Universal motor- working principles, types and control of stepper motor and servomotor - Applications – rating and duty cycle

INTRODUCTION TO POWER SYSTEMS: Structure of electric power systems - Generation, transmission, sub- transmission and distribution systems - EHVAC and EHVDC transmission systems - Substation layout-Study of typical power system and developing single line diagram (Concepts only)

TEXT BOOKS:

1. K Murugesh Kumar, "DC Machines and Transformers", 2nd Edition, Vikas Publishing House Pvt Ltd, 2004.
2. K Murugesh Kumar, "Induction and Synchronous Machines", 1st Edition, Vikash Publication Pvt Ltd, 2000.

REFERENCES:

1. V K Mehta, Rohit Mehta, "Principles of Power System", S Chand and Company Ltd, 2005.
2. B S Guru, H R Hiziroglu, “Electrical Machinery and Transformers”, 3rd Edition, Oxford University Press, 2001.
3. AE Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Machinery", 6th Edition, Tata McGraw Hill publishing Company Ltd, 2003.
4. D P Kothari, I J Nagrath, “Electric Machines”, 5th Edition, Tata McGraw-Hill Education, 2017.

23IR303 KINEMATICS AND DYNAMICS OF MACHINERY

BASICS OF MECHANISMS: Definitions: Link, Kinematic pair, Kinematic chain, Mechanism and Machine - Degree of freedom – Kutzbach criterion – Grashof’s law - Kinematic inversions: Four bar and slider crank mechanism - Mechanical advantage - Transmission angle - Description of common mechanisms, Mechanisms for robotic gripper

KINEMATIC ANALYSIS: Displacement, velocity and acceleration analysis in simple mechanisms using graphical method - Introduction tosynthesis of mechanism

BALANCING AND FORCE ANALYSIS: Balancing of rotating masses - Single mass rotating in same plane, two masses rotating in different planes, several masses rotating in same and different planes – Balancing of reciprocating masses – Force analysis - Free body diagrams, Inertia forces and moments

CAMS: Introduction to cams - Classifications -Law of cam design - Cam function and follower motion schemes: uniform velocity, simple harmonic motion, uniform acceleration and retardation motion -Introduction to high-speed cams - Layout of cam profiles for knife-edge follower and rollerfollower

GEARS: Spur gear terminology - Fundamental law of toothed gearing -Tooth forms - Helical, bevel, worm, rack and pinion gears (basics only) - Gear trains -Epicyclic gear trains, differentials and harmonic drives

TEXT BOOKS:

1. Rattan S S, "Theory of Machines", Tata McGraw -Hill Publishers, New Delhi, 2009.
2. Norton L, "Kinematics and Dynamics of Machinery", 5th Edition, Tata McGraw -Hill Publishers, 2016.

REFERENCES:

1. Myszka, DH, "Machines and Mechanisms: Applied kinematic analysis", 4th Edition, 2012.
2. Shigley J E, Uicker J J, "Theory of Machines and Mechanisms", McGraw -Hill Inc., New Delhi, 2003.
3. Bevan.T, "Theory of Machines", CBS Publishers and Distributors, New Delhi, 2002.
4. Ghosh, Mallick.A K, "Theory of Machines and Mechanisms", Affiliated East West Private Limited, New Delhi, 1988.

23IR304 MICROPROCESSORS AND MICROCONTROLLERS

NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES : Review of Number Systems - Number representation: Signed, Unsigned, Fixed point, Floating point - Computer codes-BCD, Gray code, Excess 3 code, Error detection and correction codes: Parity, Hamming codes - Logic Gates - Boolean Algebra - Basic Postulates and Theorems - Switching Functions- Canonical Forms - Standard representation of Logic Functions - Simplification of Logic Functions through K-maps and Quine – McClusky Method - Implementation using Logic Gates

COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS: Decoders, Encoders, Multiplexers and Demultiplexers - Binary /BCD adders and subtractors - Magnitude comparator - General model of sequential circuits - Latches - Flip Flops - Counters - Shift registers - Concept of State - State Diagram - Design of Synchronous Sequential Circuits – Updown / Modulo counters

MICROCONTROLLER ARCHITECTURE AND PROGRAMMING: Architecture of 8085 Microprocessor - Architecture of 8051 Microcontroller - Memory organization - Register Banks - Bit addressable area - SFR area – Addressing modes - Instruction Set - Programming Examples **-** Interrupt structure – Timer Modules - Serial Features - PortStructure – Power Saving Modes
ARM PROCESSORS: ARM Programmer’s Model – Registers - Processor Modes –State of the processor - Condition Flags – ARM Pipelines - Exception Vector Table – ARM Processor Families - Typical 3 stage pipeline ARM organization - ARM Addressing Modes - ARM Instruction Set Overview – Thumb Instruction Set Overview – Embedded C programming examples - Development boards based on ARM

ON-CHIP AND OFF-CHIP PERIPHERAL INTERFACING: Parallel Ports - Timer / Counter - Capture / Compare - RTC - WDT - PWM - QEI - EEPROM - ADC - Seven Segment LED - Switch - Matrix Keyboard - DC Motor - Servo Motor - Stepper Motor **-** Communication Protocols

TEXT BOOKS:

1. Alan B Marcovitz, "Introduction to Logic Design", , 2nd Edition, New Delhi: Tata McGraw Hill, 2005.
2. Muhammed Ali Mazidi, J G Mazidi, Rolin D Mckinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson Education Limited, 2014.

REFERENCES:

1. Muhammad Tahir and Kashif Javed, "ARM Microprocessor Systems Cortex®-M Architecture, Programming, and Interfacing", CRC Press, 2017.
2. Jochen Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Addison Wesley Trade Computer Publications, 2000.
3. Tocci R J, Widmer N and Moss G., "Digital Systems: Principles and Applications", New Delhi: Pearson, 2013.
4. Donald Givone, "Digital Principles and Design", New Delhi: Tata McGraw Hill, 2012.
5. Floyd T L, "Digital Fundamentals", New Delhi: Pearson Education, 2009.

23IR305 ENGINEERING ECONOMICS

FUNDAMENTALS OF ECONOMIC ANALYSIS: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency

COST AND INVENTORY CONTROL: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages- Depreciation Methods – Problems in Straight Line and Diminishing Balance Method.

PRICING, REVENUE AND VALUE ENGINEERING: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering

PROJECT MANAGEMENT: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis

ECONOMIC GROWTH AND DEVELOPMENT: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy

TEXT BOOKS:

1. Panneerselvam. R., "Engineering Economics", PHI Learning Private Limited, 2012.
2. Metha P.L, "Managerial Economics – Analysis, Problems and Cases", Sultan Chand & Sons, 2016.

REFERENCES:

1. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, "Principles of Engineering Economics with Applications, Cambridge University Press, 2018.
2. Varshney, R.L and K.L. Maheshwari, "Managerial Economics", Sultan Chand & Sons, 2014.
3. McEachern and Indira., "Macro ECON", Cengage India Private Limited, 2017.
4. Shalini Goyal Bhalla, "Circular Economy (Re) Emerging Movement", Invincible Publishers, 2020.

23IR311 MECHANICS AND ELECTRICAL MACHINES LABORATORY

MECHANICS:

1. Determination of transmission angle and kinematic quantities of a four-bar mechanism and slider crank mechanism.
2. Preparation of cam displacement curve and determination of jump speed of the cam.
3. Static and dynamic balancing using a dynamic balancing machine.
4. Kinematic analysis for slider crank mechanism using simulation software.
2. Kinematic analysis for four bar mechanisms using simulation software.

ELECTRICAL MACHINES:

1. Load characteristics of DC series and shunt motor
2. Speed control of dc shunt motor by armature and field control
3. Load test on single-phase transformer
4. O.C and S.C test on single-phase transformer
5. Load test on three-phase Induction motor

6. Draw a Single Line Diagram for the Electrical Power System
7. Characteristics of VR and Hybrid Stepper motor

REFERENCE:

1. Department of Robotics and Automation Engineering, "Mechanics and Electrical Machines Laboratory Manual", 2023.

23IR312 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

1. ALP for Arithmetic Operations
2. ALP for Logical Operations
3. Interfacing Matrix Keypad
4. Interfacing LED & LCD Display
5. Blink LEDs using Timers
6. Generate an Alarm at desired time using Real Time Clock
7. PWM based Speed Control of DC Motor
8. Serial Communication Protocols
9. Interfacing Stepper Motor
10. Interfacing Analog Sensors

REFERENCE:

1. Department of Robotics and Automation Engineering, "Microprocessors and Microcontrollers Laboratory Manual", 2023.

SEMESTER – 4

23IR401 PROBABILITY AND STATISTICAL METHODS

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axiomatic approach to probability, Baye's theorem, discrete random variables, probability mass functions, cumulative distribution functions, mean and variance, discrete uniform, binomial, Poisson and geometric distributions

CONTINUOUS RANDOM VARIABLES: Continuous random variables, probability density functions, cumulative distribution functions, mean and variance, uniform, exponential, Weibull and normal distributions.

JOINT PROBABILITY DISTRIBUTIONS: Two dimensional discrete and continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation and linear regression.

STATISTICAL INFERENCE: Point estimation – maximum likelihood estimation - interval estimation – hypotheses concerning means – large, small samples and matched pairs - hypotheses concerning variances – hypotheses concerning proportions, chi square test for goodness of fit and independence of attributes

ANALYSIS OF VARIANCE AND STATISTICAL QUALITY CONTROL: Analysis of variance - completely randomized designs, randomized block designs - process capability - control charts for measurements – $\bar{X}$, R charts - control charts for attributes - p, np, c charts.

TEXT BOOKS

1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018.
2. Richard A. Johnson, "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, New Delhi, 2017.

REFERENCES

1. Ronald E. W, Raymond H. M, Sharon L. M and Keying Ye, "Probability & Statistics for Engineers & Scientists, Pearson Education, New Delhi, 2016.
2. Robert V. H, Elliot T and Dale Z, "Probability and Statistical Inference", Pearson Education, New Delhi, 2021.
3. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning**,** New Delhi 2020.
4. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic press, USA, 2020.

23IR402 CONTROL SYSTEMS

INTRODUCTION: Components of Automatic control systems- Open loop and closed loop systems - Examples - Transfer function - Modeling of physical systems - Mechanical Systems - Translational and Rotational systems - Electrical Systems - Block diagram - reduction techniques - Signal flow graph - Mason's gain formula.

TIME DOMAIN ANALYSIS: Continuous time signals - Standard Test signals - Classification of continuous time systems - Linear-Nonlinear - Time variant - Time invariant - Static - Dynamic - Time response of second order system - Time domain specifications - Types of systems - Steady state error constants -Generalized error series - Introduction to P, PI and PID modes of feedback control. - Introduction to lead, lag and lead-lag compensators

FREQUENCY DOMAIN ANALYSIS: Frequency domain specifications - Estimation for second order systems- Correlation between time and frequency domain specifications for second order systems. Bode plot – Determination of Transfer Function from Bode plot - All pass minimum phase and non-minimum phase systems - Polar plot - Determination of gain and phase Margins from the plots

STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model - state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables - State equations - Transfer function from the State model - Solutions of the state equations -State Transition Matrix - Concepts of controllability and observability.

SYSTEM STABILITY: Concept of stability - stability and location of the poles in S-plane - Characteristic equation - Routh- Hurwitz stability criterion - Root Locus concepts- Construction of root locus – Root contours - Absolute and Relative stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability - Gain and Phase Margin.

TEXT BOOKS:

1. Norman S Nise, "Control System Engineering", 8th Edition, John Wiley & Sons, Singapore, 2020.
2. Nagrath I J, Gopal M, "Control Systems Engineering", 6th Edition, Prentice Hall of India, New Delhi, 2017.

REFERENCES:

1. Richard C Dorf, Robert H Bishop, "Modern Control Systems", 14th Edition, Pearson Education, New Delhi, 2022.
2. Smarajit Ghosh, "Control Systems Theory and Applications", 2nd Edition, Pearson Education, New Delhi, 2012.
3. Ogata K, "Modern Control Engineering", 5th Edition, Pearson Education, New Delhi, 2015.
4. B S Manke, “Control System Design an Introduction”, 1st Edition, Mercury Learning and Information, 2017.
5. B. C. Kuo, Automatic Control Systems, 10th Edition, McGraw Hill Education, 2018.

23IR403 BASICS OF ROBOTICS

INTRODUCTION : Classification of Robots based on Geometry, Workspace, Actuation, Control and Application - Advantages and Disadvantages of Robots - Robot Components: Manipulator, Wrist, End-effector , Actuator , Sensor, Controller - Processor,Software - Degrees of Freedom - Robot Joints - Coordinates - Reference frames - Robot Specifications: Number of Axes - Major, Minor, Redundant - Payload Capacity and Speed- Reach and Stroke - Tool Orientation (RPY) - Repeatability - Precision and Accuracy – Workspace

HOMOGENEOUS TRANSFORMATIONS: Matrix Representation: Representation of a point and vector in space, Global and Local Coordinate axes - Homogeneous Transformation Matrices: Representation of Pure Translation, Pure Rotation and Combined Transformations - Inverse of Transformation Matrices - Forward and Inverse Kinematic Equation: Position and Orientation.

FORWARD KINEMATICS: Denavit-Hartenberg Notation - Transformation between two Adjacent Coordinate Frames - Forward Kinematics of Two, Three, Four, Five and Six axis Robots

INVERSE KINEMATICS: Decoupling Technique - Inverse Transformation Technique - Inverse position: Geometric Approach – Inverse Orientation - Inverse Kinematics of Two, Three, Four, Five and Six axis Robots

VELOCITY KINEMATICS: Angular Velocity – Linear Velocity - Jacobian representation of Linear and Angular Velocity - Calculation of Jacobian for Two, Three and Four axis Robots - Inverse Jacobian - Singularities: Wrist and Arm Singularities - Manipulability - Induced joint torques and forces.

TEXT BOOKS:

1. Niku S B, "Introduction to Robotics, Analysis, Control, Applications", John-Wiley & Sons Inc, 2011.
2. Robert J. Schilling, "Fundamentals of Robotics, Analysis and Control", PHI Learning, 2009

REFERENCES:

1. Reza N Jazar, "Theory of Applied Robotics", Springer, 2010.
2. Saha S K, "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd, 2010.
3. R K Mittal and I J Nagrath, “Robotics and Control”, Tata McGraw Hill Publishing Company Ltd, 2003
4. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, "Robot Modeling and Control", Wiley, 2012.

23IR404 OBJECT ORIENTED PROGRAMMING USING C++ AND PYTHON

INTRODUCTION: Basic concepts of OOP – Characteristics of Object Oriented Languages –Structure of C++ program – Class Specification- Member Function Definition –Constructors – Destructors in C++ – objects as data types – Objects as function arguments - Structures and Classes - Static Members – Function overloading

OPERATOR OVERLOADING: Operator function, overloading unary and binary operators, Operator overloading using friend function, Overloading insertion and extraction operator, Type Conversion.

INHERITANCE AND POLYMORPHISM: Defining derived classes, Types of inheritance, Constructors in derived and base class, Virtual base classes, Abstract classes, Virtual function, Dynamic polymorphism

PYTHON: Basics of Python programming - Conditional and Looping statements- Arrays- String Manipulations-Collections: List, Tuple, Set, Dictionary- Functions - lambda function- Modules: Standard Modules - OS and SYS modules - User defined Modules - Importing modules – Packages

FILES AND EXCEPTIONS: Data Streams - Access Modes – File handling in C++ and Python - Exceptions in C++ and Python: Exception Model - Exception Hierarchy – Exception Handling - Handling Multiple Exceptions

TEXT BOOKS:

1. Deitel and Deitel, "C++ How to program", Pearson, 10th Edition, Pearson, 2016.
2. Charles Dierbach "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India., 2015

REFERENCES:

1. Herbert Schildt, "C++: The Complete Reference", Tata McGraw Hill Publishing Company, New Delhi, 2011
2. Stanley B. Lippman and JoseeLajoie, "C++ Primer", Pearson Education, New Delhi, 2010.
3. Mark Summerfield. —Programming in Python 3: A Complete introduction to the Python Languagell, Addison-Wesley Professional, 2009
4. Allen Downey, "Think Python", 1st Edition, Green Tea Press, 2016.

23IR405 HYDRAULICS AND PNEUMATICS

INTRODUCTION TO FLUID POWER: Introduction to fluid mechanics: Pascal's Law, Bernoulli's equation, Properties - hydraulic fluids, air, Selection of hydraulic fluids, comparison between hydraulics and pneumatics, Symbols of hydraulic and pneumatic elements - Introduction to bionics.

ELEMENTS OF PNEUMATIC SYSTEM: Compressors-types, constructional details of filter, regulator, lubricator, dryer - constructional features - types of actuators, control valves for direction, pressure and flow, air motors, air hydraulic equipment - Vacuum Technology – Selection criteria - Applications

PNEUMATIC CONTROL SYSTEM DESIGN: General approach to circuit design, schematic layout, travel step diagram, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping, Electro pneumatics, ladder diagram and PLC programming for specific hydraulic and pneumatic applications, Pneumatic system design for robotic applications

ELEMENTS OF HYDRAULIC SYSTEMS: Pumps - types - characteristics - Valves for control of direction, flow and pressure - types, typical construction details - Actuators – types and constructional details, Accumulators – types and application circuits, Intensifiers, Servo and Proportional valves – types and operation

HYDRAULIC SYSTEM DESIGN: Industrial Circuits - Deceleration circuit, regenerative circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits, Power pack–elements - design - Pipes- material, pipe fittings, Maintenance of hydraulic systems, Selection criteria for cylinders and valves - hydraulic system design for robotic applications

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Application", Pearson Education Pvt. Ltd, 2018.
2. Srinivasan R, "Hydraulic and Pneumatic Controls", McGraw –Hill education Pvt. Ltd, 2011.

REFERENCES:

1. Majumdar S R, "Pneumatic Systems: Principles and Maintenance", Tata McGraw Hill, New Delhi, 2017.
2. Majumdar S R, "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw Hill, New Delhi, 2017.
3. James Sullivan, "Fluid Power: Theory and Applications", 4th Edition, Prentice Hall, New Jersey, 1997.
4. Peter Rohner, "Fluid Power Logic Circuit Design - Analysis, Design Method and Worked Examples", The Macmillan Press Limited, London, 1979.

23IR410 PYTHON PROGRAMMING LABORATORY

1. Basic programs - Data types, assignments, expressions.
2. Branching statements
3. Looping statements
4. Functions and Lambda Functions
5. Lists and Tuples
6. Set and Dictionary
7. Classes and inheritance
8. File Handling
9. Exception Handling
10. Packages & Modules

REFERENCES:

1. Mark Summerfield, "Programming in Python 3: A Complete introduction to the Python Language", Addison-Wesley Professional, 2009
2. Allen Downey, "Think Python", 1st Edition, Green Tea Press, 2016

23IR411 HYDRAULICS AND PNEUMATICS LABORATORY

1. Design of simple pneumatic and hydraulic circuits using basic components
2. Construction and testing of multiple pneumatic actuator circuits using Cascade/ KV map method
3. Testing of multiple pneumatic actuator circuits with time delay valve and pneumatic counter
4. Co-ordinated motion of actuators using electro – pneumatic elements
5. Construction and testing of a hydraulic actuator application circuit
6. Co-ordinated motion of actuators using electro – hydraulic elements
7. Design and Simulation of hydraulic circuits using simulation software
8. Design and Simulation of pneumatic circuits using simulation software
9. Design and Testing of two hand safety circuits in a hydraulic punching machine
10. Pneumatic circuit design and testing of robotic grippers
11. Pneumatic circuit design and testing of suction grippers
12. Simulation and testing of MPS modules

REFERENCE:

1. Department of Robotics and Automation Engineering, "Hydraulics and Pneumatics Laboratory Manual", 2023

23IR412 DIGITAL AND CONTROL SYSTEMS LABORATORY

DIGITAL:

1. Study of Logic Gates and realization of SOP and POS Expressions
2. Implementation of Adders and Subtractors
3. Design and Implementation of Code Converters
4. Implementation Multiplexers and Demultiplexers
5. Realization of Flip Flops using AND Gates
6. Design and Implementation of Counters and Shift Registers

CONTROL SYSTEMS:

1. Determination of transfer function of AC servomotor
2. PID tuning in temperature control applications
3. Inverted pendulum control using PID
4. Aero Pendulum control using PID
5. Time domain Response of Quadcopter
6. Frequency Response of 2 DoF Robot Arm

REFERENCE:

1. Department of Robotics and Automation Engineering, "Digital and Control Systems Laboratory Manual", 2023.

SEMESTER – 5

23IR501 DYNAMICS AND CONTROL OF MANIPULATORS

ACCELERATION AND MOTION DYNAMICS: Angular Acceleration Vector and Matrix - Rigid Body Acceleration - Forward Acceleration Kinematics - Inverse Acceleration Kinematics - Force and Moment - Rigid Body Translational and Rotational Kinetics - Mass Moment of Inertia Matrix – Lagrange's form of Newton Equations - Lagrangian Mechanics

ROBOT DYNAMICS: Robot Dynamics - Forward Dynamics, Inverse Dynamics - Rigid-link Newton Euler Dynamics - Robot Lagrange Dynamics - Lagrange Equations and Link Transformation Matrices

PATH PLANNING: Cubic Path - Polynomial Path - Manipulator motion by Joint Path - Cartesian path - Rotational Path - Manipulator motion by End-Effector Path

LINEAR CONTROL: Control Techniques - Dynamic Systems - Transfer Function and State Space Representation - A Robotic Joint - Performance and Stability of Feedback Control - PID Control of a Moving Block - Selection of PID Controller Gains - State-Feedback Control - Joint Controllers

NONLINEAR AND FORCE CONTROLS: Robot Control Algorithms - Control of a Moving Block - Multivariable Robot Control - Stability of Multi-DOF Robot - Linearized Control - Proportional-Derivative Position Control - Computed-Torque Control - Feedforward Control - Force Control - Hybrid Control

TEXT BOOKS:

1. Reza N Jazar, "Theory of Applied Robotics", Springer, 2010.
2. Saha S K, "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd, 2010.

REFERENCES:

1. Robert J. Schilling, "Fundamentals of Robotics, Analysis and Control", PHI Learning, 2009.
2. Niku S B, "Introduction to Robotics, Analysis, Control, Applications", John-Wiley & Sons Inc, 2011.
3. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, "Robot Modeling and Control", Wiley, 2012.
4. R K Mittal and I J Nagrath, “Robotics and Control”, Tata McGraw Hill Publishing Company Ltd, 2003.

23IR502 DESIGN OF MECHANICAL TRANSMISSION SYSTEMS

DESIGN OF SHAFTS, KEYS AND COUPLINGS: Shafts - Types and application - Forces on shafts due to gears and belts - Design of shafts based on strength and rigidity - Keys, types and applications - Design of keys - Couplings, types and applications, design of rigid couplings
DESIGN OF GEARS: Gears – Gear materials – Gear tooth failures - Design of spur gear and helical gears – Introduction to gearbox - Selection of gear boxes

SELECTION OF BELTS AND CHAINS: Belts -Types and application - Selection of flat belt and timing belt for given power and velocity ratio - Chains -Types and application - Selection of roller chain for specific applications

SELECTION OF BEARINGS: Bearings – Types and application - Rolling contact bearings - Static and dynamic load capacity, Equivalent bearing load, probability of survival, Bearing life -Selection of deep groove ball bearings

SELECTION OF MOTION COMPONENTS: Selection of servomotor for automation system - Inertia force calculation - LM Guideways - Selection of LM guideways for specific applications - Ball screws - Selection of ball screws for specific applications

TEXT BOOKS:

1. Robert L Norton, "Machine Design - An Integrated Approach, Pearson Education", New Delhi, 2013.
2. Bandari V B, "Design of Machine Elements", 4th Edition, McGraw Hill Education India, 2016.

REFERENCES:

1. Shigley and Mische , "Mechanical Engineering Design", McGraw Hill Education India, 2003.
2. Faculty of Mechanical Engineering, PSG College of Technology, "PSG Design Data Book", Kalaikathir Achchagam, 2015.
3. Robert L Mott, "Machine Elements in Mechanical Design", Pearson Prentice Hall, 2014.
4. Wilfried Voss, "A Comprehensible Guide to Servo Motor Sizing", Copperhill Technologies Corporation, Massachusetts, 2007.

23IR503 PLC AND SCADA

INTRODUCTION: History and developments in Industrial Automation - Vertical Integration of Industrial Automation - Control elements in Industrial Automation – Safety standards - PLC Introduction - Basics of PLC - Advantages - Capabilities of PLC - Architecture of PLC - Scan cycle - Types of PLC - Types of I/O modules - Configuring a PLC - PLC wiring

PROGRAMMING OF PLC: Introduction to state machine theory -Types of Programming - Process Control Programs using Relay Ladder Logic - PLC arithmetic functions - Timers and counters - data transfer, compare and manipulation instructions - PID instructions - PTO / PWM generation

NETWORKING OF PLCs: Industrial Networking Buses (Flow Diagram Only) - Comparison of Industrial Buses - Protocols - Field bus - Process bus - Modbus - ProfiNet - ControlNet – DeviceNet - Ethernet - EtherCAT - BACnet - CAN bus protocol - Networking using Modbus and Profibus

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) : SCADA overview - Developer and runtime packages - Architecture - Tools - Tag - Internal & External graphics - Alarm logging - Tag logging - Trends - History - Report generation. Communication Protocols of SCADA - Proprietary and Open Protocols - OLE/OPC - DDE - Server/Client - Interfacing of SCADA with PLC and other field devices

HMI SYSTEMS AND APPLICATIONS: Need and Role of HMI in Industrial Automation - Types of HMI panels: Text display - operator panels - Touch panels - Panel PCs - Integrated displays - HMI Programming - Interfacing PLC to HMI - UX Design - Case studies - Machine automation - Industrial automation - Process Automation

TEXT BOOKS:

1. John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, 5th Edition, Prentice Hall India, 2013.
2. Frank D Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw-Hill Education, 2016.

REFERENCES:

1. W. Bolton, “Programmable Logic Controllers”, 5th Edition, Newnes Publication, 2009.
2. Kelvin T Erikson, “Programmable Logic Controllers”, 3rd Edition, Dogwood Valley Press, 2016.
3. David Bailey, Edwin Bright, “Practical SCADA for industry”,1st Edition, Newnes, Burlington, 2003.
4. Siemens, “S7-1200 Easy Book Manual”, 2015.

23IR504 DATA STRUCTURES AND ALGORITHMS

INTRODUCTION: Data Structures- Need for Data Structures -Types of Data Structures- Abstract DataTypes - Algorithms: Properties - Complexity Analysis- Best case and worst case complexities - Recurrence Relations- Asymptotic Notations

ARRAYS AND LISTS: Representation of linear and multidimensional arrays - Operations – Applications - Representation of linked list-Operations on singly linked list: Traversal–Search –Insertion –Deletion -Doubly linked list - Circularly linked list - Applications: Addition of Polynomials; Sparse Matrix representation

STACK AND QUEUE: Stack Representation and operations – Applications: Recursion Handling- Infix to postfix conversion - Evaluation of postfix expression - Queue: Representation and Operations - Types: Circular Queue - Deque – Priority Queue – Applications

TREES AND GRAPHS: Tree Terminologies - Binary Trees - Representation - Traversals - Expression Trees - Threaded Binary Tree - Binary Search Tree (BST): Representation and Operations – Applications, Graph: Terminologies - Types of Graphs - Representation - Traversal: Breadth first search- Depth first search – Applications

SORTING AND SEARCHING: Insertion sort - Selection sort - Bubble sort - Heap sort - Quick sort - Merge sort - Linear search – Binary search - Hashing: Hash functions-Collision resolution techniques –Searching using Hashing

TEXTBOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Pearson Education, New Delhi, 2014.
2. Seymour Lipschutz, Vijayalakshmi Pai G.A, "Data Structures", Tata McGraw Hill, New Delhi, 2013.

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, Hyderabad, 2018.
2. Yedidayah Langsam, Moshe J Augenstein, Aaron M Tannenbaum, "Data Structures using C and C++", PHI Learning, NewDelhi, 2013.
3. Michael T Goodrich, Roberto Tamassia and Michael H Goldwasser, "Data Structures and Algorithms in Python”, Wiley India Pvt Ltd, New Delhi, 2018.
4. Jean Paul Tremblay, Paul G Sorenson, "Introduction to Data Structures with Applications", Tata McGraw Hill, New Delhi, 2012.

23IR510 PLC AND CAD LABORATORY

PLC:

1. PLC wiring for three phase Induction motor direction control
2. Developing RLL using Bit logic, Timer, Counter, Compare and Math instructions
3. PLC based water level management using HMI/SCADA
4. PLC based AC servomotor control using HMI/SCADA
5. Implementation of PC based EtherCAT networking protocols
6. PLC based motion control using TwinCAT

CAD:

1. Modeling of engineering components
2. Creation of sectional views and annotation of solid models
3. Creation of assembly from part models
4. Extraction of production drawing from solid model
5. Modeling and prototyping of engineering components using 3D printer
6. Design of control panel wiring using Electrical CAD

REFERENCE:

1. Department of Robotics and Automation Engineering, "PLC and CAD Laboratory Manual", 2023.

23IR511 ROBOTICS LABORATORY

1. Forward kinematics of two axis planar articulated robot using analytical and DH algorithm
2. Inverse kinematics of two axis planar articulated robot using geometric approach and DH algorithm
3. Forward dynamics of one link and two link robot arm
4. Inverse dynamics of one link and two link robot arm
5. Implementation of trajectory planning algorithm for straight line motion of two axis planar articulated robot
6. Implementation of trajectory planning algorithm for curved path of two axis planar articulated robot
7. Programming of Four-axis Systemantics and Five-axis TAL Brabo industrial robots
8. Programming of Six-axis Universal industrial robots
9. Simulation and real time Programming of Fanuc robot
10. Programming of Kinova Robotic Arm

REFERENCE:

1. Department of Robotics and Automation Engineering, “Robotics Laboratory Manual” 2023.

SEMESTER - 6

23IR601 POWER ELECTRONICS AND DRIVES

POWER SEMICONDUCTOR DEVICES: Power diodes – Power transistors –Characteristics of SCR, TRIAC, Power MOSFET, IGBT– Thyristor protection circuits –Thyristor triggering circuits- Selection of devices - Overview of Harmonics – Introduction to Power quality

CONVERTERS: Single phase and Three phase –Fully controlled rectifiers –Effect of source and load inductance –Single phase AC voltage controller - Control Circuits for AC to DC and AC to AC converters

INVERTERS: Introduction, Classification, single phase half and full bridge Voltage Source Inverters, 120 and 180-degree conduction mode- Performance Parameters of Inverter - Pulse Width Modulation – Single and Multiple PWM - SPWM – Generation of pulses for SPWM

CHOPPERS: Control strategies- Chopper configurations, step down/step up (buck/boost) converters - Introduction to flyback converter topologies - Uninterrupted power supplies - Switched Mode Power Supply - Basics of Magnetic design for power electronics

DRIVES FOR ROBOTICS & AUTOMATION: Basic Elements of Drive –Load characteristics –Selection of Drive - Operating modes –quadrant operation of chopper –Closed loop control of DC drives. Stator and rotor voltage control, frequency, and voltage control –Current Control – Basics of vector control - Block diagram - Stepper Motor Drive - BLDC Motor Drive – PMSM Drive

TEXT BOOKS:

1. Rashid M H, "Power Electronics –Circuits, Devices and Applications", PHI, 2014.
2. Ramu Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control", 1st Edition, Pearson Education, 2015.

REFERENCES:

1. Bimal K Bose, “Modern Power Electronics and AC Drives", Pearson Education, 2015.
2. Roger C Dugan, Surya Santoso, Mark F McGranaghan, "Electrical Power Systems Quality",3rd Edition, McGraw Hill, 2012.
3. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters Applications and Design ", John Wiley and sons, 3rd Edition, 2007.
4. Vedam Subramaniam, "Thyristor control of Electrical Drives", Tata McGraw-Hill, 2017.

23IR602 MACHINE LEARNING FOR ROBOTICS

INTRODUCTION: Types of Learning - Designing a learning system- Training vs testing - Bias and Variance, Learning curves, Under-fitting and over-fitting - Validation Techniques (Cross-validations) - Mathematics for Machine Learning: Linear Algebra- Probability Theory - Calculus - Probabilistic sensor and motion models - Introduction to Python packages for Machine learning

LINEAR MODELS: Linear Regression - Maximum likelihood and least squares - Multivariate regression - Classification: Logistic Regression – Multiclass logistic regression - Linear Discriminant Analysis - Naïve Bayes - Regularization – Estimate future positions of the robot for the captured data set

GENERAL LEARNING MACHINES: Perceptron – Neural networks: Network Representation - Feed-forward Networks- Back propagation - Introduction to Convolutional Networks- Object detection using neural network – Introduction to RNN - Support Vector Machine: Nonlinear Margin classifier - Kernel functions – Build a Neural Network for an obstacle avoidance system

UNSUPERVISED LEARNING: Curse of dimensionality **–-** Dimensionality Reduction - Feature selection- Principal Component Analysis - K-means Clustering - Mixture of Gaussians - Expectation Maximization Algorithm - Restricted Boltzmann Machine - Building an Anomaly Detection System

REINFORCEMENT LEARNING: Elements of Reinforcement Learning- Markov Decision Process: Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations - Prediction and Control by Dynamic Programing - Monte Carlo Methods - Temporal Difference Learning - TD Control methods - Function Approximation

TEXT BOOKS:

1. Kevin P. Murphy, "Machine Learning – A Probabilistic Perspective", The MIT Press, 2010.
2. R. S. Sutton and A. G. Barto, “Reinforcement Learning - An Introduction”, MIT Press, 2nd Edition, 2018.

REFERENCES:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, 2010.
2. Christopher M Bishop, "Pattern Recognition and Machine Learning ", Springer, 2011
3. Tom M Mitchell, "Machine Learning", McGraw Hill, 2017.
4. EthemAlpaydin , "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2015

23IR603 AUTONOMOUS WHEELED ROBOTS

INTRODUCTION TO MOBILE ROBOTS: History of mobile robots – Present status and future trends – Need for mobile robots – Applications - Examples and Specifications of Autonomous Wheeled Mobile Robots – Locomotion - Key issues of locomotion - Legged and wheeled mobile robots- configuration and stability

KINEMATICS: Kinematic Models and Constraints - Robot Position - Forward and Inverse Kinematic Models - Maneuverability - Workspace of Differential Drive and Omni drive

LOCALIZATION: Introduction - Uncertainty and need of Probability Theory - Recursive State Estimation- Bayes filters - Gaussian Filters: Kalman Filter, EKF, UKF, Information Filter - Nonparametric Filters - Particle Filters - Probabilistic Kinematics: Velocity Motion Model and Odometry Motion Model

MAPPING: Topological maps - Metric maps - Grid maps - Sector maps – Hybrid Map - Occupancy Grid Mapping - Dempster-Shafer Theory – HIMM – SLAM - EKF with known and Unknown Correspondence –The Graph SLAM – Fast SLAM

PLANNING AND MOTION CONTROL: Introduction-Path planning overview - Global path planning - A* Algorithm - local path planning - Road map path planning - Cell decomposition path planning-Potential field path planning - Obstacle avoidance–Path control

TEXT BOOKS:

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2011.
2. Sebastian Thrun, Wolfram Burgard, Dieter Fox, "Probabilistic Robotics", MIT Press, 2005.

REFERENCES:

1. Riadh Siaer, "The future of Humanoid Robots- Research and applications", Intech Publications, 2012.
2. Karsten Berns, Ewald Von Puttkamer, "Autonomous Land Vehicles Steps towards Service Robots", Vieweg Teubner Springer, 2009.
3. Howie Choset, Kevin Lynch Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, Sebastian Thrun, "Principles of Robot Motion-Theory, Algorithms, and Implementation", MIT Press, Cambridge, 2005.
4. Bruno Siciliano, Oussama Khatib, "Springer Hand Book of Robotics", Springer, 2008.

23IR604 SENSORS AND VISION SYSTEMS

MEASURING INSTRUMENTS AND SENSORS: Functional elements of an instrument - Measurement Errors - I/O Configuration of Measuring Instruments - Static and Dynamic characteristics – Sensor Systems – Classification of Sensors - Calibration Techniques – Environmental Parameters – Sensors: Tactile Sensors – Position and Motion Sensors - Force and Torque Sensors - LIDAR Sensor Technology and Systems – Ultrasonic Sensors - Stereo Depth Cameras - Inertial Navigation Sensors - Smart Sensors - Sensor Suite

SINGLE IMAGE VISION: Image Formation -Geometric Camera Models - Camera Parameters - Calibration - Perspective Projection - Color Spaces - Image Processing: Point Operators - Linear Filtering - Neighborhood Operators - Fourier Transform – Pyramids and Wavelets - Feature Detection & Matching: Points & Patches - Edges - Lines - Segmentation - Active Contours - Split & Merge

MULTIPLE IMAGE VISION: Feature Based Alignment - Camera Calibration for Stereo Cameras - Structure From Motion: Triangulation - Two Frame Structure From Motion - Factorization - Bundle Adjustment - Constrained Structure From Motion - Optical Flow - Layered Motion - Image Stitching

HIGH LEVEL VISION: Stereo correspondence: Epipolar Geometry - Sparse Correspondence - Dense Correspondence - Multi View Stereo - 3D Reconstruction: Shape from X - 3D Scanning - Surface Representation - Volumetric Representations - Image Based Rendering

RECENT TRENDS: Introduction to Deep Learning - Recognition - Image Classification - Object Detection - Semantic Segmentation - SLAM - Pose Estimation - Computational Photography - Super Resolution - Denoising - Texture Analysis and Synthesis

T**EXT BOOKS:**

1. A K Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Co, 2010.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, London, 2021.

REFERENCES:

1. David.A. Forsyth, Jean Ponce, "Computer Vision a Modern Approach", Pearson, Upper Saddle River, 2010.
2. Kenneth Dawson-Howe, "A Practical Introduction to Computer Vision with OpenCV", Wiley, Singapore, 2014.
3. Richard Hartley, Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2012
4. Patranabis D, "Sensors and Transducers", Prentice-Hall of India Private Limited, New Delhi, 2003.

23IR610 INTELLIGENT ROBOTICS LABORATORY

1. Introduction to ROS and OpenCV
2. Interfacing IMU with Embedded Development board
3. Basics of Image Processing, Linear Filtering and Morphological Processing
4. Image Analysis with Edge Detection, Contouring, Segmentation, Feature Extraction and Matching
5. Object Detection
6. Face Recognition
7. Human Pose Estimation
8. 3D Reconstruction
9. Path Planning and Navigation
10. Autonomous Navigation using Computer Vision with ROS

REFERENCE:

1. Department of Robotics and Automation Engineering, "Intelligent Robotics Laboratory Manual", 2023.

BE/BS ELECTRONICS AND COMMUNICATION ENGINEERING

BE/BS ELECTRONICS AND COMMUNICATION ENGINEERING

S.No	Course Code	Course Title	Hours / Week				Maximum Marks		Total
			Lecture	Tutorial	Practical	Credits	CA	FE	
SEMESTER I									
1	23IL101	Calculus and its Applications	3	1	0	4	50	50	100
2	23IL102	Electrical Engineering Materials	3	0	0	3	50	50	100
3	23IL103	Applied Chemistry	3	1	0	4	50	50	100
4	23IL104	Problem Solving and C Programming	3	2	0	5	50	50	100
5	23IL105	English Language Proficiency	3	1	0	4	50	50	100
6	23IL110	Engineering Graphics	0	0	4	2	50	50	100
7	23IL111	Basic Science Laboratory	0	0	4	2	50	50	100
8	23IG065	German Language A1	12	0	0	4	-	100	100
SEMESTER 2									
1	23IL201	Complex Variables and Transforms	3	1	0	4	50	50	100
2	23IL202	Sensors for Engineering Applications	3	1	0	4	50	50	100
3	23IL203	Electron Devices	3	1	0	4	50	50	100
4	23IL204	Circuit Theory	3	1	0	4	50	50	100
5	23IL205	Object Oriented Programming with Python	2	2	0	4	50	50	100
6	23IL211	Devices and Circuits Laboratory	0	0	4	2	50	50	100
7	23IL213	Foundations of Problem Solving	0	0	2	0	50	50	100
8	23IH073	Organizational Behaviour	3	0	3	3	50	50	100
9	23IG066	German Language A2	12	0	0	4	-	100	100
SEMESTER 3									
1	23IL301	Matrix Theory and Numerical Method	3	1	0	4	50	50	100
2	23IL302	Analog Electronics	3	0	0	3	50	50	100
3	23IL303	Digital Electronics	3	0	0	3	50	50	100
4	23IL304	Electromagnetic Fields and Waves	3	1	0	4	50	50	100
5	23IL305	Engineering Economics	3	1	0	4	50	50	100
6	23IL310	Analog Electronics Laboratory	0	0	2	1	50	50	100
7	23IL311	Digital Electronics Laboratory	0	0	2	1	50	50	100
8	23IH074	TOEFL/ IELTS Training	6	0	9	2	50	50	100
9	23IG067	German Language B1	12	0	0	4	-	100	100
SEMESTER 4									
1	23IL401	Probability and Random Processes	3	1	0	4	50	50	100
2	23IL402	Linear Integrated Circuits	3	0	0	3	50	50	100
3	23IL403	Signals and Systems	3	0	0	3	50	50	100
4	23IL404	Computer Architecture	3	2	0	5	50	50	100
5	23IL405	Data Structures and Algorithms	3	2	0	5	50	50	100

6	23IL410	Linear Integrated Circuits Laboratory	0	0	2	1	50	50	100
7	23IL411	Signals and Systems Laboratory	0	0	2	1	50	50	100
8	23IG068	German Language B2.1	12	0	0	4	-	100	100
SEMESTER 5									
1	23IL501	Communication Engineering	3	0	0	3	50	50	100
2	23IL502	Embedded Systems	3	0	0	3	50	50	100
3	23IL503	Control Systems	3	1	0	4	50	50	100
4	23IL504	Computer Networks	3	2	0	5	50	50	100
5	23IL505	Antennas and Wave Propagation	3	1	0	4	50	50	100
6	23IL510	Communication Engineering Laboratory	0	0	2	1	50	50	100
7	23IL511	Embedded Systems Design Laboratory	0	0	4	2	50	50	100
8	23IG069	German Language B2.2	12	0	0	4	-	100	100
SEMESTER 6									
1	23IL601	Digital Signal Processing	3	0	0	3	50	50	100
2	23IL602	Digital Communication	3	0	0	3	50	50	100
3	23IL603	VLSI Design	3	0	0	3	50	50	100
4	23IL610	Digital Signal Processing Laboratory	0	0	2	1	50	50	100
5	23IL611	VLSI Design Laboratory	0	0	4	2	50	50	100
6	23IL620	Innovation Practices	0	0	2	1	50	50	100
7	23IG070	German Language C1	12	0	0	4	-	100	100

SEMESTER-1

23IL101 CALCULUS AND ITS APPLICATIONS

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables.

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton 's law of cooling, decay and growth problems.

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits.

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes 's theorem.

TEXT BOOKS

1. J. Hass, C. Heil, Maurice D.W "'Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES

5. Howard Anton, Irl Bivens, Stephen Davis, "Calculus", John Wiley and Sons, USA, 2016.
6. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
7. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
8. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23IL102 ELECTRICAL ENGINEERING MATERIALS

ELECTROMAGNETISM: Review of definitions of fundamental terms. Permeability. Forces due to currents. Uniform and non-uniform magnetic fields. Static and time-varying magnetic fields. Electromagnetic induction. Expression for induced emf. Electric fields definition of fundamental terms. Dielectric constant, Permittivity. Dielectric displacement. Gauss theorem. Electromagnetic waves. Propagation of electromagnetic waves through isotropic media. Maxwell's equations and interpretation of Maxwell's equations.

QUANTUM MECHANICS: Wave particle duality, de Broglie waves- Heisenberg's uncertainty principle. Wave function-normalization. The wave equation. Schrodinger's equation of motion: Time dependent form, steady-state form. Particle in a box. Quantum Tunneling and applications: Zener diode and Tunnel diode

ELECTRICAL PROPERTIES: Conducting materials-quantum free electron theory -Fermi Dirac Statistics-Band theory of solids-the density of states. Dielectrics-types of polarization-measurement of dielectric permittivity-Loss Factor-Dielectric loss mechanisms.

PHYSICS OF SEMICONDUCTORS: P type and N type semiconductors-the effective mass. Electrical conductivity in P type and N type semiconductors. P-N junction, rectifier equation. Hall effect and its applications. Hetero junction-Quantum well, wire, dots-Optical properties of Semiconductors: LD, LED, Photo diode. Introduction to MEMS

MAGNETIC PROPERTIES: Types of magnetic materials-domain theory-hysteresis- hard and soft magnetic materials-Applications-eddy current brakes, regenerative braking. Magnetic lenses, Magnetostriction. Superconductivity –Meissner's effect-Josephson junction, SQUID magnetometer, applications.

TEXTBOOKS:

1. William D CallisterJr, "Materials Science and Engineering-An Introduction", John Wiley and Sons Inc., 10th Edition, NewYork, 2018.
2. Arthur Beiser, "Concepts of Modern Physics" Tata McgrawHill,India , 7th Edition, 2017
3. Richard Wolfson, "Essential University Physics".,Vols 1 and 2. Pearson Education, Singapore, 2021

REFERENCES:

1. Rolf E. Hummel, Electronic Properties of Materials, Springer, 4th Edition, 2013
2. Van Vlack, "Elements of Material Science and Engineering", Pearson Education India, 2008.
3. Sze S.M, Physics of Semiconductor Devices, John Wiley and Sons,USA, 4th Edition, 2021

23IL103 APPLIED CHEMISTRY

ELECTRONIC MATERIALS: Inorganic semiconductors – Elemental – Si and Ge - band theory, doping, compound semiconductors – band gap engineering – applications. Organic semiconductors – conjugated polymers – mechanism of charge transport, doping, states of aggregation, material properties – thermal, mechanical, electrical, chemical, electrochemical. Applications – OLED, OPV – working principle. Liquid crystalline materials – display application.

PROCESSES IN ELECTRONICS MANUFACTURE: Microchip fabrication – overview, photoresists – chemistry, types. Fabrication facilities – clean rooms - maintenance, ultrapure water– specification, production processes – ion exchange, reverse osmosis, continuous electrodeionisation. PCB fabrication – electroless and electroplating of copper – principle, bath chemistries and process parameters, formation of copper track on plastic board.

ELECTRONICS PACKAGING AND PROTECTION: Packaging materials-encapsulants and underfills - adhesives – chemical types, application methods, factors influencing adhesion, soldering alloys – phase diagrams, lead free alloys, phase change materials for cooling. Conducting inks for printed electronics - metal and carbon based – graphene, CNT– synthesis, structure, electrical properties. Corrosion in electronics – types, protection – vapour phase inhibitors.

ELECTROCHEMICAL POWER SOURCES: Electrochemical cells – emf, electrode potential, dependence of emf on electrolyte concentration – Nernst equation. Batteries**–**performance characteristics. Materials, construction, reactions, characteristics of lechlanche cell, primary lithium batteries, lead - acid battery and lithium-ion batteries. Supercapacitors – EDLC – fundamentals, electrode materials, electrolytes, pseudocapacitors– materials.
CHEMICAL SENSORS:– Sensors – basic components. Electrochemical sensors- potentiometrictransducers – principle, ion-selective electrodes – configurations, response functions and selectivity, applications –potentiometric titrations, water quality monitoring - pH, Hardness, fluoride ion sensors Amperometric transducers – principle, application - glucose biosensors, conductivity sensors – principle – application in conductometric titrations. Colorimetric sensors - Beer-Lambert's law, components, application - determination of ferric ion in water sample. Chemiresistive sensors - principle, application – environmental monitoring – CO_2 sensor. Microelectrodes for sensors – fabrication.

TEXT BOOKS:
1. Shashi Chawla, "A Textbook of Engineering Chemistry", 1st Edition, New Delhi: Dhanpat Rai and Co. , 2005.
2. Cowie J.M.G,Valeria Arrighi "Polymers: Chemistry and Physics of modern materials", CRC Press, 2007.

REFERENCES:
1. Bansi D. Malhotra "Handbook of Polymers in Electronics", Rapra Technology Ltd., 2002.
2. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Mc Graw Hill, 2014.
3. Derek Pletcher and Frank C. Walsh. "Industrial Electrochemistry", Chapman and Hall , 1993.
4. Florinel-Gabriel Banica, " Chemical Sensors and Biosensors – Fundamentals and Applications", John Wiley & Sons Ltd, 2012.

23IL104 PROBLEM SOLVING AND C PROGRAMMING

INTRODUCTION TO PROBLEM SOLVING: Analyzing and Defining the Problem - Algorithm - Flow Chart – Program development steps -Types of programming language. **C:** The C character set - Identifiers and keywords - Data types – Constants - Variables - Declarations -input and output functions-preprocessor directives.

OPERATORS AND EXPRESSIONS: Arithmetic operators - Unary operators - Relational operators - logical operators - Assignment operators - Conditional operators- bitwise operators - comma operator - sizeof operator -precedence and associativity- Library functions. **CONTROL STATEMENTS**:simple if, if..else, nested if .. else ,elseifladder , switch case - while -do while - for - nested loops - break – continue – goto statements.

ARRAYS: Defining an array - Processing an array - Multi dimensional arrays–strings-string operations.

FUNCTIONS: Function prototype - Defining a function – function call - Passing arguments to a function –nested function – recursive function- Storage classes - auto - static - extern and register variables.

STRUCTURES: Definitions - Processing a structure – Array and structures – Nested structures - Structures and functions. Pointers: Definition - Pointer Arithmetic – types of pointer - const pointer, pointer to a constant, void pointer, null pointer. (10+8)

TEXT BOOKS:
1. Paul Deitel and Harvey Deitel, "C How to Program: With an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. Ajay Mittal, "Programming in C - A Practical approach".Pearson,New Delhi, 2010

REFERENCES:
1. Gottfried B., "Programming with C", McGraw Hill Education, New Delhi, 2018.
2. Herbert Schildt, "C: The Complete Reference", McGraw Hill, New Delhi, 2017.
3. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", Prentice Hall of India, New Delhi, 2013.

23IL105 ENGLISH LANGUAGE PROFICIENCY

VOCABULARY: Etymology- prefixes and suffixes – synonyms – antonyms – guessing meanings from context – word formation - single-word substitutes - different forms of a word– phrasal verbs – collocations.

LISTENING AND SPEAKING: Understanding listening – listening techniques - introducing oneself and others – seeking and sharing information– description - conversation skills – extempore speaking .

GRAMMAR: Wh-questions –Yes/no questions – parts of speech – articles – prepositions – gerunds – degrees of comparison – tenses – modal verbs – direct and indirect questions.
(6+3)
READING: Reading strategies: skimming & scanning, predicting – reading comprehension: techniques.
WRITING: Discourse markers – dialogue writing - completing sentences – jumbled sentences –paragraph writing - writing compare & contrast paragraphs.

TEXTBOOKS:
1. Shoba K.N.and Lourdes Joavani Rayen, “Communicative English”, Cambridge University Press, Cambridge, 2021.
2. Raymond Murphy, “Intermediate English Grammar”, Cambridge University Press., New Delhi, 2020.

REFERENCES:
1. Raymond Murphy, “English Grammar in Use”, Cambridge University Press., New Delhi, 2020.
2. Sudharshana N P and Savitha C, “English for Engineers”, Cambridge University Press, New York, 2018.
3. Anne Laws, "Writing Skills", Orient Black Swan., Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, “Essential English Grammar”, Cambridge University Press, New Delhi, 2019.

23IL110 ENGINEERING GRAPHICS

INTRODUCTION:
1) Lettering practice
2) Dimensioning practice as per BIS conventions
3) Types of projection and concepts of orthographic projection

ORTHOGRAPHIC PROJECTION:
1) Projection of points and lines
2) Projection of planes
3) Projection of solids

SECTIONS AND DEVELOPMENT:
1) Sectional views of regular solids
2) Development of lateral surfaces of regular solids
3) Projection of truncated solids and simple engineering sheet metal components

PICTORIAL PROJECTIONS:
1) Isometric view of simple engineering components
2) Conversion of isometric views to orthographic views
3) Perspective projection methods

REFERENCES:
1. Venugopal K, Prabhu Raja V "Engineering Graphics", New Age International Publishers, 16th edition, 2021.
2. John K.C "Engineering Graphics for Degree", PHI Learning Private Limited, 2009.
3. Bureau of Indian Standards "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, 2003.
4. Shaw M.B, Rana B.C "Engineering Drawing", Pearson Education India, 2009.

23IL111 BASIC SCIENCE LABORATORY

List of Experiments:
1. Determination of thermal conductivity of bad conductor using Lee’s Disc method
2. Determination of fibre thickness – air wedge method
3. Determination of wavelength of mercury spectrum using transmission grating
4. Measurement of vibration frequency of electrically maintained tuning fork using Melde’s apparatus
5. Determination of velocity of sound – Helmholtz resonator
6. Determination of Hysteresis loss of a ferromagnetic material
7. Study of reverse bias characteristics of Germanium diode and determination of its band gap
8. Thermistor: Measurement of temperature and band gap
9. Find the finesse and free spectral region of the Etalon.
10. Determine the charge of an electron by Millikan’s oil drop method.

Demonstration:
1. Determine the excitation potential of Argon using the Franck Hertz method.
2. Determine the number of turns & radius of the coil and magnetic field of ‘Helmholtz’ coil using Biot-Savart’s Law – apparatus
3. Find the Hall voltage, Hall coefficient, mobility & charge density of the given ‘Ge’ crystal using Hall apparatus.
4. Determine e/m (charge to mass ratio) of the electron by Thomson’s method.
5. Determine the Planck’s constant using Photo Electric method.

6. Determine the wavelength of the laser source by Michelson Interferometer.
7. Determine the thickness of the film by Mach Zehnder Interferometer.
8. Analyze the mercury spectrum and find wavelength using polynomial equation.
9. Determine the refractive index of given specimen using Brewster's angle apparatus.

REFERENCES:
1. Department of Physics," Physics laboratory observation", 2022.
2. Jerry D Wilson; Cecilia A Hernandez Hall, "Physics laboratory experiments", Boston, MA : Cengage Learning, 2016.

CHEMISTRY (Any eight experiments)
1. Determination of total hardness of water by EDTA method.
2. Demineralisation of water using ion-exchange resins and determination of water quality - pH, TDS and conductivity.
3. Electroplating of copper and Nickel and determination of cathode efficiency of electroplating.
4. Construction of phase diagram for a simple eutectic system.
5. Demonstration of different forms of metallic corrosion using ferroxyl indicator test and determination of rate of galvanic corrosion using zero-resistance ammeter.
6. Designing a battery and determination of its characteristics.
7. Potentiometric estimation of ferrous iron.
8. Preparation of a chloride ion sensor and ascertaining nerstian response by construction of calibration curve.
9. Conductometric estimation of a mixture of strong and weak acids.
10. Photocolorimetric estimation of Ferric ion in a water sample.

SEMESTER 2

23IL201 COMPLEX VARIABLES AND TRANSFORMS

COMPLEX DIFFERENTIATION: Derivative, analytic function, Cauchy-Riemann equations, Laplace's equation, linear fractional transformations

COMPLEX INTEGRATION: Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only).

LAPLACE TRANSFORMS: Laplace transform, linearity, first shifting theorem, transforms of derivatives and integrals, unit step function, second shifting theorem, Dirac's delta function, periodic functions, differentiation and integration of transforms, solving ODEs with constant coefficients and initial value problems

FOURIER ANALYSIS: Fourier series – arbitrary period, even and odd functions, half range expansions. Fourier transforms, Fourier cosine and sine transforms.
PARTIAL DIFFERENTIAL EQUATIONS: Basic concepts of PDEs, wave equation, heat equation, steady state two-dimensional heat problems, solution by separating variables and Fourier series

TEXT BOOKS
1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.
2. Dennis G. Z, "Advanced Engineering Mathematics", Jones and Bartlett Pvt Ltd, New Delhi, 2017.

REFERENCES
1. Dennis G. Z and Patrick D Shanahan, "A first course in Complex Analysis with applications", Jones and Bartlett Pvt Ltd, New Delhi, 2015.
2. Wylie C R and Barret L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2018.
4. Dean G. D, "Advanced Engineering Mathematics with MATLAB", CRC Press, USA, 2017.

23IL202 SENSORS FOR ENGINEERING APPLICATIONS

STRAIN AND PRESSURE MEASUREMENT: Resistance strain gauge, piezoelectric pressure sensor, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic pressure sensor. capacitance pressure sensor.

ELECTRONIC SENSORS: Inductive,capacitive and ultrasonic based proximity sensors Reed switch, Hall-effect switching sensors, capacitive based humidity sensor, liquid level detectors, flow sensors, smoke sensors.

MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors, piezoelectric devices for motion sensing, Hall effect-based speed sensor.

LIGHT SENSORS: Color temperature, light flux, photo sensors, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic sensors and their applications. LIDAR working principle and automotive applications.

THERMAL SENSORS: Bimetallic strip, semiconductor based temperature sensor, thermocouples, Resistance thermometers, thermistors, PTC and NTC thermistors and their applications. Infrared sensors: bolometer, Pyroelectric detector, photodiodes and phototransistor.

TEXTBOOKS:

1. Ian R Sinclair, Sensors and Transducers, Third Edition, Newnes publishers, 2011.
2. Krzysztof Iniewski, Smart sensors for industrial applications, CRC Press Taylor and Francis, 2019.
3. Doebelin E O, Measurement Systems, Application and Design, McGraw Hill, seventh Edition, 2019.

REFERENCES:

1. Jack P Holman, —Experimental Methods for Engineers, Eighth Edition, McGraw Hill, USA, 2011.
2. Jacob Fraden, Handbook of modern sensors: Physics,design,and applications, Springer, 5th Edition, 2016.

23IL203 – ELECTRON DEVICES

SEMICONDUCTOR PHYSICS: Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors. Carrier transport: diffusion current, drift current, mobility and resistivity, Poisson and continuity equations, generation and recombination of carriers.

SEMICONDUCTOR DIODE: Theory of PN Junction Diode and Zener diode – Characteristics, Temperature dependence- Break down mechanisms- Diode Resistance- Diode Capacitance- Diode Models- Rectifiers- Clipper- Clamper- Voltage regulator- Tunnel Diode, Varactor Diodes.

BIPOLAR JUNCTION TRANSISTOR : Transistor types - Transistor Action - Current Components –Configurations - Transistor as a Switch and Amplifier - Small Signal Low Frequency Hybrid and π Model - Ebers Moll Model - DC and AC Load Lines - Operating Point - Bias stability, Bias Methods, Bias Compensation.

FIELD EFFECT TRANSISTORS:JFET – Operation and Characteristics, MOSFET: Physical Operation,Current—Voltage Characteristics, Threshold voltage equations – MOS device equations, MOSFET as an Amplifier and Switch, MOS Capacitor ,Small-Signal Operation and Models , MOSFET Configurations and Biasing- Second order effects.

SPECIAL SEMICONDUCTOR DEVICES : Thyristor Family, UJT- Operation, Characteristics and Applications - Opto Electronic Devices and applications- Laser diode - Photo diodes - Photo Transistors - Light emitters – Organic LED – Liquid Crystal Displays – FINFETs, MESFETs, HEMT.

TEXT BOOKS:

1. MillmanJ., Halkias C. C., Satyabrata J, "Electronic Devices and Circuits", Mcgraw Hill Education (I) P Ltd, Chennai 2019.
2. Floyd T. L, "Electronic Devices and Circuits",Pearson, Chennai, 2021.

REFERENCES:

1. Boylestad, R. L. and Nashelsky, L., "Electronic Devices and Circuit Theory", Pearson, Chennai, 2021.
2. David A.Bell , "Electronic Devices and Circuits", Oxford University Press , New Delhi, 2021.
3. Sedra and Smith, "Microelectronic Circuits", Seventh Edition, Oxford University Press, New Delhi, 2022.
4. Neil.H.E.Weste, Kamran Eshranghian , "Principles of CMOS VLSI Design- A system perspective", Pearson, Noida, 2017.

23IL204 CIRCUIT THEORY

DC CIRCUIT ANALYSIS: Charge and Current, Voltage, Power and Energy, Network Elements - Current and Voltage sources. Ohm's Law - Resistive circuits - Series and Parallel reduction method and analysis. Voltage and Current division. Source Transformation. Wye-Delta transformation. AC circuit analysis: Average and RMS values - Phasor representation of variables - Power triangle and average power - Resonance, Magnetically coupled circuits.

NETWORKS THEOREMS: Kirchoff"s Laws -Source Transformation - Duality - Mesh and Nodal analysis- Superposition, Thevenin's and Norton's, Maximum power transfer, Reciprocity theorem, Tellegen"s theorem

TIME DOMAIN ANALYSIS: Source free RL and RC circuits, Transient Response of RL and RC circuits for DC excitation and Sinusoidal excitation. Frequency Domain Analysis: Transient Response of RL, RC, RLC circuits for DC and Sinusoidal excitation using Laplace transform.

ANALYSIS OF TWO PORT NETWORK: Network functions of single-port network, Driving point and transfer function of Two-port networks, Poles and Zeros of network functionsNetwork parameters-Impedance, admittance, transmission and hybrid, Conversion formulae. Properties – reciprocity and symmetry - Equivalents of T, Π, Ladder, bridged T and Lattice networks.

FILTERS AND ATTENUATORS: Passive Filters - Low Pass, High Pass, Band Pass and Band Stop filters – Constant K and m-derived filter – Attenuators – T type, Π type, Lattice Attenuator

TEXT BOOKS:

1. Singh, Ravish R, "Network Analysis and Synthesis", McGraw-Hill Education, New Delhi, 2019.
2. Alexander C. and Sadiku M. N. O., "Fundamentals of Electric Circuits ", Tata McGraw Hill, New Delhi, 2020.
3. Sudhakar A. and Shyammohan S. Pillai, "Circuits and Networks Analysis and Synthesis", McGraw Hill, New Delhi, 2020.

REFERENCES:

1. AbhijitChakrabarthy, "Circuit Theory Analysis & Synthesis", DhanpathRai& Sons, New Delhi, 2019.
2. Nahvi M. and Edminister J. A., "Theory and Problems Electric circuits", Tata McGraw Hill, New Delhi, 2017.

23IL205 OBJECT ORIENTED PROGRAMMING WITH PYTHON

BASICS : Python - Variables - Executing Python from the Command Line - Editing Python Files - Python Reserved Words - Comments - Simple Input and Output—Indenting. Datatypes: Numeric, Boolean Data Types .Control Statements: if Statements - Loops: while Loop - break and continue - for Loop -String data type -methods

COLLECTIONS: Sequence types:Lists, Tuples - Sets – frozensets-Mapping types: Dictionaries.Standard Modules :math- sys - dir Function.

FUNCTIONS: Definition - Passing parameters to a Function - Variable Number of Arguments - recursive functions -Scope - Passing Functions to a Function – Lambda functions- Modules:Creating modules . Introduction to numpy –matplotlib
FILE ORGANIZATION- Access Modes : Writing data to a File -Reading data From a file – seek –tell. .Error Handling: Run Time Errors - Exception Model - Exception Hierarchy - Handling Multiple Exceptions – raise exceptions- user defined Exceptions. (9+6)

OBJECT ORIENTED FEATURES: Principles of Object Orientation - Creating Classes,objects - Instance Methods –Special Methods - Class Variables – Inheritance – Polymorphism - Type Identification.

TEXT BOOKS:
1. Mark Summerfield. “Programming in Python 3: A Complete introduction to the Python Language”, Addison-Wesley Professional, 2009.
2. ReemaThareja ,”Python Programming : Using Problem Solving Approach”, Oxford university Press 2017

REFERENCES:
1. Wesley J Chun, “Core Python Applications Programming”, Prentice Hall, 2012.
2. Allen B Downey, “Think Python”, O’Reilly, 2012.
3. Martin C. Brown, “PYTHON: The Complete Reference”, McGraw-Hill, 2018.

23IL211 DEVICES AND CIRCUITS LABORATORY

Hardware Experiments
Verification of Kirchhoff's Voltage and Current laws
2. Verification of Thevenin's theorem and Maximum Power Transfer Theorem
3. PN Junction Diodes and Rectifier circuits
4. Wave shaping circuits: Clippers and clampers
5. Zener Voltage Regulator
6. Evaluation of BJT Hybrid parameters
7. BJT Biasing Techniques
8. MOSFET Characteristics and its application as a switch

Software Experiments
Verification of theorems – Superposition, Reciprocity
1. BJT and FET Characteristics
2. Characteristics of Thyristor Family Devices

AUGMENTED EXPERIMENTS*
1. Application circuits based on BJT.
2. Application circuits based on FET.
3. Application based on optoelectronic devices.
4. Design of Relaxation oscillator using UJT.

REFERENCES:
1. ECE Department "Laboratory Manual”2019
* Augmented experiments will be evaluated at the end of the semester.

23IL213 FOUNDATIONS OF PROBLEM SOLVING

PROBLEM SOLVING:
1.Speed Mathematics (SAW, Oz, Mirror methods)
2. Speed Mathematics (High5, Minion, Butterfly methods)
3. Speed Mathematics (Inception, Goldeneye methods)
4. Thinking with Numbers
5. Problem Solving with Visual information
6. Words Puzzles
7. Resume Writing Essentials

REFERENCES:
1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.

23IH 073 ORGANIZATIONAL BEHAVIOR

Introduction to OB: Meaning & Importance of OB – Historical Development & Contributing Disciplines

Personality – Personality determinants & attributes, Emotional Intelligence and Wor k Values
Employment relationship and the psychological contract
Motivation - Basic Concepts, Motivation Theories, Problems in Motivation
Leadership - Theories of leadership, Leadership styles and effectiveness
Group Dynamics: Types of Groups, Group Norms and Cohesiveness: Group Roles.
Organizational Culture - Elements, Culture and Performance, merging organizational cultures, changing and strengthening culture.
Organizational Change - Forces for change force field analysis model Organization Development
Work Stress - Causes and consequences – Stress coping strategies
Case studies

REFERENCES:

1. Mc Shane Von Glinow and Radha Sharma, "Organisational Behaviour", Tata Mc Graw Hill, 4th Edition, 2008
2. Stephen P Robbins, "Organisational Behaviour", Prentice Hall (India) Pvt. Ltd., New Delhi, 13 th Edition, 2009
3. Kreitner Robert, Kinicki , Angelo, "Organsiational Behaviour", Irwin Inc., Illinois, 2 nd Edition, 2006
4. Hellriegel, "Organsiational Behaviour" Thomson Learning, 1st edition, 2005
5. Ivancevich, "Organsiational Behaviour" Tata Mc Graw Hill, 7th Edition, 2006.

SEMESTER 3

23IL301 MATRIX THEORY AND NUMERICAL METHODS

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors of a real matrix – characteristic equation, properties - diagonalization - quadratic forms, reduction to canonical form by orthogonal reduction - Errors and approximations in numerical methods, power method for dominant eigenvalue.

LINEAR ALGEBRIAC SYSTEM OF EQUATIONS AND NONLINEAR EQUATIONS: System of linear equations – Gauss elimination method, Crouts method, Gauss Seidal iterative method, Roots of equations - false- position method, Newton-Raphson method, Graeffe's root squaring method.

INTERPOLATION, DIFFERENTIATION AND INTEGRATION: Newton's forward and backward interpolating polynomials, Lagrange and Newton's divided difference interpolating polynomials. Numerical differentiation, numerical integration - Newton-Cotes formulae, Trapezoidal rule, Simpson's 1/3 rule.

ORDINARY DIFFERENTIAL EQUATIONS: Taylor-series method, Euler method, 4^{th} order Runge-Kutta method, multi-step method – Milne's method.

PARTIAL DIFFERENTIAL EQUATIONS: Finite difference: elliptic equations – Laplace equation, Poisson equation – Liebmann method, parabolic equations – heat conduction equation – Crank Nicolson's method, hyperbolic equations – vibrating string.

TEXT BOOKS:

1. David C Lay, Judi J. McDonald, Steven R. Lay "Linear Algebra and its Applications", Pearson Education, New Delhi, 2021.
2. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2021.

REFERENCES:

1. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, New Delhi, 2017.
2. Rizwan Butt, "Introduction to Numerical Analysis Using MATLAB", Infinity Science Press, Hingham, 2010.
3. Richard L Burden and Douglas J Faires, "Numerical Analysis", Thomas Learning, NewYork, 2017.
4. Howard Anton, Chris Rorres, Anton Haul "Elementary Linear Algebra", Wiley India, New Delhi, 2019.

23IL302 ANALOG ELECTRONICS

POWER SUPPLIES : Half wave and Full wave Rectifiers - Calculation of Ripple factor, Regulation, Rectification efficiency and TUF - Filters - L, C , L-Section and Pi - Voltage Regulators - Series and Shunt - Current limiting and protection circuits.

SINGLE STAGE AMPLIFIERS AND TUNED AMPLIFIERS: BJT and MOSFET amplifiers - calculation of input and output impedance, voltage gain – Low and High Frequency Response of BJT and MOSFET Amplifier - Analysis of single tuned amplifiers.

DIFFERENTIAL AMPLIFIERS : BJT and MOSFET Current Mirrors- Simple, Widlar, Wilson - Differential amplifier- Differential and common mode gain - CMRR - Circuits for improving CMRR using active load - Cascode and Darlington amplifiers.

POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS: Classification of Power Amplifiers-Class A/B/AB/C/D - Single ended and Push-pull configuration - Feedback Concepts - Effect of negative feedback on voltage and current feedback amplifier circuits.

OSCILLATORS AND MULTIVIBRATORS : RC and RL integrator and differentiator circuits- Barkhausen criteria - Sinusoidal oscillators - RC, LC and Quartz – Frequency stability of oscillators - Non-sinusoidal oscillators - Multivibrators - Bistable, Monostable and Astable -Schmitt Trigger.

TEXT BOOKS:

1. Jacob Millman, Christos C Halkias, SatyabrataJit , "Electronic Devices and Circuits", Fourth Edition, McGraw Hill Education,2015.
2. Sedra and Smith , "Micro electronic Circuits", Seventh Edition, Oxford University Press, NY,USA, 2017.

REFERENCES:

1. MillmanJ ,Taub H. , "Pulse, Digital and Switching waveforms", Third, McGraw Hill International, 2011.
2. Donald L Schilling , Charles Belove , "Electronic Circuits", 3rd Edition, Tata McGraw-Hill, 2002.
3. Allen Mottershed , "Electronic Devices and Circuits", Prentice Hall of India, 2009.
4. David A Bell, "Electronic Devices and Circuits", Prentice Hall of India, New Delhi, 2008.

23IL303 DIGITAL ELECTRONICS

NUMBER SYSTEMS AND BOOLEAN ALGEBRA : Number systems - Arithmetic operations-computer codes – Boolean algebra – basic postulates and theorems - canonical forms- Standard representation of logic functions- K-maps and Quine McClusky method- Introduction to Verilog

COMBINATIONAL LOGIC DESIGN : Binary / BCD adders, Subtractors, encoders, decoders, multiplexers and demultiplexers - Carry look ahead adder – Multiplier - magnitude comparator – ALU - Verilog implementation of Combinational logic circuits.

SYNCHRONOUS SEQUENTIAL CIRCUITS : Flip-flops- latches - Shift registers- Design and analysis of clocked sequential circuits- synchronous counters- Sequence detector - state reduction techniques- Verilog implementation of Synchronous Sequential circuits.

ASYNCHRONOUS SEQUENTIAL CIRCUITS : Fundamental and pulse mode circuits-Binary / BCD Ripple counter – Races - Hazards. Verilog implementation of Asynchronous sequential circuits.

PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES: Classification of memories, Read/write operations- Memory decoding and expansion, Static and Dynamic RAM- PLDs- Architecture and implementation - Digital logic families - Characteristics - TTL, ECL and CMOS logic – Applications of PLDs.

TEXT BOOKS:

1. Morris Mano, and M.D. Ciletti , "Digital Design: with an introduction to Verilog HDL, VHDL and system verilog", 6th Edition, Pearson, New Delhi, 2018.
2. Joseph Cavanagh , "Digital Design and Verilog HDL Fundamentals", CRC Press, 2017.

REFERENCES:

1. Charles Roth, Lizykurian john , "Digital Systems Design using Verilog", 1st Edition, cengage India private limited, 2016.
2. Floyd T L , "Digital Fundamentals", 11th Edition, Pearson education, New Delhi, 2017.
3. AAnandkumar , "Fundamentals of Digital circuits", 4th Edition, Prentice Hall of India, New Delhi, 2016.
4. B.SSonde, "Introduction to System Design using Integrated circuits", New Age international Publishers, Second edition,1992.

23IL304 ELECTROMAGNETIC FIELDS AND WAVES

ELECTROSTATIC FIELDS : Review of vector calculus and Co-ordinate systems - Electrostatic fields - Coulomb's Law and field intensity - Electric flux density - Gauss's law and its application - Electric potential - Relationship between E and V-Flux lines - Dipole- Energy density - Conductors -Boundary conditions in electrostatic fields - Boundary value problems.

MAGNETOSTATIC FIELDS : Biot-Savart's Law - Ampere's circuital law - Magnetic flux density and Maxwell's equations – Magnetic forces due to magnetic fields - Magnetic -Scalar and Vector potential - Magnetic Boundary conditions – Boundary value problems - Magnetic energy.

TIME VARYING FIELDS: Faraday's Law – Equation of continuity - Inconsistency of Ampere's law - Maxwell's equations and their interpretation – Time varying Potentials.

ELECTROMAGNETIC WAVES: Uniform plane waves- Wave equation - Wave propagation in different media - Poynting Vector and Theorem – wave Polarization - Reflection of a plane wave at Normal and Oblique incidence - EMI / EMC Interference.

TRANSMISSION LINES AND WAVEGUIDES : Transmission line-parameters-VSWR- reflection coefficient - stub matching using Smith chart - Rectangular waveguide – TE and TM modes and propagation characteristics – Impossibility of TEM waves.

TEXT BOOKS:

1. Sadiku M H . Principles of Electromagnetics , New Delhi: Oxford University Press Inc, 2015.
2. William H Hayt . Engineering Electromagnetics, 8th Edition , New Delhi: McGraw Hill international Edition, 2012.

REFERENCES:

1. David K Cheng . Fields and Wave Electromagnetics ,2nd Edition , Pearson Education, 2013.
2. Umran S. Inan, Aziz Inan, Ryan Said . Engineering Electromagnetics and Waves ,2nd Edition , Pearson, 2015

23IL305 ENGINEERING ECONOMICS

FUNDAMENTALS OF ECONOMIC ANALYSIS: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency.

COST AND INVENTORY CONTROL: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages- Depreciation Methods – Problems in Straight Line and Diminishing Balance Method)

PRICING, REVENUE AND VALUE ENGINEERING: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering

PROJECT MANAGEMENT: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis

ECONOMIC GROWTH AND DEVELOPMENT: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy

TEXT BOOKS:

1. Panneerselvam. R., “Engineering Economics”, PHI Learning Private Limited, 2012.
2. Metha P.L, “Managerial Economics – Analysis, Problems and Cases”, Sultan Chand & Sons, 2016.

REFERENCES:

1. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, “Principles of Engineering Economics with Applications, Cambridge University Press, 2018.
2. Varshney, R.L and K.L. Maheshwari, “Managerial Economics”, Sultan Chand & Sons, 2014.
3. McEachern and Indira., “Macro ECON”, Cengage India Private Limited, 2017.
4. Shalini Goyal Bhalla, “Circular Economy (Re) Emerging Movement”, Invincible Publishers, 2020.

23IL310 ANALOG ELECTRONICS LABORATORY

Hardware Experiments

1. Full Wave Rectifiers with and without filters.
2. Series voltage regulators.
3. BJT amplifiers.
4. MOSFET amplifiers.
5. RC phase shift and Colpitt’s oscillators.
6. Class B and Class AB amplifiers.
7. Astable and MonostableMultivibrators.
8. Schmitt Trigger.

Software Experiments

1. Current mirrors and Differential amplifiers
2. MOS CS amplifier with resistive load and current source load
3. Feedback Amplifiers
4. RC Integrator and Differentiator Circuits.

AUGMENTED EXPERIMENTS*

1. Design of a regulated power supply.
2. Design of an audio power amplifier.
3. Design of an Automatic gain control circuit using differential amplifier.
4. Application using multivibrator circuits.

REFERENCES:

1. Laboratory Manual Prepared by ECE Department, 2019.
2. David A Bell, Electronic Devices and Circuits, Prentice Hall of India, New Delhi, 2008.

* Augmented experiments will be evaluated at the end of the semester

23IL311 DIGITAL ELECTRONICS LABORATORY

HARDWARE EXPERIMENTS:
1. Half adder and Full adder
2. Code Conversion: BCD to Gray and Seven segment conversion
3. Multiplexers/Demultiplexers
4. Encoders/Decoders
5. Flip-flops
6. Shift Registers
7. Ring Counter and Johnson Counter
8. Asynchronous Counters

SOFTWARE EXPERIMENTS (FPGA Implementation):
1. Adder / Subtractor Circuits and BCD adder using verilog code
2. Magnitude Comparator and ALU using verilog code
3. Synchronous Counters using verilog code
4. Sequence Detector using verilog code

AUGMENTED EXPERIMENTS*
1. Design of Hamming code generator for 8-bit data
2. Design of Digital Clock
3. Develop Verilog code for 4-bit Universal Shift Register
4. Develop Verilog code for Arithmetic Logic Unit

TEXT BOOKS:
1. Morris Mano, and M.D. Ciletti , "Digital Design: with an introduction to Verilog HDL, VHDL and system verilog", 6th Edition, Pearson Education, New Delhi, 2018.

*Augmented experiments will be evaluated at the end of the semester.

SEMESTER-4

23IIL401 PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axioms, conditional probability, law of total probability, Baye's theorem, discrete random variables, probability mass function, families of discrete random variables - binomial, Poisson and geometric random variables, cumulative distribution function, expected values

CONTINUOUS RANDOM VARIABLES: Cumulative distribution function, probability density function, families of continuous random variables - uniform, exponential and Gaussian random variables, expected values)

PAIRS OF RANDOM VARIABLES: Joint cumulative distribution function – joint probability mass function – marginal probability mass function – joint probability density function – marginal probability density function – independent random variables – expected value – covariance, correlation and independence.

STOCHASTIC PROCESSES: Types of stochastic processes – Poisson process - discrete time Markov chains - classification of states - limiting state probabilities

STATISTICAL INFERENCE: Hypothesis : general concepts - testing a statistical hypothesis - one-and two-tailed tests - tests concerning mean, proportion, and variance - single and two samples, tests for goodness of fit and independence of attributes.

TEXT BOOKS:
1. Roy D Yates and David J Goodman, "Probability and Stochastic Processes", Wiley India, New Delhi, 2021.
2. Ronald E. Walpole, Raymond H Myers, Sharon L Myers and Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, New Delhi, 2016.

REFERENCES:
1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", CRC Press, USA, 2018.
2. Dougles C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018.
3. Athanasios Papoulis and Unnikrishna Pillai S, "Probability, Random Variables and Stochastic Processes", Tata McGraw Hill, New Delhi, 2017.
4. Arnold O Allen, "Probability, Statistics and Queueing theory: with computer science applications", Academic press, USA, 2014.

23IL402 LINEAR INTEGRATED CIRCUITS

OPERATIONAL AMPLIFIERS: Block diagram - Ideal Operational Amplifier Characteristics - DC and AC characteristics - frequency response - Stability.

APPLICATION OF OPERATIONAL AMPLIFIERS: Linear applications- DC & AC amplifiers- summing differential amplifier-instrumentation amplifier-Log and antilog amplifiers-V to I and I to V converters-Integrator-Differentiator-Active filters.
Nonlinear applications - Op-Amp circuits using diodes-Comparators-Schmitt Trigger- Oscillators-Waveform generators-Sample and hold circuits.

TIMER AND PHASE LOCKED LOOP: 555 Timer - modes of operation and applications- Voltage Controlled Oscillator - Phase Locked Loop and applications

A-D AND D-A CONVERTERS : Digital to Analog converters: Binary weighted and R-2R Ladder types - Analog to digital converters: Flash, Counter, Successive approximation and Dual slope - DAC / ADC performance characteristics and comparison

VOLTAGE REGULATORS: Fixed voltage regulators - adjustable voltage regulators - IC Voltage regulators - Buck & Boost regulators - Switching regulators

TEXTBOOKS:
1. D. RoyChoudhury&ShailBala Jain, "Linear IntegratedCircuits",6thEdition, New Age International Publishers, NewDelhi, 2022.
2. James.M.Fiore , "OP- AMPS and Linear Integrated Circuits-concepts and applications", 3rd Edition, cenage learning india, New Delhi,2019.

REFERENCES:
1. Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, 4th Edition, Pearson Noida, 2016.
2. Michael Jacob J,"Analog Integrated Circuits and Applications", 1st Edition, Prentice Hall of India, New Delhi,2019.
3. Robert F Coughlin and Fedrick F Driscoll. , "Operational amplifiers and linear Integrated Circuits", Pearson, Noida, 2016.

23IL403 SIGNALS AND SYSTEMS

INTRODUCTION & LTI SYSTEMS: Continuous Time (CT) and Discrete Time (DT) signals: Operations - Basic signals - Classification - Properties of CT & DT systems – Analysis of LTI systems - Convolution Sum - Convolution Integral – Properties.

FOURIER SERIES ANALYSIS FOR CT & DT SIGNALS AND SYSTEMS: Representation of CT periodic signals by Continuous Time Fourier Series (CTFS) - Convergence - Properties - Representation of DT periodic signals by Discrete Time Fourier Series (DTFS) – Properties**.**

FOURIER TRANSFORM ANALYSIS FOR CT & DT SIGNALS AND SYSTEMS: Representation of CT aperiodic and periodic signals by Continuous Time Fourier Transform (CTFT) - Convergence - Properties - Frequency response of CT systems - Representation of DT aperiodic and periodic signals by Discrete Time Fourier Transform (DTFT) – Convergence - Properties - Frequency response of DT systems.

SAMPLING: Representation of CT signals by samples - Impulse train sampling - Effect of under sampling - Reconstruction of CT signal from samples using interpolation - Zero-order hold Sampling.
Z TRANSFORM ANALYSIS OF DT SIGNALS AND SYSTEMS: z- transform - Properties - Inverse z-transform - Partial fraction and Cauchy Residue methods - Analysis of LTI systems using z transform - Solution of difference equations - Stability and causality in z-plane.

TEXT BOOKS:
1. Alan V Oppenheim, Alan S Willsky, Hamid NawabS , "Signals and Systems", Second Edition, Pearson, 2021.
2. V Krishnaveni, A Rajeswari , "Signals and Systems", First Edition, Wiley India, 2019.

REFERENCES:
1. Simon Haykin, Barry Van Veen, "Signals and Systems" Second Edition, Wiley India, 2018..
2. HP Hsu, R Ranjan , "Signals and Systems Schaums‘s Outlines, Second Edition,, Tata McGraw Hill, 2010.
3. Samir S. Soliman, MandyamDhatiSrinath , "Continuous and Discrete Signals and Systems", Second Edition, Prentice Hall International, 2011.
4. Luis F. Chaparro , "Signals and Systems Using MATLAB", 1st Edition, Academic Press, An Imprint of Elsevier, 2011.

MIT open courseware
https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/

23IL404 COMPUTER ARCHITECTURE

INTRODUCTION: Generations of computer system - Elements of computer - CPU organization - Instruction formats - Addressing modes - Instruction types - CISC and RISC architectures.

DATA PATH DESIGN: Fixed point arithmetic - adder / subtractor - Signed magnitude multiplication algorithm - Robertson multiplication algorithm - Booth's and modified Booth's multiplication algorithm - non-restoring division algorithm - restoring division algorithm - floating point arithmetic - addition, subtraction, multiplication and division - ALU - Verilog implementation of datapath components

CONTROL LOGIC DESIGN: Control organization - Hardwired Control - one flip flop per state - sequence register and decoder - PLA control - Micro programmed control - performance enhancement techniques - parallel processing - arithmetic pipeline, instruction pipeline - Amdhal's law - Measuring CPU performance – Verilog implementation of control logic components.

MEMORY ORGANIZATION: Basic Concepts - Memory Hierarchy - Main Memory - Auxiliary Memory – Associative Memory - Cache and Virtual Memory - SDRAM, DDRAM, QDRAM - Flash memories.

INPUT / OUTPUT AND SYSTEM ORGANIZATION: Input / Output Interface - Modes of data transfer - I/O Processor - Interrupts - Communication methods - Buses - Bus control - Bus interfacing - Bus arbitration - Multicore architectures - Introduction to RISC

TEXT BOOKS:

1. Morris Mano M , "Digital Logic and computer design", Pearson Education, New Delhi, 2016.
2. Hayes J P , "Computer architecture and Organization", McGraw Hill, New Delhi, 2012.

REFERENCES:

1. Stallings W, "Computer Organization and Architecture: Designing for performance, Pearson Education, New Delhi, Tenth Edition", 2016.
2. Patterson D, Hennessy J, "Computer Organization and Design RISC-V Edition: The Hardware Software Interface", Second Edition, Morgan Kaufmann Publishers, 2021.
3. Joseph Cavanagh, "Computer Arithmetic and Verilog HDL Fundamentals", CRC Press, 2020.

23IL405 DATA STRUCTURES AND ALGORITHMS

INTRODUCTION: Data types – Abstract data types – Types of Data structures- Algorithms- properties – Design and development of algorithm-Recursive Algorithms- Analysis of Algorithms-Best case, Average case, Worst case – Asymptotic Notations.

LINEAR DATA STRUCTURES: Arrays-operations – Memory Representation- Row Major and Column Major – Multi Dimensional Arrays – Sparse Matrix, Dense Matrix. Stack: Array implementation – operations-Applications – Checking of well-formedness Parenthesis Infix to Postfix –Conversions.

QUEUES: Queue Operations-Circular Queue - Priority Queues - Array Implementation of Queue.Linked List:. Types-Singly Linked List – Circularly Linked List – Doubly Linked List–List operations-linked stack-linked queue.

NONLINEAR DATA STRUCTURES: Trees-Terminologies - Binary trees – Representations – Operations – Traversals- Inorder, Preorder and Postorder- Binary Search Trees – Insertion and deletion. Graph: Terminologies -Breadth First Search algorithm-Depth First Search Algorithm

SORTING AND SEARCHING: Bubble Sort – Insertion Sort – Radix Sort- Quick sort- Algorithms and Time Complexity. Linear Search – Binary Search – Hashing: Hash functions – Separate Chaining – Open Addressing – Linear Probing.

TEXT BOOKS:

1. Thomas H Cormen, Charles E Leiserson,Ronald L Rivest,CliffordStein,"Introduction to Algorithms" ,The MIT Press , 2022.
2. Mark Allen Weiss," Data Structures and Algorithm Analysis in C++",Pearson Education , 2012.

REFERENCES:

1. Ellis Horowitz,SartajSahni,SanguthevarRajasekaran. "Fundamentals of Computer Algorithms" Second Universities Press , 2011.
2. SahniSartaj. "Data Structures, Algorithms and Applications in C++",Silicon Press , 2009.
3. Aaron M Tanenbaum,Moshe J Augenstein,YedidyahLangsam. "Data structures using C and C++" ,PHI Learning , 2009.
4. G A V VijayalakshmiPai. "DataStructures and Algorithms Concepts, Techniques and Allocations", New Delhi: McGraw Hill Education(India) Private Limited , 2015.

23IL410 LINEAR INTEGRATED CIRCUITS LABORATORY

HARDWARE EXPERIMENTS:

1) Design and testing of Inverting,Non-Inverting, Differential amplifiers,Integrator and Differentiator
2) Design and testing of Rectifiers using precision diodes
3) Design and testing of Comparators and Schmitt Trigger using op-amp
4) Design and testing of Phase shift and Wien bridge oscillators using op-amp
5) Frequency response analysis of Second order High pass and wide Band pass filters
6) Design and testing of Astable and monostablemultivibrators using Timer.
7) Design and testing of Digital to Analog Converters and Analog to Digital converters
8) Design and testing of Low dropout voltage regulators

SOFTWARE EXPERIMENTS:

1) Design and testing of Instrumentation amplifier
2) Design and testing of Log and Antilog amplifiers
3) Design and testing of Universal Filters
4) Design and testing of Voltage Controlled Oscillator

AUGMENTED EXPERIMENTS*

1) Design of a function generator to generate sine/square/Triangular waveforms.
2) Design a circuit to reduce the power supply noise.
3) Design of a frequency synthesizer using PLL.
4) Application using 555 timer circuits.

TEXT BOOKS:

1. D. RoyChoudhury&ShailBala Jain, "Linear IntegratedCircuits",6th Edition,New Age International Publishers, NewDelhi, 2022.
2. Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, 4th Edition, PEARSON 2016 NOIDA, 2016.

* Augmented experiments will be evaluated at the end of the semester.

23IL411 SIGNALS AND SYSTEMS LABORATORY

Simulation experiments

1. Generation of Continuous -time (CT) and Discrete-time (DT) signals
2. Signal operations on CT and DT signals
3. Verification of CT and DT System properties
4. Computation of Linear Convolution
5. Analyze and Synthesize the continuous time periodic signals using Fourier Series and study of Gibbs phenomenon
6. Analyze and Synthesize the continuous time aperiodic signals using Fourier Transform
7. Analyze and Synthesize the discrete time periodic signals using Fourier Series
8. Analyze and Synthesize the discrete time aperiodic signals using Fourier Transform
9. Sampling and Reconstruction
10. Analysis of DT systems using z-transform

REFERENCES:

1. “Signals and Systems Lab Manual”, Department of ECE, PSG college of Technology, 2019.
2. Krishnaveni.V, Rajeswari.A, "Signals and Systems", First Edition, Wiley India Pvt.Ltd, 2019 (Reprint).
3. Luis F. Chaparro, “Signals and Systems Using MATLAB” 1st Edition, Academic Press, An Imprint of Elsevier, 2018.

SEMESTER-5

23IL501 COMMUNICATION ENGINEERING

AMPLITUDE MODULATION SYSTEMS : Communication system model – Amplitude Modulation – DSBFC, DSBSC, SSB - Generation and detection of DSB-FC, DSB-SC, SSB waves, Vestigial Sideband Modulation, Independent Sideband Modulation - Comparison of AM systems – FDM.

ANGLE MODULATION SYSTEMS : FM and PM - Narrow band FM and Wideband FM - Bandwidth requirements- Carson‘s Rule - Pre emphasis, De-emphasis - Generation and demodulation of FM waves – FM Stereo Multiplexing.

TRANSMITTERS AND RECEIVERS : Transmitter characteristics & Classification - Low Level and High Level transmitters – AM broadcasting transmitters - Pilot carrier technique- FM transmitters. Receiver -characteristics and Classification- Tuned radio frequency receiver - Super heterodyne receiver – AM and FM receivers – Introduction to Software Defined Radio

NOISE IN COMMUNICATION SYSTEMS : Types of Noise – Noise Calculations – Equivalent Noise Bandwidth – Noise Figure – Effective Noise Temperature – Narrowband Noise representation- Noise in CW Modulation systems, Noise in Linear Receiver using coherent detection, Noise in AM receivers using envelope Detection – Noise in FM receivers

PULSE MODULATION SCHEMES : Sampling Theorem - Pulse Amplitude Modulation – TDM - Pulse Width Modulation – Pulse Position Modulation – Pulse Frequency Modulation –Quantization - PCM – Noise Performance of PPM and PCM - Delta Modulation – Adaptive Delta Modulation – Delta Sigma Modulation – DPCM.

TEXT BOOKS:
1. Simon Haykin , "Communication Systems", Wiley, 2014.
2. Kennedy G , "Electronic Communication systems", Tata McGraw Hill, 2017.

REFERENCES:
1. HerbutTaub, Donald L. Schilling, GoutamSaha , "Principles of Communication Systems", McGraw Hill, 2017.
2. Carlson A B , "Communication systems: An Introduction to signals and noise in electrical communication", McGraw Hill,2010.
3. Dennis Roddy, John Coolen , "Electronic Communications", Prentice Hall of India, 2013.
4. Lathi B P , "Modern Digital and Analog communication Systems", Oxford University Press, 2017.

23IL502 EMBEDDED SYSTEMS

MICROCONTROLLER ARCHITECTURE AND PROGRAMMING: Introduction - Product Design Life Cycle of Embedded Systems- Functional block diagram of 8051- Program and Data memory Organization-Addressing Modes and Instruction Set – Assembly language Programming.

ON-CHIP PERIPHERALS INITIALIZATION AND PROGRAMMING TECHNIQUES: Parallel Ports, Timer/Counter, Capture/Compare, WDT, RTC, PWM, QEI, Interrupts, EEPROM, ADC and DAC.

OFF-CHIP PERIPHERALS INTERFACING AND PROGRAMMING TECHNIQUES: LED, 7-segment, LCD, Push-to-On switch, Matrix keyboard, DC Motor, Servo Motor & Stepper Motor.

WIRED & WIRELESS PROTOCOLS: UART, I2C, CAN, USB, SPI and Ethernet - LoRa, Bluetooth and WiFi.

RTOS: Device Drivers - Tasks and Task States, Context Switching - Intertask Communication: Shared Data, Semaphores, Message Queues, Mailbox, Pipe - Timer Functions - Events - Memory Management Functions - Interrupt handling in RTOS.

TEXT BOOKS:
1. Kenneth J Ayala, “The 8051 Microcontroller: Architecture, Programming & Applications”, West Publishing Company, 3rd Edition, 2007.
2. David. E. Simon, “An Embedded Software Primer” Pearson Education, 2015.

REFERENCES:
1. Muhammad Ali Mazidi, J.G. Mazidi, R.D. McKinlay , "The 8051 Microcontroller and Embedded Systems", Second Edition, Pearson Education Limited, 2014.
2. Arnold S. Berger, “Embedded Systems Design: An Introduction to Processes, Tools, and Techniques” CMP Books, 2002.
3. Bai Y, “Practical Micro Controller Engineering with ARM Technology”, John Wiley and Sons, 2015.

23IL503 CONTROL SYSTEMS

INTRODUCTION : Modeling of Electrical and Mechanical systems - Translational and Rotational systems – Block diagram – Signal flow graph - Mason's gain formula.

TIME AND FREQUENCY DOMAIN ANALYSIS : Standard Test signals – Time response of second order systems -Performance specifications on system time response - Types of systems - Steady state error - Generalized error series -Introduction to PID Controllers –Performance specifications on system Frequency response – Correlation between time and frequency response.

STABILITY ANALYSIS : Concepts of Stability - Routh Stability Criterion - Root locus technique

FREQUENCY RESPONSE PLOTS AND SYSTEM STABILITY: Polar plot - Nyquist stability Criterion - Bode plot - Compensator design using Bode Plot.

STATE VARIABLE ANALYSIS : Introduction –State space representation of continuous time systems using Physical and Phase Variables – Solution of state equations–Concepts of Controllability and Observability.

TEXTBOOKS:
1. Nagrath I J, and Gopal, M, “Control Systems Engineering”, New Age International P Ltd, 7th Edition, 2022, New Delhi
2. C.Norman, SNise, “Nise's Control Systems Engineering”,5thEdition, Wiley ,2022, New Delhi.

REFERENCES:
1. Katsuhiko Ogata, “Modern Control Engineering”, 5thEdition, Pearson, 2021, New Delhi.
2. Kuo B C, “Automatic Control Systems”, 10thEdition, McGraw Hill Education (I) P Ltd, 2018, Chennai.
3. Katsuhiko Ogata, “DiscreteTime Control SystemsII”,2ndEdition, Pearson Education Asia, New Delhi,2016.
4. Smarajit Ghosh, “Control Systems Theory and Applications”, 2ndEdition, Pearson Education Asia, Chennai, 2022.

23IL504 COMPUTER NETWORKS

INTRODUCTION AND QUEUING PRINCIPLES : Network Criteria - Network Types - Transmission modes - Network Models: OSI Model, TCP/IP model - Digital to Digital Conversion – Digital Data Transmission - Transmission Media – Multiplexing – Switching - Connecting devices - Queuing Models: M/M/n and M/G/1-Queues with blocking and priority queues.

DATA LINK LAYER: Error Detection and Correction - Data Link Control - Media Access Control- Wired LANs: Ethernet, Token bus,Token ring, FDDI - Virtual LAN

NETWORK LAYER: IPv4 addressing- Class ful and Classless addressing, Subnetting–NAT–DHCP–ICMP–IGMP– Routing Algorithms:Distance Vector and Link State -Progression to IPv6- Network Layer Performance.

TRANSPORT LAYER: Process to process delivery–UDP–TCP–SCTP–Congestion control–Quality of Service.

APPLICATION LAYER: ClientServerProgramming–WWW–HTTP - FTP–Email–Telnet–DNS–SNMP –VoIP

TEXT BOOKS:

1. Behrouz A Forouzan , "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, New Delhi, 2017.
2. Kurose James F, Keith W. Ross , "Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, New Delhi, 2016.

REFERENCES:

1. J.F. Shortle, J.M. Thompson, D. Gross and C.M. Harris, “Fundamentals of Queueing Theory”, 5th Edition, Wiley, 2018.
2. AndrewS Tanenbaum, "Computer Networks",PrenticeHallofIndia,NewDelhi,2011.
3. William Stallings,"Data and Computer Communication",PrenticeHallofIndia,NewDelhi, 2014.
4. Larry L. Peterson, Bruce S. Davie , "Computer Networks: A Systems Approach", Morgan Kauffmann Publishers Inc, 2012.
5. Keizer G.E , "Local Area Networks", 2nd Edition, McGraw Hill, New Delhi, 2001.

23IL505 ANTENNAS AND WAVE PROPAGATION

ANTENNA PARAMETERS: Introduction **-** Types of antennas-Radiation mechanism-current distribution-Parameters: Radiation Pattern, Beam solid angle, Radiation intensity, Radiation Power density, Directivity, Gain, Effective aperture, Polarization, Bandwidth, Beamwidth, antenna impedance - Poynting vector- Friis Transmission formula - Duality theorem

SMALL ANTENNAS: Transmission line as an antenna - Radiation from a dipole antenna - Radiation fields of point source - infinitesimal dipole and half wave dipole-Radiation resistance-Directivity and Design procedure.

ANTENNA ARRAYS: Introduction, Array of two point sources - Power patterns – Pattern multiplication-Broadside array-End fire array-N-element linear array, Evaluation of null directions and maxima, amplitude distributions, Binomial arrays, Dolph –Chebychev arrays

SPECIAL ANTENNAS: Construction, Features and applications of Yagi-Uda , Turnstile, Log periodic, Loop, Helical: normal mode and axial mode - Rhombic- Horn-Reflector and their feed systems- Micro strip-Rectangular patch antennas - Phased array. (9+3)

ANTENNA MEASUREMENTS AND WAVE PROPAGATION: Antenna ranges-Measurement of radiation pattern, Gain, directivity and impedance measurements-Polarization measurements-scale model measurements. Propagation in free space-Surface wave-structure of the ionosphere-determination of critical frequencies - maximum usable frequency - effect of the earth‘s magnetic field –ionospheric variations – fading – tropospheric propagation - space wave propagation- super refraction -refractive index of troposphere

TEXT BOOKS:

1. Balanis E S, "Antenna Theory Analysis and Design", 5th Edition, John Wiley and Sons Inc, Singapore, 2016.
2. Prasad K D," Antennas and Wave Propagation",12th Edition, Satya Prakash, Tech India Publications, New Delhi, 2019.

REFERENCES:

1. Harish A R, and ScahidanandaM,"Antennas and Wave Propagation" ,3rdEdition,Oxford University Press, Chennai, 2018.
2. Edward C Jordan, Keith G Balmain,"Electromagnetic waves and Radiating systems", 5th Edition, Prentice Hall of India, New Delhi, 2018.

23IL510 COMMUNICATION ENGINEERING LABORATORY

HARDWARE EXPERIMENTS :

1. Amplitude Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. Pre emphasis and De emphasis circuits
4. Frequency Modulation and Demodulation
5. Single tuned amplifier
6. FM Reception using Universal Software Radio Peripheral
7. Pulse Modulation Schemes
8. TDM and FDM systems

SOFTWARE EXPERIMENTS :

1 Automatic Gain Control circuits
2 Figure of Merit Analysis of AM and FM
3 PCM and DPCM
4 Delta Modulation and Adaptive Delta Modulation

AUGMENTED EXPERIMENTS*

1. Audio Amplifier
2. Superheterodyne Receiver
3. Application of Pulse Modulation Schemes
4. Application of PCM and DPCM

REFERENCES:

1. Laboratory Manual Prepared by ECE Department, 2019.
2. Simon Haykin , "Communication Systems", Wiley, 2014.

* Augmented experiments will be evaluated at the end of the semester.

23IL511 EMBEDDED SYSTEMS LABORATORY

HARDWARE (8051) EXPERIMENTS

1. Display Interface
2. Keyboard Interface
3. Timer/Counter Applications
4. RTC and WDT Interface
5. Hardware & Software Interrupts
6. Serial Communication Protocols
7. ADC Applications
8. Motor Control Applications

SOFTWARE EXPERIMENTS (KEIL IDE)

1. Arithmetic and Logical Operations
2. Searching & Sorting
3. Code Conversion Techniques
4. Multi-tasking using tiny RTOS

AUGMENTED EXPERIMENTS*

1. Temperature monitoring and control
2. Speed measurement and calculation
3. Object recognition using camera interface
4. Attendance monitoring system with display interface

REFERENCES:

1. Laboratory Manual Prepared by ECE Department, 2019.
2. Muhammad Ali Mazidi, J.G.Mazidi, R.D. McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly & C”, Pearson, 2008.

* Augmented experiments will be evaluated at the end of the semester.

SEMESTER-6

23IL601 DIGITAL SIGNAL PROCESSING

DISCRETE FOURIER TRANSFORM (DFT) : Review of CTFT & DTFT - DFT – Properties - Radix 2 FFT algorithms - Decimation in time - Decimation in frequency - Use of FFT in Linear filtering - Filtering of long data sequences

DESIGN AND REALIZATION OF IIR FILTERS : Review of design techniques for analog low pass filters - Design of IIR filters - Approximation of derivatives - Impulse Invariance - Bilinear transformation - Butterworth and Chebychev Type 1 filters - Realization of IIR filters.

DESIGN AND REALIZATION OF FIR FILTERS : FIR filters - Symmetric and anti-symmetric FIR filters - Design of linear phase FIR filters using windows - Realization of FIR filters.

ANALYSIS OF FINITE WORD LENGTH EFFECTS : Representation of Numbers - Quantization of filter coefficients in IIR and FIR filters - Round Off effects in Digital filters - Quantization effects in computation of DFT.

PROGRAMMABLE DIGITAL SIGNAL PROCESSORS : Introduction to Digital Signal Processors - Architecture of TMS320C6748 - Device characteristics - Memory mapping – Peripherals.

TEXTBOOKS:

1. Lonnie C Ludeman , "Fundamentals of Digital Signal Processing", Wiley India, New Delhi, 2011.
2. John G Proakis and Dimitris G Manolakis , "Digital Signal Processing", Prentice Hall India, New Delhi, 2010.

REFERENCES:

1. Oppenheim A V , "Discrete Time Signal Processing", Prentice Hall India, New Delhi, 2010.
2. Mitra S K , "Digital Signal Processing – A Computer based Approach", Tata McGraw Hill, New Delhi,2012.
3. Vinay K Ingle, John G Proakis , "Digital signal processing using MATLAB", Brooks / Cole, California,United States, 2011.
4. B.Venkatramani,M.Bhaskar, ”Digital Signal Processor Architecture, Programming and Application”, McGraw hill, Second edition 2002.
5. TI Team, “TMS320C6748 Technica; Reference Manual”, September 2016.

23IL602 DIGITAL COMMUNICATION

INFORMATION THEORY : Review of Probability theory and random process - Self information measure - Entropy function - Conditional Entropies - Mutual information - Redundancy - Efficiency – Source Coding - channel capacity - capacities of channels with symmetric noise structure Shannon‘s Hartley Law

BASEBAND SIGNALLING : Power Spectral Density - Concept of base band signaling - Signaling formats – Line coding -Optimum Filtering - Error due to Noise – ISI - Pulse Shaping - Scrambling and unscrambling - channel equalization, tapped delay line and Transversal filters

ERROR CONTROL CODING : Parity check codes - Linear block codes – Decoding of linear Block codes – Polynomial representation of code structures - cyclic codes - convolution codes –The Generating function-Viterbi Decoding algorithms - turbo codes.

PASSBAND SIGNALLING : Signal Space Analysis - Detection using matched filters for signals via AWGN channels – Analysis of coherent and non coherent detection Schemes for ASK, FSK, PSK, DPSK - M-arysignaling – MSK – GMSK – QAM - Probability of error for each scheme - Multicarrier modulation – OFDM.

SPREAD SPECTRUM AND SYNCHRONIZATION : PN sequences - Direct Sequence Spread spectrum – Frequency Hop Spread Spectrum - Need for Synchronization - Bit, word, frame and Carrier synchronization.

TEXT BOOKS:

1. Simon Haykin , "Digital Communications", John Wiley & Sons, Inc, Singapore, 2017
2. Lathi B P , "Modern Digital and Analog communication Systems", Oxford University Press, 2020

REFERENCES:

1. Proakis J G, SalehiM , "Digital Communications", Tata McGraw Hill, New Delhi, 2016.
2. Bernard Sklar , "Digital Communications- Fundamentals and applications", Pearson Education, New Delhi, 2019.
3. Reza F M , "An Introduction to information theory", McGraw Hill, New Delhi, 2010.
4. Sam ShanmugamK , "Digital and Analog communication systems", John Wiley Inc, Singapore, 2008.

23IL603 VLSI DESIGN

INVERTERS : Review of MOS transistor equations -Passive load inverter- CMOS inverter – Transfer Characteristics, Power dissipation- Depletion mode and enhancement mode pull ups – Pseudo nMOS Inverter - Sheet resistance - Area Capacitance - Inverter delay and Logical Effort.

LOGIC DESIGN : Combinational logic circuits - Static CMOS logic- Complementary CMOS, Ratioed logic, Pass- Transistor, Transmission gate - Dynamic CMOS logic – Performance, Noise considerations, domino, npCMOS logic - Sequential logic circuits - static and dynamic flip-flops

SUBSYSTEM DESIGN : Design of adders-Static adder, Mirror adder, Carry Look Ahead adder, Binary adder – Multipliers-Array multiplier, Carry Save multiplier, Booths and Modified Booths multiplier - Barrel shifter, Logarithmic shifter.

MEMORY DESIGN : 6T SRAM Cell**,** CAM memory,4x4 -OR ROM, NOR ROM, NAND ROM cell array,6-T SRAM cell,3-T DRAM cell, Memory peripheral circuitry-Address Decoders-Sense amplifiers-Power dissipation in memories.

VLSI LAYOUT DESIGN AND FABRICATION TECHNIQUES : Layout styles – Full custom and Semi custom approaches -Layout Design Rules – CMOS nwell process rules - Stick diagram - Layout examples – Fabrication techniques – Wafer processing - Oxidation - Patterning - Diffusion - Ion implantation - Deposition - CMOS processes : nWell, Twin tub, Silicon on Insulator.

TEXT BOOKS:

1. Neil H E Weste, David Money Harris, “CMOS VLSI Design: A Circuits and System Perspective, Pearson, 2017.
2. Jan M Rabaey, AnanthaChandrakasan, "Digital Integrated Circuits- A Design Perspective", Prentice hall of India, 2016.

REFERENCES:

1. Caver Mead, Lynn Conway , "Introduction to VLSI Systems", Addison-Wesley, 2017.
2. Douglas A Pucknell , Kamran Eshranghian , "Basic VLSI Design", Prentice Hall of India, 3rd edition, 2011.
3. Amar Mukherjee , "Introduction to nMOS and CMOS VLSI System Design", Prentice Hall, 1986.
4. Sung-Mo Kang , Yusuf Leblebici “CMOS Digital Integrated Circuits, Analysis and Design”, McGraw Hill Education; Fourth edition, 2019.

23IL610 DIGITAL SIGNAL PROCESSING LABORATORY

SOFTWARE EXPERIMENTS:

1) Compute DFT
2) FFT Algorithms
3) Linear filtering using FFT
4) Filtering of long data sequences
5) IIR filter design using BLT
6) IIR filter design using IIT
7) FIR filter design using windows
8) Analysis of Finite word length effects

HARDWARE EXPERIMENTS:

1) Signal generation
2) Linear convolution
3) FIR filter
4) IIR filter

TEXT BOOKS:

1. Vinay K Ingle and John G Proakis , "Digital signal processing using MATLAB", , Brooks / Cole, California, United States,2011.

REFERENCES:

1. Mitra S K , "Digital Signal Processing – A Computer based Approach", Tata McGraw Hill, New Delhi, 2010.
2. Vinay K Ingle, John G Proakis , "Digital signal processing using MATLAB", United States, Brooks / Cole, California, 2011.
1. B.Venkatramani,M.Bhaskar, ”Digital Signal Processor Architecture, Programming and Application”,McGrawhill,Second edition 2002**.**

23IL611 VLSI DESIGN LABORATORY

SOFTWARE EXPERIMENTS:

1) Characteristics of NMOS and PMOS transistors
2) Design and Simulation of nMOS inverter, CMOS inverter, Pseudo nMOS inverter and obtaining its Transfer characteristics, Noise Margin
3) Power analysis of nMOS inverter, CMOS inverter and Pseudo NMOS inverter
4) Design of combinational Static CMOS circuits - Complementary CMOS, Pass transistors, Transmission gates
5) Design of combinational Dynamic CMOS circuits –Domino, npCMOS logic
6) Design and Simulation of simple combinational and sequential circuits using CMOS gates (Encoder, Multiplexer, Code Converters, Counters, Registers)
7) Design and Simulation of static and dynamic flip flops – C2MOS, Pseudostatic, NORA CMOS
8) Design and Simulation of subsystem modules-Adders, Multipliers
9) Design and simulation of 6-T SRAM memory cell
10) Layout design of Digital logic circuits

23IL620 INNOVATION PRACTICES

- **Preparing a project – brief proposal including**
  - Problem Identification
  - A Statement of system / process specifications proposed to be developed (Block diagram / concept tree)
  - List of possible solutions including alternatives and constraints
  - Cost benefit analysis
  - Time line of activities
- **A report highlighting the design finalization (based on functional requirements & standards (if any))**

- **A Presentation including the following**
  - Implementation Phase (Hardware / Software / both)
  - Testing and validation of the developed system
  - Learning in the project
- **Consolidated report preparation**

GERMAN LANGUAGE

23IG065 GERMAN LANGUARE – A1

TOPIC 1
How to talk about yourself, how to introduce yourself, and get introduce to people. Asking their names, where they live, where they are from, age, languages, countries.

TOPIC 2
Talking about describing cities, places, and famous buildings in cities. Also about transport and directions.

TOPIC 3
Conversation about hobbies, friends, family, profession, weekdays, months, dates, time.

TOPIC 4
Discuss about food and drink, how it tastes, different food items, and placing an order in a restaurant, and paying bills. Groceries, stores, and prices.

TOPIC 5
Hobbies, habits, planning some activities together, talking about places or programs to go out.

TOPIC 6
Talk about day-to-day routine, Talk about the weekly or monthly schedule, using verbs, framing questions.

TOPIC 7
Communication at the workplace, talking with colleagues, writing emails, talking about the work schedule, meetings, and telephonic communication.

TOPIC 8
Types of houses and house rents, apartments, furniture, renting a house in Germany, describing house or apartment, how to use adjectives.

TOPIC 9
How to shop; types of shops; online shopping; talking about shops; going to a mall; buying things and clothes, size, shape, colour, brands.

TOPIC 10
How to talk about health, communicating with the doctor, fixing appointments at the doctor, discussing health issues, talking about diet plans.

TOPIC 11
Travel, Tickets booking, hotels. Hotel and services, Tourist places in various countries

23IG066 GERMAN LANGUAGE – A2

TOPIC 1
Around Eating- Talk about food & restaurant, Eating habits, introduction about yourself and other people.
TOPIC 2
After School- Learn about the German school system. Determine about various types of schools in Germany. Furthermore, Understanding and giving tips about the city.
TOPIC 3
Expression of feelings and emotions- Learn how to speak about your feelings, about festivals, understanding blogs, and cultural expressions.
TOPIC 4
Day today life- Learning about ticket counters and train travel, expressing career aspirations, working worlds.
TOPIC 5
Being Mobile- Expressing uncertainty, newspaper article, All about travel, trip information
TOPIC 6
Working life - understanding about everyday working life, radio reports, learning problems, presentation making.
TOPIC 7
Zeal and enthusiasm experience- How to express enthusiasm, hope and disappointments formulation of consequences.
TOPIC 8
Living together in the society- How to complain, apologize, talk about pets
TOPIC 9
Entertainment- Talk about various styles of music, concert ticket, a musician, band , and all about entertainment.

23IG067 GERMAN LANGUAGE – B1

TOPIC 1: Vacation and Travel
Planning a Vacation. Talking about special offers and conditions. Understanding more complex information. Evaluating different options. Expressing dissatisfaction and frustration.

TOPIC 2: Neighbours
Propose solutions in conflicts. Report events and advocate for one's rights. Understand formal text modules in written communication. Terminate a rental agreement.

TOPIC 3: A school project on environmental protection
Understand important information and facts at a Parent-Teacher meeting. Justify facts, discuss, and make counter proposals. Discuss fears, worries, and uncertainties regarding childcare. Exchange thoughts on differences from one's home country and intercultural experiences related to environmental protection.

TOPIC 4: Online shopping
Discuss the advantages and disadvantages of specific shopping or payment options. Clarify payment terms and delivery conditions. Understand terms and conditions (AGBs).

TOPIC 5: Television and entertainment
Discuss media experiences and television habits. Talk about watching television to improve German language skills. Engage in small talk about sports events. Discuss intercultural experiences and
compare behaviour patterns in Germany with those in home country.

23IG068 GERMAN LANGUAGE – B2.1

TOPIC 1: Time
Interview and introduce a partner. Talk about the past. Understand a song and discuss it. Introduce a song from own country and share information about the song, its meaning, cultural significance, or why it is popular in one’s own country. Summarize a text.

TOPIC 2: Learning
Understand a street survey about learning. Talk about one's own learning. Write a comment. Understand forum posts. Report about personal experience.

TOPIC 3: Living Environment
Recollect vocabulary related to Living. Understand a podcast. Talk about tips for organizing the house. Discuss cultural differences related to Living. Talk to the landlord and ask for information. Write a story.

TOPIC 4: Professional World
Understanding and presenting development in the working environment. Talking about professions. Understanding tips for applying for Jobs. Writing a cover letter. Understanding forum posts and an interview. Expressing and writing one's own opinion. Engaging in small talk.

TOPIC 5: Purchase, money and consumption
Present an advertisement. Understand information about a trend. Present/introduce a concept. Understanding and discussing an article about future developments. Describing a graphic. Understand a podcast on the topic of consumption. Write a comment or tips for a friend. Carry out a roll play – express dissatisfaction about a product purchased and demand for a solution.

TOPIC 6: Fitness
Assign and write dialogues for various leisure situations. Talk about nutrition. Understand short magazine articles. Give a short presentation. Understand radio programs about exceptional sports achievements and discuss them. Hold a conversation at the pharmacy. Talk about health issues.

TOPIC 7: Leisure time
Talk about the importance of leisure time and leisure activities. Compare and contrast leisure time and work. Make assumptions about people and circumstances. Discuss ways of planning leisure time.

TOPIC 8: Work and Profession
Discuss the meaning of work. Coordinate work tasks and working hours with colleagues. Talk about changes in the world of work. Formulate ideas for new career opportunities.

TOPIC 9: Live path
Interview others about their lives. Understand and explain important decisions made . Compare different life concepts. Formulate and evaluate some life goals. Evaluate decisions made in retrospect.

TOPIC 10: On the go
Describe types of travellers and variations in travel. Understand reports about travel and migration. Formulate and assess prognosis. Express and justify one's own opinion.

23IG069 GERMAN LANGUAGE – B2.2

TOPIC 1: Climate and Weather
Make assumptions about the relationships between climate and weather. Explain the formation of complex natural phenomena using graphics. Understand and differentiate the difference between weather and climate. Portray and present special features of nature.

TOPIC 2: Globalisation
Discuss the advantages and disadvantages of globalization. Understand definitions of historically relevant events. Create self-definitions on issues. Understand and describe modern job profiles and biographical information**.**

TOPIC 3: Education
Talk about one's own learning experience. Compare the German education system with that of one's home country. Capture and present relevant information from a graphic. Discuss about the significance and purpose of professional developments and trainings. Research opportunities for professional developments and trainings.

TOPIC 4: Conflicts
Describe behaviour and emotions in conflicts. Understand and overcome conflicts due to cultural differences. Recognize and resolve conflict potential in the workplace. Politely set boundaries. Draft grievances.

TOPIC 5: Society
Compare forms of government and electoral systems. Advocate socio-political opinions. Understand and evaluate rights, commandments and prohibitions. Reflect on one's own values and norms. Give a presentation.

TOPIC 6: Knowledge and Skills
Understand and apply semantic nuances in the lexical field of "knowledge". Write notes for a presentation. Know, assess, and apply strategies for knowledge acquisition. Assess and present one's own skills and competencies. Report on practical experiences.

23IG070 GERMAN LANGUAGE – C1

TOPIC 1

Studying in Germany, financing the studies and the Student life. Sentence structures with – es.

TOPIC 2

Future of the Mobility, mobility in the work environment, virtual travel, Passive and its alternate forms.

TOPIC 3

Technical developments, Artificial intelligence, Discoveries and Inventions, Bionics, nominal style sentences and its usages.

TOPIC 4

Politics and History, the European Union, Participle structures with prepositions.

TOPIC 5

Communication, Misunderstandings, Transition of Languages, influence of foreign languages, subjective meanings of modal verbs.

TOPIC 6

Health and Sport, healthy nutrition, fitness and technique, motion for prevention, noun-verb-combinations.

TOPIC 7

Digital media and its consumption, virtual contacts, online and offline learning, Verbs with prefix and its meaning.

TOPIC 8

Economy, Stress in work place, establishing a company , using more advanced nominal, verbal and writing skills and linking to texts.

TOPIC 9

Inter-cultural encounters, cultural identification, migration and integration, stereotypes about belongingness, using indirect speech.

TOPIC 10

Environment and environmental pollution, the post-fossil era, protection of nature and environment, Prepositions in complex language including the genitive case. Conjunctive adverbs.