## 101 Civil

### Semester III (Second year)

#### Branch/Course Civil Engineering

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Category</th>
<th>Code</th>
<th>Course Title</th>
<th>Hours per week</th>
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|          |                                      |            |                                             |                |         |         | Total credits 25 |


### 102 Mechanical

#### Semester III [Second year]
Branch/Course: Mechanical Engineering

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#### 103 EE

#### Semester III [Second year] Branch/Course: Electrical Engineering

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<td>2. Industrial Visit/Internship (2 Weeks)</td>
<td>3. Fundamental Electronics Lab Training (1 Week)</td>
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iv
### 105 CS

#### Semester III (Second year)

<table>
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<tr>
<th>Sl. No.</th>
<th>Type of course</th>
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<td>1</td>
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<td>Analog Electronic Circuits</td>
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<td>2</td>
<td>Professional Core Courses</td>
<td>PCC CS 301</td>
<td>Data Structure &amp; Algorithm</td>
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<td>Professional Core Courses</td>
<td>PCC CS 302</td>
<td>Object Oriented Programming using C++</td>
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<td>Basic Science Courses</td>
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<td>Mathematics-III (Differential Calculus)</td>
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Total credits: **24**

### 106 IT

#### Semester III (Second year)

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Total credits 29

107 LT

**Semester III (Second year)**

**Branch/Course Leather Technology**

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**Total credits 23**

**110 EEE**

**SEMESTER III [Second year]**

**Branch/Course: Electrical & Electronics Engineering**

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<th>Hours per week</th>
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101 CE

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The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the devices, instruments and sensors used in Civil Engineering applications. Lab should be taken concurrently. This course emphasizes more on the laboratory/practical use of the knowledge gained from the course lectures.

**What Will I Learn?**

a) Know broadly the concepts and functionalities of the electronic devices, tools and instruments

b) Understand use, general specifications and deployabilities of the electronic devices, and assemblies

c) Confidence in handling and usage of electronic devices, tools and instruments in engineering applications

**Proposed Syllabus (All modules to provide only broad overview)**

**Module 1: Diodes and Applications** covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs,

Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

**Module 2: Transistor Characteristics** covering, Bipolar Junction Transistor (BJT) –

Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect

Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

**Module 3: Transistor Amplifiers and Oscillators** covering, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

**Module 4: Operational Amplifiers and Applications** covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;

**Practicals:**

**Module 1:** Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread

Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;
Module 2: Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; (CRO);

Module 3: Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator,

Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;


Module 6: Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs; (15 Sessions)

Text/Reference Books:
1. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India
2. Santiram Kal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India

<table>
<thead>
<tr>
<th>BSC109</th>
<th>Biology (Biology for Engineers)</th>
<th>3L:0T:0P</th>
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</table>

[3 credit course; 2 (one hour) lectures and one (one hour) tutorial per week. Only lecture hours are shown]

Module 1. (2 hours)- Introduction
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. (3 hours)- Classification
**Module 3. (4 hours)-Genetics**

**Purpose:** To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”

Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

**Module 4. (4 hours)-Biomolecules**

**Purpose:** To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

**Module 5. (4 Hours). Enzymes**

**Purpose:** To convey that without catalysis life would not have existed on earth


**Module 6. (4 hours)- Information Transfer**

**Purpose:** The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

**Module 7. (5 hours). Macromolecular analysis**

**Purpose:** How to analyses biological processes at the reductionistic level


**Module 8. (4 hours)- Metabolism**

**Purpose:** The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoing reactions. Concept of $K_{eq}$ and its relation to standard free energy. Spontaneity, ATP as an energy currency. This should include the breakdown of glucose to $\text{CO}_2 + \text{H}_2\text{O}$ (Glycolysis and Krebs cycle) and synthesis
of glucose from CO₂ and H₂O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

**Module 9: Microbiology**


**Module 10: Plant Physiology**

covering, Transpiration; Mineral nutrition (3 Lectures)

**Module 10B: Ecology**

covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids; (3 Lectures)

**References:**

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher


<table>
<thead>
<tr>
<th>ESC203</th>
<th>Computer-aided Civil Engineering Drawing</th>
<th>1L:0T:2P</th>
<th>2 credits</th>
</tr>
</thead>
</table>

The students will be able to

a) Develop Parametric design and the conventions of formal engineering drawing
b) Produce and interpret 2D & 3D drawings
c) Communicate a design idea/concept graphically/ visually
d) Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
e) Get a Detailed study of an engineering artifact

**Proposed Syllabus** (No. of lectures shown within brackets)

**Module 1:** INTRODUCTION; Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.(2)

**Module 2:** SYMBOLS AND SIGN CONVENTIONS: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards (2)
Module 3: MASONRY BONDS: English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall (1)


Module 5: PICTORIAL VIEW: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM) (3) Total 15 sessions

It may be advisable to conduct Theory sessions along with Lab demonstrations.

List of Drawing Experiments:
1. Buildings with load bearing walls including details of doors and windows. 09
2. Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars, finishing and other details and writing out a description of the Facility in about 500 -700 words. 06
3. RCC framed structures 09
4. Reinforcement drawings for typical slabs, beams, columns and spread footings. 09
5. Industrial buildings - North light roof structures - Trusses 06
6. Perspective view of one and two storey buildings 06

Total L: 15 + P: 45=60

Text/Reference Books:
3. Sham Tickoo Swapna D (2009), “AUTOCAD for Engineers and Designers”, Pearson Education,
6. (Corresponding set of) CAD Software Theory and User Manuals.
The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behaviour of materials under various load conditions. Lab should be taken concurrently.

What Will I Learn?

a) Confidently tackle equilibrium equations, moments and inertia problems
b) Master calculator/computing basic skills to use to advantage in solving mechanics problems.
c) Gain a firm foundation in Engineering Mechanics for furthering the career in Engineering

Proposed Syllabus

Module 1: Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

Module 2: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 3: Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Module 4: Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.


Module 6: Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton’s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Module 7: Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D’Alembert’s principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;
Module 8: Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Tutorials from the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

Text/Reference Books:
6. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education

PCC-CE206  Surveying and Geomatics  2L:0T:2P  3 credits

Course Objectives
With the successful completion of the course, the student should have the capability to:  a) describe the function of surveying in civil engineering construction,

b) Work with survey observations, and perform calculations,

c) Customary units of measure. Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,

d) Be familiar with the principals of recording accurate, orderly, complete, and logical field notes from surveying operations, whether recorded manually or with automatic data collection methods,

e) Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses,

f) Operate an automatic level to perform differential and profile leveling; properly record notes; mathematically reduce and check levelling measurements,

g) Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments. Be able to identify hazardous environments and take measures to insure one’s personal and team safety,

h) Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments,
i) Calculate azimuths, latitudes and departures, error of closure; adjust latitudes and departures and determine coordinates for a closed traverse,

j) Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations and mapping,

k) Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,

l) Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion,

m) Calculate, design and layout horizontal and vertical curves, Understand, interpret, and prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities.

Proposed Syllabus:

**Module 1: Introduction to Surveying (8 hours):** Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling-booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.


**Module 2: Curves (6 hours) Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves**

**Module 3: Modern Field Survey Systems (8 Hours):** Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications,

Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

**Module 4: Photogrammetry Surveying (8 Hours):** Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

**Module 5: Remote Sensing (9 Hours):** Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

**Text/Reference Books:**

2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011
4. Anji Reddy, M., Remote sensing and Geographical information system, B.S.
Objectives:
(1) To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
(2) To provide an overview of probability and statistics to engineers

Contents:
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D’Alembert’s solution of the wave equation; Duhamel’s principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. (14 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev’s Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes’ rule. (12 hours)

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. (12 hours)

Course Outcomes:
Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

Textbooks/References:

| HSMC201 | Humanities – I (Effective Technical Communication) | 3L:0T:0P | 3 credits |

Module 1: Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Module 2: Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Human factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

Module 3: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

Module 4: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Module 5: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

Text/Reference Books:
1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004

| HSMC251 | Introduction to Civil Engineering | 2L:0T:0P | 2 credits |

When the students enter the college to pursue a degree in Civil Engineering and as well pursue a career in Civil Engineering after graduation, they need to understand the breadth and depth available in this field for possible engagement. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Civil Engineering student should realize the solid foundations available in this
mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all pervasive field of engineering.

This course is designed to address the following:

- to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering
- to motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

**Proposed Syllabus**

What is Civil Engineering/ Infrastructure, History of Civil Engineering, Overview of ancient & modern civil engineering marvels, current national planning for civil engineering/ infrastructure projects, scope of work involved in various branches of Civil Engineering – Architecture & Town planning, Surveying & Geomatics, Structural Engineering, Construction Management, Construction materials, Hydrology and Water Resources Engineering, Hydraulic Engineering, Environmental Engineering & Sustainability, Pavement Engineering and construction, Traffic & Transportation Engineering and Management, Geotechnical Engineering, Ocean Engineering, Building Energy Efficiency, Basics of Contract Management, Professional Ethics, Avenues for entrepreneurial working, Creativity & Innovativeness in Civil Engineering,

**Modules**

1. **Basic Understanding**: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career
2. **History of Civil engineering**: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers
3. **Overview of National Planning for Construction and Infrastructure Development**: Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets for infrastructure works;
4. **Fundamentals of Architecture & Town Planning**: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities
5. **Fundamentals of Building Materials**: Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes
6. **Basics of Construction Management & Contracts Management**: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management
7. **Environmental Engineering & Sustainability:** Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction;
8. **Geotechnical Engineering:** Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunnelling
9. **Hydraulics, Hydrology & Water Resources Engineering:** Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multipurpose reservoir projects
10. **Ocean Engineering:** Basics of Wave and Current Systems; Sediment transport systems; Ports & Harbours and other marine structures
11. **Power Plant Structures:** Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects
12. **Structural Engineering:** Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies;
13. **Surveying & Geomatics:** Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR;
14. **Traffic & Transportation Engineering:** Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples.
15. **Repairs & Rehabilitation of Structures:** Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; NonDestructive testing systems; Use of carbon fibre wrapping and carbon composites in repairs.
16. **Computational Methods, IT, IoT in Civil Engineering:** Typical software used in Civil Engineering - Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD,...GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, ...)
17. **Industrial lectures:** Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning;
18. **Basics of Professionalism:** Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction

**ORGANISATION OF COURSE (2-1-0)**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Module [No of Lectures within brackets]</th>
<th>Tutorials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic Understanding (1)</td>
<td>Develop a matrix of various disciplines and possible roles for engineers in each</td>
</tr>
<tr>
<td>2</td>
<td>History of Civil engineering (1)</td>
<td>Identify 10 ancient monuments and ten modern marvels and list the uniqueness of each</td>
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<tr>
<td>3</td>
<td>Overview of National planning for Construction and Infrastructure Development (1)</td>
<td>Develop a Strategic Plan for Civil Engineering works for next ten years based on past investments and identify one typical on-going mega project in each area</td>
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<tr>
<td>No.</td>
<td>Course Title</td>
<td>Description</td>
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<tr>
<td>4</td>
<td>Architecture &amp; Town Planning (1)</td>
<td>Identify ten best civil engineering projects with high aesthetic appeal with one possible factor for each; List down the possible systems required for a typical Smart City</td>
</tr>
<tr>
<td>5</td>
<td>Building Materials (2)</td>
<td>Identify three top new materials and their potential in construction; Visit a Concrete Lab and make a report</td>
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<tr>
<td>6</td>
<td>Construction Management, Contracts management (2)</td>
<td>Identify 5 typical construction methods and list their advantages/ positive features</td>
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<tr>
<td>7</td>
<td>Environmental Engineering &amp; Sustainability (2)</td>
<td>Environmental Engineering &amp; Sustainability: Sustainability principles, Sustainable built environment, water treatment systems, good practices of wastewater management. examples of Solid and hazardous waste management, Air pollution and control</td>
</tr>
<tr>
<td>8</td>
<td>Geotechnical Engineering (2)</td>
<td>List top five tunnel projects in India and their features; collect and study geotechnical investigation report of any one Metro Rail (underground) project; Visit a construction site and make a site visit report</td>
</tr>
<tr>
<td>9</td>
<td>Hydraulics, Hydrology &amp; Water Resources Engineering (1)</td>
<td>Identify three river interlinking projects and their features; visit a Hydraulics Lab and make a report</td>
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<tr>
<td>10</td>
<td>Ocean Engineering, Ports &amp; Harbours (1)</td>
<td>Identify 5 typical ports in India and list the structures available in them; Visit a related/similar facility, if possible in nearby place and make a report</td>
</tr>
<tr>
<td>11</td>
<td>Power Plant Structures (1)</td>
<td>Collect the typical layout for a large thermal power plant and a large hydro power plant and identify all the structures and systems falling in them.</td>
</tr>
<tr>
<td>12</td>
<td>Structural Engineering (3)</td>
<td>Identify 5 unique features for typical buildings, bridges, tall structures and large span structures; Visit Structures Testing Lab/facility and make a report</td>
</tr>
<tr>
<td>13</td>
<td>Surveying &amp; Geomatics (1)</td>
<td>Collect visual representations prepared by a Total Station and LIDAR and compare; Study typical Google street map and Google Earth Map and study how each can facilitate the other</td>
</tr>
<tr>
<td>14</td>
<td>Traffic &amp; transportation (1)</td>
<td>Investments in transport infrastructure; Developments and challenges; Intelligent Transport Systems; Smart Cities, Urban Transport; Road Safety; Sustainable and resilient highway design principles; Plan a sustainable transport system for a city; Identify key features/components in the planning and design of a green field highway/airport/port/railway and the cost – economics.</td>
</tr>
<tr>
<td>15</td>
<td>Repairs &amp; rehabilitation of Structures (1)</td>
<td>Collect the history of a major rehabilitation project and list the interesting features</td>
</tr>
</tbody>
</table>
16. **Computational Methods, IT, IoT in Civil Engineering (2)**
   Visit an AutoCad lab and prepare a report; Identify ten interesting software systems used in Civil Engg and their key features.

17. **Industrial lectures (2)**
   For each case study list the interesting features.

18. **Basics of Professionalism (3)**
   List 5 cases of violation of professional ethics and list preventive measures; Identify 5 interesting projects and their positive features; Write 400 word reports on one ancient monument and a modern marvel of civil engineering.

**TOTAL NO LECTURES =30**

**Text/Instruction Books:**
14. Bare text (2005), Right to Information Act
15. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
16. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
18. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
20. Engineering Ethics, National Institute for Engineering Ethics, USA
21. www.ieindia.org
22. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
23. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (Teaching Case Study) -S. Ramakrishna Velamuri -CEIBS
25. Internet and Business Handbook, Chap 4, CONTRACTS LAW,
   http://www.laderapress.com/laderapress/contractslaw1.html
26. Contract &Agreements


102 ME

| BSC202 | Mathematics III (PDE, Probability & Statistics) | 3L:1T:0P | 4 credits |

Objectives:
1. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
2. To provide an overview of probability and statistics to engineers

Contents:

Module 1: (14 lectures)
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D’Alembert’s solution of the wave equation; Duhamel’s principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

Module 2: (12 lectures)
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev’s Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes’ rule.

Module 3: (12 lectures)
Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi- square
test for goodness of fit and independence of attributes.

Textbooks/References:

Course Outcomes:
Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data.

<table>
<thead>
<tr>
<th>BSC203</th>
<th>Biology</th>
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<tr>
<td>2L:1T:0P</td>
<td>3 credits</td>
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</table>

2 (one hour) lectures and one (one hour) tutorial per week. Only lecture hours are shown

Module 1: Introduction (2 lectures)
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2: Classification (3 lectures)
Purpose: To convey that classification per sei is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted.

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity - Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitat-acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E. coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3: Genetics (4 lectures)
Purpose: To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”
Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4: Biomolecules (4 lectures)
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5: Enzymes (4 lectures)
Purpose: To convey that without catalysis life would not have existed on earth.


Module 6: Information Transfer (4 lectures)
Purpose: The molecular basis of coding and decoding genetic information is universal

Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7: Macromolecular analysis (5 lectures)
Purpose: How to analyse biological processes at the reductionist level


Module 8: Metabolism (4 lectures)
Purpose: The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge
Module 9: Microbiology

(3 lectures)


References:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urr y, Lisa; Cain, M, L.; Wasser man, S. A.; Minorsk y, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher

Course Outcomes:

After studying the course, the student will be able to:

Describe how biological observations of 18th Century that lead to major discoveries. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Classify enzymes and distinguish between different mechanisms of enzyme action. Identify DNA as a genetic material in the molecular basis of information transfer. Analyse biological processes at the reductionistic level Apply thermodynamic principles to biological systems. Identify and classify microorganisms.
Objectives:

To provide an overview of electronic device components to Mechanical engineering students

Contents:

Module 1:  
Semiconductor Devices and Applications: Introduction to P-N Junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Module 2:  

Module 3:  
Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as table and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Module 4:  
Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using Kmap, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Module 5:  
Text /Reference Books:


Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

<table>
<thead>
<tr>
<th>ESC 202</th>
<th>Engineering Mechanics</th>
<th>3L:0T:2P</th>
<th>4 credits</th>
</tr>
</thead>
</table>

Objectives:

The primary purpose of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering.

Contents:

Module 1: (7 lectures)
Statics: Force System, Moment of a force about a point and an axis; Equivalent force and moment

Module 2: (6 lectures)
Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimension; plane frames and trusses.

Module 3: (8 lectures)
Friction: Laws of Coulomb friction, impending motion problems involving large and small contact surfaces; square threaded screw; principle of virtual work and stability.

Module 4: (6 lectures)
Dynamics: Kinematics and kinetics of particles dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables.

Module 5: (8 lectures)
Properties of areas: Center of mass; Moments of inertia; kinematics of rigid bodies; Chasle’s Theorem, concept of fixed vector, velocity and acceleration of particles in different frames of references. General plane motion.

Module 6: (7 lectures)
Work & Energy and impulse and Momentum methods for particles and rigid bodies: Conservation of momentum, coefficient of restitution, moment of momentum equation.

Text /Reference Books:

Practical:
1. Practical based on mechanical advantage of different machines.
2. Verification of triangle law & parallelogram law of forces
3. Verification of polygon law of forces
4. Determination of moment of inertia of a flywheel
5. Crank Lever apparatus
6. Verification of support reactions of a simply supported beam
7. Verification of condition of equilibrium of a system of forces
8. Verification of axial forces in the members of a truss
9. Verification of equilibrium of three dimensional forces.
10. Determination of coefficient of friction between two surfaces
11. Verification of centroid of different laminae
12. Verification of Newton’s laws of motion

* At least 6 experiments should be performed from above list.

Course outcomes:

Students will be able to articulate and describe:

2. Parameters defining the motion of mechanical systems and their degrees of freedom.
3. Study of the interaction of forces between solids in mechanical systems.
4. Centre of mass and inertia tensor of mechanical systems.
5. Application of the vector theorems of mechanics and interpretation of their results.

<table>
<thead>
<tr>
<th>PCC-ME 201</th>
<th>Thermodynamics</th>
<th>3L:1T:0P</th>
<th>4 credits</th>
</tr>
</thead>
</table>

Objectives:
1. To learn about work and heat interactions, and balance of energy between system and its surroundings
2. To learn about application of 1st law to various energy conversion devices
3. To evaluate the changes in properties of substances in various processes
4. To understand the difference between high grade and low grade energies and 2nd law limitations on energy conversion

Contents:

Module 1: (5 lectures)

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Module 2: (5 lectures)

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

Module 3: (8 lectures)

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier’s chart.

Module 4: (5 lectures)

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.
Module 5:  
(5 lectures)
Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Module 6:  
(8 lectures)
Clausius inequality; Definition of entropy S; Demonstration that entropy S is a property; Evaluation of Entropy for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables-Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Module 7:  
(4 lectures)
Properties of dry and wet air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Text Books:

Course Outcomes:
1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions
2. Students can evaluate changes in thermodynamic properties of substances
3. The students will be able to evaluate the performance of energy conversion devices
4. The students will be able to differentiate between high grade and low grade energies.
Objective:
The student will acquire a knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.

Module 1: (2 Lectures)
Introduction to full section, half section, revolved-section off-set section.

Module 2: (3 Lectures)
Nut Bolts, Riveted joints, Thread profiles, Screw jack.

Module 3: (3 Lectures)
Bushed bearing, pedestal, bearing, foot step bearing.

Module 4: (2 Lectures)
Flanged coupling, flexible coupling, solid coupling.

Module 5: (2 Lectures)
Engine parts - Stuffing box, Connecting rod, Atomizer, spark plug, etc.

Module 6: (2 Lectures)
Eccentric.

Module 7: (2 Lectures)
Cross Head.

Module 8: (2 Lectures)
Assembly of dissembled parts. disassembly of assembly parts.

Text Books:
3. Engineering Drawing Practice for Schools and Colleges SP: 46- 19
4. Engineering Drawing by ND Bhatt

Course Outcomes:
On successful completion of the course, the student will be able to,

1. Identify the national and international standards pertaining to machine drawing.
2. Apply limits and tolerances to assemblies and choose appropriate fits.
3. Recognize machining and surface finish symbols.
4. Explain the functional and manufacturing datum.
103 EE

<table>
<thead>
<tr>
<th>PCC-EE01</th>
<th>Electrical Circuit Analysis</th>
<th>3L:1T:0P</th>
<th>4 credits</th>
</tr>
</thead>
</table>

**Course Outcomes:**
At the end of this course, students will demonstrate the ability to
- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior.

Module 1: Network Theorems (10 Hours)

Module 2: Solution of First and Second order networks (8 Hours)
Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Module 3: Sinusoidal steady state analysis (8 Hours)
Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Module 4: Electrical Circuit Analysis Using Laplace Transforms (8 Hours)

Module 5: Two Port Network and Network Functions (6 Hours)
Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

**Text / References:**

**Electrical Circuit Analysis Laboratory**
*PCC-EE02: Electrical Circuit Analysis (0:0:2 – 1 credit)*
Hands-on experiments related to the course contents of EE01.
Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand the characteristics of transistors.
- Design and analyse various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Module 1: Diode circuits (4 Hours)
P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module 2: BJT circuits (8 Hours)
Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Module 3: MOSFET circuits (8 Hours)
MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 4: Differential, multi-stage and operational amplifiers (8 Hours)
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 5: Linear applications of op-amp (8 Hours)
Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).

Analogue to Digital Conversion.

Module 6: Nonlinear applications of op-amp (6 Hours)
Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Text/References:

PCC-EE04: Analog Electronic Circuits Laboratory (0:0:2 – 1 credit)
Hands-on experiments related to the course contents of EE03.
Course Outcomes:

At the end of this course, students will demonstrate the ability to
- Understand the concepts of magnetic circuits.
- Understand the operation of dc machines.
- Analyse the differences in operation of different dc machine configurations.
- Analyse single phase and three phase transformers circuits.

Module 1: Magnetic fields and magnetic circuits (6 Hours)
Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Module 2: Electromagnetic force and torque (9 Hours)
B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

Module 3: Transformers (12 Hours)

Module 4: DC machines (8 Hours)
Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Module 5: DC machine - motoring and generation (7 Hours)
Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Text / References:
2013.

PCC-EE06: Electrical Machines Laboratory– I (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of EE05.

<table>
<thead>
<tr>
<th>Course</th>
<th>Electromagnetic Fields</th>
<th>3L:1T:0P</th>
<th>4 credits</th>
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<tbody>
<tr>
<td>PCC-EE07</td>
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</table>

Course Outcomes:

At the end of the course, students will demonstrate the ability
- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyse time varying electric and magnetic fields.
- To understand Maxwell’s equation in different forms and different media.
- To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Module 1: Review of Vector Calculus (6 hours)

Vector algebra—addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus—differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to an other.

Module 2: Static Electric Field (6 Hours)

Module 3: Conductors, Dielectrics and Capacitance (6 Hours)
Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson’s equation, Laplace’s equation, Solution of Laplace and Poisson’s equation, Application of Laplace’s and Poisson’s equations.

Module 4: Static Magnetic Fields (6 Hours)

Module 5: Magnetic Forces, Materials and Inductance (6 Hours)

Module 6: Time Varying Fields and Maxwell’s Equations (6 Hours)
Faraday’s law for Electromagnetic induction, Displacement current, Point form of Maxwell’s equation, Integral form of Maxwell’s equations, Motional Electromotive forces. Boundary Conditions.

Module 7: Electromagnetic Waves (6 Hours)
Derivation of Wave Equation, Uniform Plane Waves, Maxwell’s equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References:

<table>
<thead>
<tr>
<th>ESC 201</th>
<th>Engineering Mechanics</th>
<th>3L:1T:0P</th>
<th>4 credits</th>
</tr>
</thead>
</table>

Course Outcomes: At the end of this course, students will demonstrate the ability to
- Understand the concepts of co-ordinate systems.
- Analyse the three-dimensional motion.
- Understand the concepts of rigid bodies.
- Analyse the free-body diagrams of different arrangements.
- Analyse torsional motion and bending moment.

Module 1: Introduction to vectors and tensors and co-ordinate systems (5 hours)
Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

Module 2: Three-dimensional Rotation (4 hours)
Three-dimensional rotation: Euler’s theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.
Module 3: Kinematics of Rigid Body (6 hours)
Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two- and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Module 4: Kinetics of Rigid Bodies (5 hours)
Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler’s laws of rigid body motion.

Module 5: Free Body Diagram (1 hour)
Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Module 6: General Motion (9 hours)

Module 7: Bending Moment (5 hours)
Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Module 8: Torsional Motion (2 hours)
Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Module 9: Friction (3 hours)
Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:
## EC101: Network Theory

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Contents</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to signals, their classification and properties, different types of systems, LTI systems and their properties, periodic waveforms and signal synthesis, properties and applications of Laplace transform</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform.</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td><strong>Graph theory</strong>: Concept of tree, Tie-set matrix, Cut-set matrix and application to solve electric networks. Two port networks – Introduction of two port parameters and their interconversion, Interconnection of two 2-port networks, Open circuit and Short circuit impedances and ABCD constants, Relation between image impedances and Short circuit and Open circuit impedances.</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Network functions, their properties and concept of transfer impedance, Hurwitz polynomial ,Positive real function and synthesis of LC, RC, RL Networks in Foster’s I and II, Cauer’s I and II forms.</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Introduction of passive filter and their classification, frequency response, Characteristic impedance of low pass, high pass, Band Pass and Band reject prototype section</td>
<td>4</td>
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<td></td>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
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<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Authors / Books /Publishers</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>“Engineering Circuit Analysis”, by W H Hayt, TMH Eighth Edition</td>
</tr>
<tr>
<td>2</td>
<td>“Network analysis and synthesis”, by F F Kuo, John Wiley and Sons, 2nd Edition</td>
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<tr>
<td>4</td>
<td>“Network analysis”, by M. E. Van Valkenburg, PHI, 2000</td>
</tr>
<tr>
<td>5</td>
<td>“Networks and Systems”, by D. R. Choudhary, New Age International, 1999</td>
</tr>
</tbody>
</table>

## EC102: Signals and Systems

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Contents</th>
<th>Contact Hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Signal and System : Definition, classification of systems, standard test signal, properties of system, properties of linear system, Properties: linearity: additivity and homogeneity, Shift-invariance, Causality</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Linear time-invariant (LTI) systems, impulse response and step response, convolution, Characterization of causality and stability of linear time-invariant systems. System representation through differential equations and difference equations.</td>
<td>7</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Name of Authors / Books /Publishers</td>
<td></td>
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<tr>
<td>--------</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>“Signal and System”, A.V Oppenheim, A.S Willsky and I.T Young, Prentice Hall</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>“Analysis of Linear System” by D.K Cheng, Narosa pub. House</td>
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<tr>
<td>4</td>
<td>“Signal &amp; system” by H.P Hsu, Tata McGraw Hill</td>
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</table>

**BS101 Mathematics III**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Contents</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unit1 (6 Lectures): Polynomials: Orthogonal Polynomials –Lagrange’s, Chebysev Polynomials; Trigonometric Polynomials; Wavelet transforms : properties, methods, inverses and their applications.</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Unit2 (10 Lectures): Sets, relations and functions: Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions: Ber and Bei functions; recurrence relations, orthogonality properties.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Unit3 (6 Lectures): Introduction to Graphs: Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees,</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Unit4 (10 Lectures): Basic Statistics: Measures of Central tendency: Moments, skewness and Kurtosis ; Probability distributions - Binomial, Poisson and Normal ; evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Unit5 (10 Lectures): Applied Statistics: Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>

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<tr>
<th>Sl. No.</th>
<th>Name of Authors / Books /Publishers</th>
</tr>
</thead>
</table>
## EC 103 - Object Oriented Programming

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Contents</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to C++ : Object Oriented Technology, Advantages of OOP, Input-output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derives data types. The void data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings.</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Control Structures : Decision making statements like if-else, Nested if-else, goto, break, continue, switch case, Loop statement like for loop, nested for loop, while loop, do-while loop.</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Functions : Parts of Function, User-defined Functions, Value-Returning Functions, void Functions, Value Parameters, Function overloading, Virtual Functions.</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Classes and Data Abstraction : Structure in C++, Class, Build-in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects (Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors.</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Overloading and Templates : Operator Overloading, Function Overloading, Function Templates, Class Templates.</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Inheritance : Single and Multiple Inheritance, virtual Base class, Abstract Class, Pointer and Inheritance, Overloading Member Function.</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Pointers and Arrays : Void Pointers, Pointer to Class, Pointer to Object, The this Pointer, Void Pointer, Arrays.</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Exception Handling : The keywords try, throw and catch. Creating own Exception Classes, Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), Stack Unwinding.</td>
<td>5</td>
</tr>
</tbody>
</table>

**Total**                                                                                     | **40**         |


<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Authors / Books /Publishers</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>“Thinking in C++”, Volume 1 and 2 by Bruce Eckel, Chuck Allison, Pearson Education</td>
</tr>
<tr>
<td>2</td>
<td>“Mastering C++”, 1/e by Venugopal, TataMcGraw Hill.</td>
</tr>
<tr>
<td>4</td>
<td>“Starting Out with Object Oriented Programming in C++”, by Tony Gaddis, Wiley India.</td>
</tr>
</tbody>
</table>

Object Oriented Programming Lab are according to the theory mentioned above.

<table>
<thead>
<tr>
<th></th>
<th>0L:0T:2P</th>
<th>1 Credit</th>
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<tbody>
<tr>
<td>Sl. No.</td>
<td>Contents</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PN junction diode : Depletion layer, Barrier potential, Forward and Reverse bias, Breakdown voltage, I-V characteristics of PN junction diode, Knee voltage, Ideal PN junction diode, Diode capacitances, Breakdown diodes (Avalanche and Zener diode), Photodiode and Light Emitting Diode.</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Rectifiers and filters : Half wave and Full wave rectifiers (Centre-tap and Bridge), Regulation, Ripple factor, R-C, L-C and Pi filters. Clipping and Clamping circuits, Voltage multiplier.</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>BJT: Basic theory and Operation of PNP and NPN transistors, Characteristics of C-B, C-E and C-C configuration. Biasing : Base bias, Emitter feedback bias, Voltage divider bias, Load line, Operating point, Incremental analysis using hybrid model.</td>
<td>10</td>
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<tr>
<td>4</td>
<td>FET : Introduction, Operation, I-V characteristics, JFET parameters, JFET amplifiers. MOSFET: Introduction, Operation, MOSFET parameters.</td>
<td>8</td>
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<tr>
<td></td>
<td>Total</td>
<td>42</td>
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</table>

Basic Electronics Lab are according to the theory mentioned above.

<table>
<thead>
<tr>
<th></th>
<th>3L:0T:0P</th>
<th>3 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sl. No.</td>
<td>Contents</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>“Electronic devices and circuit theory” by Boylestead and Nashelsky, Pearson</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>“Electronic principle” by Albert Malvin and Davis J Bates, TMH</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>“Integrated Electronics”, By Jacob Millman and Christos Halkias</td>
<td></td>
</tr>
</tbody>
</table>

Basic Electronics Lab are according to the theory mentioned above.
## ES102  Electrical & Electronic Material  3L:0T:0P  3 Credits

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Contents</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Atomic structure and bonding in materials. Crystal structure of materials, Crystal systems, Unit cells and space lattices, Determination of structures of single crystals by X-ray diffraction, Miller indices of planes and directions, Packing geometry in Metallic, Ionic and Covalent solids. Concept of amorphous, single and polycrystalline structures and their effect on properties of materials. Crystal growth techniques. Imperfections in crystalline solids and their role in influencing various properties.</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td><strong>Band theory of Solids</strong> : Energy band diagram, E – K Diagram, Reduced E – K Diagram, Insulators, Semiconductors &amp; Conductors.</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td><strong>Dielectric behavior of materials</strong> : Polarization, Dielectric constant at low frequency &amp; high frequency, Dielectric loss, Piezoelectricity &amp; FerroElectricity</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td><strong>Magnetic Properties</strong> : Origin of magnetism in metallic and ceramic materials, Paramagnetism, Diamagnetism, Antiferromagnetism, Ferromagnetism, Ferrimagnetism, magnetic hysteresis, Influence of temperature on magnetic behaviour, domains and Hysteresis.</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td><strong>Superconductors</strong> : Low and High temperature (YBaCuO) superconductors, Meissner effect, Applications.</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td><strong>Printed Circuit Board</strong> : Manufacturing process, Single- &amp; Double-sided boards, surface mounted devices</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Authors / Books / Publishers</th>
</tr>
</thead>
</table>

Electrical and Electronics Materials Lab are according to the theory mentioned above.  0L:0T:2P  1 Credit
Objectives of the course:

1. To learn the fundamentals of analog electronic circuits.
2. To design, construct and debug the analog electronic circuits.
3. Principles of operation, terminal characteristics, and equivalent circuit models for diodes, transistors, and op-amps.
5. Linear and nonlinear applications of op-amp.

Module 1

Diode circuits: P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module 2

BJT circuits: Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.

Module 3

MOSFET circuits: MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 4

Differential, multi-stage and operational amplifiers: Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 5
**Linear applications of op-amp:** Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

**Module 6**

**Nonlinear applications of op-amp:** Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector, Monoshot.

**Suggested Books:**

**Course Outcomes**

After the completion of course, students can able to able to:

1. Understand the characteristics of transistors.
2. Design and analyze various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.

<table>
<thead>
<tr>
<th>ESC 301P</th>
<th>Analog Electronic Circuits Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hands-on experiments related to the course contents of ESC 301.</td>
</tr>
</tbody>
</table>

PCC CS 301 | Data Structure & Algorithms | 3L:0T: 4P | 5 credits
---|-----------------------------|----------|----------
Pre-requisite | Programming for Problem Solving |          |          |

**Objectives of the course:**

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques.
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Detailed contents:

Module 1

Module 2
Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation — corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each Type of Queues: Algorithms and their analysis.

Module 3
Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Module 4
Searching, Sorting and Hashing: Linear Search and Binary Search Techniques and their complexity analysis. Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Module 5
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested reference books:

by Mark Allen Weiss, Addison-Wesley Publishing Company.
2. “How to Solve it by Computer”, 2nd Impression by R.G. Dromey, Pearson Education.

Course outcomes

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

<table>
<thead>
<tr>
<th>PCC CS 301P</th>
<th>Data Structure &amp; Algorithms Lab</th>
</tr>
</thead>
</table>

Hands-on experiments related to the course contents of PCC CS 301.

**********************************************************

PCC CS 302 | Object Oriented Programming using C++ | 3L:0T: 4P | 5 credits
---|---|---|---
Pre-requisite | Programming for Problem Solving | |

Objectives of the course:

1. To impart the basic concepts of Object Oriented Programming.
2. To understand concepts about Classes and Data Abstraction
3. To understand basic concepts about Inheritance.
4. To enable them to write algorithms for solving problems using object oriented approach.
Detailed contents:

Module 1

Lecture: 3 hrs.

Introduction to C++ : Object Oriented Technology, Advantages of OOP, Input- output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derives data types. The void data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings.

Module 2

Lecture: 6 hrs.

Control Structures and Functions: Decision making statements like if-else, Nested if-else, goto, break, continue, switch case, Loop statement like for loop, nested for loop, while loop, do-while loop. Parts of Function, User- defined Functions, Value- Returning Functions, void Functions, Value Parameters, Function overloading, Virtual Functions.

Module 3

Lecture: 12 hrs.

Classes and Data Abstraction : Structure in C++, Class, Build- in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects (Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors.

Module 4

Lecture: 8 hrs.

Overloading, Templates and Inheritance: Operator Overloading, Function Overloading, Function Templates, Class Templates. Single and Multiple Inheritance, virtual Base class, Abstract Class, Pointer and Inheritance, Overloading Member Function.

Module 5

Lecture: 11 hrs.

Pointers, Arrays and Exception Handling: Void Pointers, Pointer to Class, Pointer to Object, Void Pointer, Arrays. The keywords try, throw and catch. Creating own Exception Classes, Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), Stack Unwinding.

Suggested books:

1. Thinking in C++, Volume 1 & 2 by Bruce Eckel, Chuck Allison, Pearson Education

Suggested Reference Books:

1. The C++ Programming language 3/e by Bjarne Stroustrup, Pearson Education.
2. C++, How to Programme, 4e, by Deitel, Pearson Education.
3. Big C++ by Cay Horstmann, Wiley India.
4. C++ Primer, 3e by Stanley B. Lippmann, JoseeLajoie, Pearson Education.
5. C++ and Object Oriented Programming Paradigm, 2e by Debasish Jana, PHI.

Course outcomes

After the completion of course, students can able to able to:

1. Understand the concepts of Class, Object, Inheritance and Polymorphism.
2. Apply overload operators in C++
3. Understand the difference between function overloading and function overriding
4. Incorporate exception handling in object-oriented programs
5. Able to use template classes.
6. Able to write object-oriented programs of moderate complexity in C++

<table>
<thead>
<tr>
<th>PCC CS 302P</th>
<th>Object Oriented Programming using C++ Lab</th>
</tr>
</thead>
</table>

Hands-on experiments related to the course contents of PCC CS 302.

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<table>
<thead>
<tr>
<th>BSC 301</th>
<th>Mathematics-III (Differential Calculus)</th>
<th>2L:0T: 0P</th>
<th>2 credits</th>
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</thead>
</table>

Detailed contents:

Module 1
Lecture: 6 hrs.

Successive Differentiation, Leibnitz’s Theorem. Limit, Continuity and Differentiability of function for one variable.

Module 2
Lecture: 8 hrs.

Limit, Continuity and Differentiability of function for several variables. Partial Derivatives, Euler’s Theorem for Homogeneous functions, Total derivatives, Change of Variables. Maxima and Minima of
Several Variables. Methods of Lagrange Multipliers. Taylor’s and Maclaurin’s Theorem with remainders of several variables.

Module 3

Lecture: 8 hrs.


Module 4

Lecture: 6 hrs.

**First Order Ordinary Differential Equations:** Exact, Linear and Bernoulli’s Equations, Euler’s Equations, Equations not of First Degree: Equations Solvable for P, Equations Solvable for Y, Equations Solvable for X and Clairaut’s Type.

Module 5

Lecture: 8 hrs.

**Ordinary Differential Equations of Higher Orders:** Second Order Linear Differential Equations with Variable Coefficients, Method of Variation of Parameters, Cauchy-Euler Equation; Power Series Solutions; Legendre Polynomials, Bessel Functions of the First Kind and their properties.

Module 6

Lecture: 6 hrs.

**Partial Differential Equations – First Order:** First Order Partial Differential Equations, Solutions of First Order Linear and Non-Linear PDEs.

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<table>
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<tr>
<th>HSMC 301</th>
<th>Technical Writing</th>
<th>3L:0T: 0P</th>
<th>3 credits</th>
</tr>
</thead>
</table>

Objectives of the course:

1. To understand the variety of structure of technical documents
2. To convey clearly, cogently and correctly, through written media, the technical aspects of a practice to audiences.
3. To recognize and use of the verbal and technical elements necessary for the successful practice of scientific and technical communication
4. To work collaboratively and individually to research, to analyze, and to write about, public debates regarding the conduct of science and technology

Detail contents
Module 1

Lecture 10 hrs.


Module 2

Lecture 10 hrs.

**Performing Technical Studies:** Types of Technical Studies, General Methodology - Proposing a Project, Gathering Background Information, Designing Test Plans, Performing Experiments, Reporting Results. **Writing Strategy:** Analysis of Readers, Scope of Writing, Purpose and Objective. **Document Options:** Document Hierarchy, Report Types and Selection. **Criteria for Good Technical Writing:** Technical Content, Presentation, Language Skills. **Writing Style:** Elements of Style, Examples of Writing Styles, Recommended Style, Learn to Prepare Effective Illustrations.

Module 3

Lecture 10 hrs.

**Formal Reports:** The Outline and Introduction (Outline, Title, Front Matter, Writing the Introduction), Writing the Body (Writing a Procedure, Describing Machines/Processes, Writing Test Results, Writing the Discussion Section), Closure (Conclusions, Recommendations, References, Abstract, Back Matter, Report Distribution, Saving Reports). **Informal Reports:** Elements of an Informal Report, Investigation Reports, Service Work, Action Letters and Proposals. Typical Memo Reports.

Module 4

Lecture 10 hrs.

**Review and Editing:** Types of Review and Edit, Review and Editing Methodology, Examples of Reviews. **Oral Presentations:** Types of Oral Presentations, Preparation, Visual Aids, Impediments to Technical Writing, Maintaining Writing Skills, Measuring Report Results.

**Suggested books:**


**Suggested reference books:**


**Course outcomes**
1. Student should be able to demonstrate improved competence in Standard Written English, including grammar, sentence and paragraph structure, coherence, and document design (including the use of the visual), and use this knowledge to revise texts.
2. Student should identify and practice the stages required to produce competent, professional writing through planning, drafting, revising, and editing.
3. It determine and implement the appropriate methods for each technical writing task.
4. Students learn to practice the ethical use of sources and the conventions of citation appropriate to each genre.

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106_IT

| PCC-IT301 | Discrete Mathematics | 3L:1T:0P | 4 Credits |

Objectives of the course

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

1. Use mathematically correct terminology and notation.
2. Construct correct direct and indirect proofs.
3. Use division into cases in a proof.
4. Use counterexamples.
5. Apply logical reasoning to solve a variety of problems.

Module 1: Lecture 6


Module 2: Lecture 8

**Basic counting techniques**—inclusion and exclusion, pigeon-hole principle, permutation and combination.

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**Module 3:**

**Lecture 8**


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**Module 4:**

**Lecture 8**

**Algebraic Structures and Morphism:** Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

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**Module 5:**

**Lecture 10**

**Graphs and Trees:** Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Coloring maps and Planar Graphs, Coloring Vertices, Coloring Edges, List Coloring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

**Suggested books:**


**Suggested reference books:**


**Course Outcomes**

1. For a given logic sentence express it in terms of predicates, quantifiers, and
logical connectives.
2. For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference.
3. For a given a mathematical problem, classify its algebraic structure
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
5. Develop the given problem as graph networks and solve with techniques of graph theory.

PCC-CS301: Data Structure & Algorithm

<table>
<thead>
<tr>
<th>PCC-IT302</th>
<th>Data Structure &amp; Algorithms</th>
<th>3L:0T: 4P</th>
<th>5 credits</th>
</tr>
</thead>
</table>

Objectives of the course:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Detailed contents:

Module 1: Lecture 4

Module 2: Lecture 10
Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each Type of Queues: Algorithms and their analysis.

Module 3: Lecture 6
Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.
Module 4: Lecture 12

Searching, Sorting and Hashing: Linear Search and Binary Search Techniques and their complexity analysis. Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Module 5: Lecture 8

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVLTree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested books:


Suggested reference books:

5. “How to Solve it by Computer”, 2nd Impression by R.G. Dromey, Pearson Education.

Course outcomes

6. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
7. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
8. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
9. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
10. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.
Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use Programmable logic devices to implement the given logical problem.

Module 1 \hspace{1cm} Lecture: 7 hrs.

**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one’s and two’s complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2 \hspace{1cm} Lecture: 7 hrs.

**Combinational Digital Circuits:** Standard representation for logic functions K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don’t care conditions, Multiplexer, DeMultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3 \hspace{1cm} Lecture: 7 hrs.

**Sequential circuits and systems:** A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC’s, asynchronous sequential counters, applications of counters.
Module 4

Lecture: 7 hrs.


Module 5

Lecture: 7 hrs.

Semiconductor memories and Programmable logic devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Suggested books:


<table>
<thead>
<tr>
<th>ESC 401P</th>
<th>Digital Electronics Lab</th>
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</tbody>
</table>

Hands-on experiments related to the course contents of ESC 401.

***************************************************************************
Objectives of the course:

5. To impart the basic concepts of Object Oriented Programming.
6. To understand concepts about Classes and Data Abstraction
7. To understand basic concepts about Inheritance.
8. To enable them to write algorithms for solving problems using object oriented approach.

Detailed contents:

Module 1: Lecture: 3

Introduction to C++: Object Oriented Technology, Advantages of OOP, Input-output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derives data types. The void data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings.

Module 2: Lecture: 6

Control Structures and Functions: Decision making statements like if-else, Nested if-else, goto, break, continue, switch case, Loop statement like for loop, nested for loop, while loop, do-while loop. Parts of Function, User-defined Functions, Value-Returning Functions, void Functions, Value Parameters, Function overloading, Virtual Functions.

Module 3: Lecture: 15

Classes and Data Abstraction: Structure in C++, Class, Build-in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects (Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors.

Module 4: Lecture: 10

Overloading, Templates and Inheritance: Operator Overloading, Function Overloading, Function Templates, Class Templates. Single and Multiple Inheritance, virtual Base class, Abstract Class, Pointer and Inheritance, Overloading Member Function.

Module 5: Lecture: 11

Pointers, Arrays and Exception Handling: Void Pointers, Pointer to Class, Pointer to Object, Void Pointer, Arrays. The keywords try, throw and catch. Creating own Exception
Classes, Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), Stack Unwinding.

**Suggested books:**

5. *Thinking in C++, Volume 1 & 2* by Bruce Eckel, Chuck Allison, Pearson Education  
8. *Starting Out with Object Oriented Programming in C++,* by Tony Gaddis, Wiley India.

**Suggested Reference Books:**

9. *C++, How to Programme, 4e* by Deitel, Pearson Education.  
10. *Big C++* by Cay Horstmann, Wiley India.  
11. *C++ Primer, 3e* by Stanley B. Lippmann, JoseeLajoie, Pearson Education.  
12. *C++ and Object Oriented Programming Paradigm, 2e* by Debasish Jana, PHI.  

**Course outcomes**

A student who successfully fulfills the course requirements will have demonstrated:

7. An understanding of the concepts of inheritance and polymorphism.
8. An ability to overload operators in C++
9. An understanding of the difference between function overloading and function overriding
10. An ability to incorporate exception handling in object-oriented programs
11. An ability to use template classes.
12. An ability to write object-oriented programs of moderate complexity in C++

<table>
<thead>
<tr>
<th>BSC 301</th>
<th>Mathematics-III (Differential Calculus)</th>
<th>2L:0T: 0P</th>
<th>2 credits</th>
</tr>
</thead>
</table>

**Detailed contents:**

**Module 1**  
Lecture: 6 hrs.  
Successive Differentiation, Leibnitz’s Theorem. Limit, Continuity and Differentiability of function for one variable.

**Module 2**  
Lecture: 8 hrs.  
Limit, Continuity and Differentiability of function for several variables. Partial Derivatives, Euler’s Theorem for Homogeneous functions, Total derivatives, Change of Variables. Maxima and Minima of
Several Variables. Methods of Lagrange Multipliers. Taylor’s and Maclaurin’s Theorem with remainders of several variables.

Module 3  
Lecture: 8 hrs.


Module 4  
Lecture: 6 hrs.

**First Order Ordinary Differential Equations:** Exact, Linear and Bernoulli’s Equations, Euler’s Equations, Equations not of First Degree: Equations Solvable for P, Equations Solvable for Y, Equations Solvable for X and Clairaut’s Type.

Module 5  
Lecture: 8 hrs.

**Ordinary Differential Equations of Higher Orders:** Second Order Linear Differential Equations with Variable Coefficients, Method of Variation of Parameters, Cauchy-Euler Equation; Power Series Solutions; Legendre Polynomials, Bessel Functions of the First Kind and their properties.

Module 6  
Lecture: 6 hrs.

**Partial Differential Equations – First Order:** First Order Partial Differential Equations, Solutions of First Order Linear and Non-Linear PDEs.

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<table>
<thead>
<tr>
<th>HSMC 301</th>
<th>Technical Writing</th>
<th>3L:0T: 0P</th>
<th>3 credits</th>
</tr>
</thead>
</table>

Objectives of the course:

5. To understand the variety of structure of technical documents
6. To convey clearly, cogently and correctly, through written media, the technical aspects of a practice to audiences.
7. To recognize and use of the verbal and technical elements necessary for the successful practice of scientific and technical communication
8. To work collaboratively and individually to research, to analyze, and to write about, public debates regarding the conduct of science and technology

Detail contents
Module 1  
Lecture 10 hrs.


Module 2  
Lecture 10 hrs.


Module 3  
Lecture 10 hrs.


Module 4  
Lecture 10 hrs.


Suggested books:


Suggested reference books:


Course outcomes
5. Student should able to demonstrate improved competence in Standard Written English, including grammar, sentence and paragraph structure, coherence, and document design (including the use of the visual), and use this knowledge to revise texts.

6. Student should identify and practice the stages required to produce competent, professional writing through planning, drafting, revising, and editing.

7. It determine and implement the appropriate methods for each technical writing task.

8. Students learn to practice the ethical use of sources and the conventions of citation appropriate to each genre.

******************************************************************************

107 LT

| BSC | Physics (Waves and Optics) | L:3 | T:1 | P:0 | Credit:4 |

Contents

Module 1: Waves (3 lectures)

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, forced mechanical and electrical oscillators, impedance, steady state motion of forced damped harmonic oscillator

Module 2: Non-dispersive transverse and longitudinal waves (4 lectures)

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves

Module 3: Light and Optics (3 lectures)

Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster’s
angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

Module 4: Wave Optics (5 lectures)

Huygens’ principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young’s double slit experiment, Newton’s rings, Michelson interferometer, Mach Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Module 5: Lasers (5 lectures)

Einstein’s theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity

Module 6: Solution of Wave Equation (6 lectures)

Solution of stationary-state Schrodinger equation for one dimensional problems–particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Scattering from a potential barrier and tunneling; related examples like alpha- decay, field-ionization and scanning tunneling microscope, tunneling in semiconductor structures. Three-dimensional problems: particle in three dimensional box and related examples.

Text / References:
Objectives:
(1) To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
(2) To provide an overview of probability and statistics to engineers

Contents:
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification. Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. (14 lectures)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule. (12 lectures)

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi- square test for goodness of fit and independence of attributes. (12 lectures)

Course Outcomes:
Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

Textbooks/References:
Reprint, 2010.


<table>
<thead>
<tr>
<th>ESC 201</th>
<th>Basic Electronic Engineering</th>
<th>3L:1T:0P</th>
<th>4 credits</th>
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</thead>
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Objectives:
To provide an overview of electronic device components to Mechanical engineering students

Contents
Module 1
Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth. (10 lectures)

Module 2
Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator. (8 lectures)

Module 3
Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as table and monostable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator. (6 lectures)

Module 4
Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using Kmap, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications. (10 lectures)

Module 5

(8 lectures)

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

Text /Reference Books:

<table>
<thead>
<tr>
<th>ESC 202</th>
<th>Engineering Mechanics</th>
<th>3L:0T:2P</th>
<th>4 credits</th>
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</thead>
</table>

Objectives:
The primary purpose of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering.

Contents:

Module 1
Statics: Force System, Moment of a force about a point and an axis; Equivalent force and moment.  

(7 lectures)

Module 2
Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimension; plane frames and trusses.  

(6 lectures)

Module 3
Friction: Laws of Coulomb friction, impending motion problems involving large and small contact surfaces; square threaded screw; principle of virtual work and stability  

(8 lectures)
Module 4
Dynamics: Kinematics and kinetics of particles dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables. (6 lectures)

Module 5
Properties of areas: Center of mass; Moments of inertia; kinematics of rigid bodies; Chasle’s Theorem, concept of fixed vector, velocity and acceleration of particles in different frames of references. General plane motion. (8 lectures)

Module 6
Work & Energy and impulse and Momentum methods for particles and rigid bodies: Conservation of momentum, coefficient of restitution, moment of momentum equation. (7 lectures)

Course outcomes:
Students will be able to articulate and describe:

8. Parameters defining the motion of mechanical systems and their degrees of freedom.
9. Study of the interaction of forces between solids in mechanical systems.
10. Centre of mass and inertia tensor of mechanical systems.
11. Application of the vector theorems of mechanics and interpretation of their results.

Text /Reference Books:

Practical:
1. Verification of triangle law & parallelogram law of forces
2. Verification of polygon law of forces
3. Crank Lever apparatus
4. Verification of support reactions of a simply supported beam
5. Verification of condition of equilibrium of a system of forces
6. Verification of axial forces in the members of a truss
7. Verification of equilibrium of three dimensional forces.
8. Determination of coefficient of friction between two surfaces
9. Verification of centroid of different laminae
10. Determination of moment of inertia of a flywheel
11. Verification of Newton’s laws of motion
12. Verification of motion parameters using conservation of energy.

* At least 8 experiments should be performed from above list.

<table>
<thead>
<tr>
<th>PCC-LT201</th>
<th>Introduction to Leather Technology</th>
<th>3L: 0T:0 P</th>
<th>3 Credits</th>
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</table>

**Module: 1**
Live stock population, animal mortality and availability of hides and skins in India.

**Module: 2**
(12 Hours)
Statistical analysis of leather Industries, Leather, Leather products (National & International Scenario).

**Module: 3**
(05 Hours)
Chemical constituents of hides and skins.

**Module: 4**
(15 Hours)
General principles involved in raw hide and skin preservation, assortment and their processing, pre tanning, tanning and post tanning operations.

**Module: 5**
(05 Hours)
Defects in leather, Microscopy & Bacteriology

**Suggested books:**

110 – EEE

<table>
<thead>
<tr>
<th>PCC-EEE01</th>
<th>Electrical Circuit Analysis</th>
<th>3L:1T:0P</th>
<th>4 credits</th>
</tr>
</thead>
</table>

Course Outcomes:
At the end of this course, students will demonstrate the ability to
- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
• Analyse two port circuit behavior.

Module 1: Network Theorems (9 Hours)
   Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources.
   Node and Mesh Analysis. Concept of duality and dual networks.

Module 2: Solution of First and Second order networks (8 Hours)
   Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Module 3: Sinusoidal steady state analysis (8 Hours)
   Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Module 4: Electrical Circuit Analysis Using Laplace Transforms (8 Hours)

Module 5: Two Port Network and Network Functions (6 Hours)
   Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Module 6: Network Topology and Graph Theory (3 Hours)
   Introductory concepts of network graphs, cut sets, loops, cut set and loop analysis.

Text / References:

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Course Outcomes:
At the end of this course, students will demonstrate the ability to
- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

Module 1: Fundamentals of Digital Systems and logic families (7Hours)
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one’s and two’s complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2: Combinational Digital Circuits (7Hours)
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don’t care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial ladder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (7Hours)
A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D-Types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC’s, asynchronous sequential counters, applications of counters.

Module 4: A/D and D/A Converters (7Hours)
Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Module 5: Semiconductor memories and Programmable logic devices (7Hours)
Memory organization and operation, expanding memory size, classification and characteristics of
memories, sequential memory, read only memory (ROM), read and write memory (RAM),
addressable memory (CAM), charge de coupled device memory (CCD), commonly used
memory chips, ROM as a PLD, Programmable logic array, Programmable array logic,
complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/References:

| PCC-EEE03 | Electrical Machines-I | 3L:0T:0P | 3 credits |

Course Outcomes:
At the end of this course, students will demonstrate the
ability to
- Understand the concepts of magnetic circuits.
- Understand the operation of dc machines.
- Analyse the differences in operation of different dc machine configurations.
- Analyse single phase and three phase transformers circuits.

Magnetic fields and magnetic circuits (6 Hours)
Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law
and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current
carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on
the magnetic flux lines.

Module 2: Electromagnetic force and torque (9 Hours)
B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits;
linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial
derivative of
stored energy with respect to position of a moving element; torque as a partial derivative of
stored energy with respect to angular position of a rotating element. Examples - galvanometer coil,
relay contact, lifting magnet, rotating element with eccentricity or saliency.

Module 3: DC machines (8 Hours)
Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-
faces or
shoes, air gap and armature core, visualization of magnetic field produced by the field
winding excitation with armature winding open, air gap flux density distribution, flux per pole,
induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil
and commutator, lap and wave windings, construction of commutator, linear commutation
Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

**Module 4: DC machine - motoring and generation (7 Hours)**
Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

**Module 5: Transformers (12 Hours)**

**Text /References**

**PCC-EE04: Electrical Machines Laboratory– I (0:0:2 – 1 credit)**

Hands-on experiments related to the course contents of PCC-EEE03.
PCC-EEE05  | Electromagnetic Fields  | 3L:1T:0P  | 4 credits

Course Outcomes:
At the end of the course, students will demonstrate the ability
- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyse time varying electric and magnetic fields.
- To understand Maxwell’s equation in different forms and different media.
- To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Module 1: Review of Vector Calculus (6 hours)
Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Module 2: Static Electric Field (6 Hours)

Module 3: Conductors, Dielectrics and Capacitance (6 Hours)
Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson’s equation, Laplace’s equation, Solution of Laplace and Poisson’s equation, Application of Laplace’s and Poisson’s equations.

Module 4: Static Magnetic Fields (5 Hours)

Module 5: Magnetic Forces, Materials and Inductance (6 Hours)

Module 6: Time Varying Fields and Maxwell’s Equations (5 Hours)
Faraday’s law for Electromagnetic induction, Displacement current, Point form of Maxwell’s equation, Integral form of Maxwell’s equations, Motional Electromotive forces. Boundary Conditions.

Module 7: Electromagnetic Waves (6 Hours)
Derivation of Wave Equation, Uniform Plane Waves, Maxwell’s equation in Phasor form,
Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Module 8: Transmission line (4 Hours)

Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Text/References:

<table>
<thead>
<tr>
<th>ESC 301</th>
<th>Engineering Mechanics</th>
<th>3L:1T:0P</th>
<th>3 credits</th>
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</thead>
</table>

Course Outcomes: At the end of this course, students will demonstrate the ability to
- Understand the concepts of co-ordinate systems.
- Analyse the three-dimensional motion.
- Understand the concepts of rigid bodies.
- Analyse the free-body diagrams of different arrangements.
- Analyse torsional motion and bending moment.

Module 1: Introduction to vectors and tensors and co-ordinate systems (5 hours)
Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

Module 2: Three-dimensional Rotation (4 hours)
Three-dimensional rotation: Euler’s theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Module 3: Kinematics of Rigid Body (6 hours)
Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two-and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Module 4: Kinetics of Rigid Bodies (5 hours)
Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass
moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler’s laws of rigid body motion.

Module 5: Free Body Diagram (1 hour)
Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Module 6: General Motion (9 hours)

Module 7: Bending Moment (5 hours)
Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Module 8: Torsional Motion (2 hours)
Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Module 9: Friction (3 hours)
Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:
### IV SEMESTER

**Branch/Course: Civil Engineering (101)**

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<th>sr. no.</th>
<th>CODE</th>
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### IV SEMESTER

**Branch/Course: Mechanical Engineering (102)**

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<th>CODE</th>
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### 103 – ELECTRICAL ENGINEERING

**Semester IV [Second year] Branch/Course: Electrical Engineering**

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**104 – ELECTRONICS & COMMUNICATION ENGINEERING**  
Semester IV [Second year] Branch/Course Electronics & Communication Engineering

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**105 – COMPUTER SCIENCE & ENGINEERING**  
Semester IV [Second year] Branch/Course: COMPUTER SCIENCE & ENGINEERING

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106 – INFORMATION TECHNOLOGY
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107 – LEATHER TECHNOLOGY
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110 – Electrical & Electronics Engineering
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Module 3: Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energy conversion, Kelvin’s and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady-flow work, minimizing the compressor work, isentropic efficiencies of steady-flow devices, and entropy balance. Energy - a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat, work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closed systems and control volumes energy balance.

Module 5: Power Cycles- Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, an overview of reciprocating engines, air standard assumptions, gasoline engine Otto cycle, diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles.


Text/Reference Books:

<table>
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<tr>
<th>PCC-CE202</th>
<th>Engineering Geology</th>
<th>2L:0T:2P</th>
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The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, and liquefaction.

Engineering geology is an applied geology discipline that involves the collection, analysis, and interpretation of geological data and information required for the safe development of civil works. Engineering geology also includes the assessment and mitigation of geologic hazards such as earthquakes, landslides, flooding; the assessment of timber harvesting impacts; and groundwater remediation and resource evaluation. Engineering geologists are applied geoscientists with an awareness of engineering principles and practice—they are not engineers.
Proposed Syllabus:

**Module 1:** Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.


Module 6: Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging. Rock Quality Designation. Rock mass description.

Module 7: Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

Module 8: Rock Mechanics- Sub surface investigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, Bearing capacity of rocks.

Practicals:
1. Study of physical properties of minerals.
2. Study of different group of minerals.
3. Study of Crystal and Crystal system.
4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.

Text/Reference Books:


| PCC-CE203 | Disaster Preparedness & Planning Management | 1L:1T:0P | 2 credits |

The overall aim of this course is to provide broad understanding about the basic concepts of Disaster Management with preparedness as a Civil Engineer. Further, the course introduces the various natural hazards that can pose risk to property, lives, and livestock, etc. and understanding of the social responsibility as an engineer towards preparedness as well as mitigating the damages.
The objectives of the course are i) To Understand basic concepts in Disaster Management ii) To Understand Definitions and Terminologies used in Disaster Management iii) To Understand Types and Categories of Disasters iv) To Understand the Challenges posed by Disasters v) To understand Impacts of Disasters vi) To understand Key Skills

Proposed Syllabus

**Module 1:** Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation.

**Module 2:** Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

**Module 3:** Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

**Module 4:** Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and nonstructural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Postdisaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

**Module 5:** Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, landuse changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

**Text/Reference Books:**

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation


| PCC-CE204 | Introduction to Fluid Mechanics | 3L:0T:2P | 4 credits |

The objective of this course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. A training to analyse engineering problems involving fluids – such as
those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in later semesters.

**Module 1:** Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

**Module 2:** Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

**Module 3:** Fluid Kinematics- Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three-dimensional continuity equations in Cartesian coordinates.

**Module 4:** Fluid Dynamics- Surface and body forces; Equations of motion - Euler’s equation; Bernoulli’s equation – derivation; Energy Principle; Practical applications of Bernoulli’s equation: venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham’s π-Theorem.

**Module 5:** Laminar Flow-Laminar flow through: circular pipes, annulus and parallel plates. Stoke’s law, Measurement of viscosity

**Module 6:** Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham’s Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model Studies to fluid flow problem. Dynamic Similitude- Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number.

**Module 7:** Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem

**Module 8:** Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl’s mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody’s diagram

**Lab Experiments**

1. Measurement of viscosity
2. Study of Pressure Measuring Devices
3. Stability of Floating Body
4. Hydrostatics Force on Flat Surfaces/Curved Surfaces
5. Verification of Bernoulli’s Theorem
6. Venturimeter
The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modelling and design of a large range of engineering materials. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behaviour of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material. These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behaviour is carefully observed and measured. For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analytical mechanics.

**Proposed Syllabus**


**Module 2:** Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

**Module 3:** Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams. BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of
concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.


**Module 5: Shear Stresses- Derivation of formula** – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

**Module 6:** Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay’s method. Use of these methods to calculate slope and deflection for determinant beams.

**Module 7:** Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

**Module 8:** Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

**List of Experiments:**
- Tension test
- Bending tests on simply supported beam and Cantilever beam.
- Compression test on concrete
- Impact test
- Shear test
- Investigation of Hook’s law that is the proportional relation between force and stretching in elastic deformation,
- Determination of torsion and deflection,
- Measurement of forces on supports in statically determinate beam,
- Determination of shear forces in beams,
- Determination of bending moments in beams,
- Measurement of deflections in statically determinate beam,
- Measurement of strain in a bar
- Bend test steel bar;
- Yield/tensile strength of steel bar;

**Text/Reference Books:**

Analysis of indeterminate structures by force methods, flexibility coefficients, Energy methods:
Principle of minimum potential energy, principle of virtual work, Castigliano’s theorems, Reciprocal
theorem, unit load method, Influence line and Rolling loads, beam, frames and arches, Muller-
Breslau Principles and its applications to determinate and indeterminate structures.

Analysis of Beams and Frames: Moment Area method, Slope deflection method, Three Moment
Equation, Moments distribution methods, effect of symmetry and anti symmetry, sway correction,
Lateral load analysis: Portal and Cantilever methods, Matrix method of structural analysis,
Displacement/Stiffness methods.

Text books:


The objective of this Course is to deal with an experimental determination and evaluation of
mechanical characteristics and advanced behavior of metallic and non-metallic structural
materials. The course deals with explanation of deformation and fracture behavior of structural
materials. The main goal of this course is to provide students with all information concerning
principle, way of measurement, as well as practical application of mechanical characteristics.

Make measurements of behavior of various materials used in Civil Engineering.
Provide physical observations to complement concepts learnt
Introduce experimental procedures and common measurement instruments, equipment,
devices.
Exposure to a variety of established material testing procedures and techniques
Different methods of evaluation and inferences drawn from observations

The course reviews also the current testing technology and examines force applications
systems, force measurement, strain measurement, important instrument considerations,
equipment for environmental testing, and computers applications for materials testing provide an
introductory treatment of basic skills in material engineering towards (i) selecting material
for the design, and (ii) evaluating the mechanical and structural properties of material, as well as
the knowledge necessary for a civil engineer. The knowledge acquired lays a good foundation for
analysis and design of various civil engineering structures/systems in a reliable manner.

What will I learn?

- Different materials used in civil engineering applications
- Planning an experimental program, selecting the test configuration, selecting the test
  specimens and collecting raw data
- Documenting the experimental program including the test procedures, collected data,
  method of interpretation and final results
- Operating the laboratory equipment including the electronic instrumentation, the test
  apparatus and the data collection system
- Measuring physical properties of common structural and geotechnical construction
  materials
• Interpreting the laboratory data including conversion of the measurements into engineering values and derivation of material properties (strength and stiffness) from the engineering values
• Observing various modes of failure in compression, tension, and shear
• Observing various types of material behavior under similar loading conditions

Proposed Syllabus

Module 1: Introduction to Engineering Materials covering, Cements, M-Sand, Concrete (plain, reinforced and steel fibre/glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these

Module 2: Introduction to Material Testing covering, What is the “Material Engineering”?; Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundamentals and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics

Module 3: Standard Testing & Evaluation Procedures covering, Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep.


Practicals:

✓ Gradation of coarse and fine aggregates
✓ Different corresponding tests and need/application of these tests in design and quality control
✓ Tensile Strength of materials & concrete composites
✓ Compressive strength test on aggregates
✓ Tension I - Elastic Behaviour of metals & materials
✓ Tension II - Failure of Common Materials
✓ Concrete I - Early Age Properties
✓ Concrete II - Compression and Indirect Tension
✓ Compression – Directionality
✓ Consolidation and Strength Tests
✓ Tension III - Heat Treatment
✓ Torsion test
✓ Hardness tests (Brinnel’s and Rockwell)
✓ Tests on closely coiled and open coiled springs
Theories of Failure and Corroboration with Experiments
Concrete Mix Design as per BIS

Text/Reference Books:
3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
7. Related papers published in international journals

<table>
<thead>
<tr>
<th>HSMC252</th>
<th>Civil Engineering – Societal &amp; Global Impact</th>
<th>2L:0T:0P</th>
<th>2 credits</th>
</tr>
</thead>
</table>

The course is designed to provide a better understanding of the impact which Civil Engineering has on the Society at large and on the global arena. Civil Engineering projects have an impact on the Infrastructure, Energy consumption and generation, Sustainability of the Environment, Aesthetics of the environment, Employment creation, Contribution to the GDP, and on a more perceptible level, the Quality of Life. It is important for the civil engineers to realise the impact which this field has and take appropriate precautions to ensure that the impact is not adverse but beneficial.

The course covers:

- Awareness of the importance of Civil Engineering and the impact it has on the Society and at global levels
- Awareness of the impact of Civil Engineering for the various specific fields of human endeavour
- Need to think innovatively to ensure Sustainability

Module 1: Introduction to Course and Overview; Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;

Module 2: Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering

Module 3: Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic,
Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;

**Module 4:** Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and nonstationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.

**Module 5:** Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability

**Module 6:** Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;

**Module 7A:** Population Dynamics covering, Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity; *(3 Lectures)*

**Module 8B:** Environmental Management covering, Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies
*(International Airport, thermal power plant); *(3 Lectures)*

**Module 9A:** Molecular Genetics covering, Structures of DNA and RNA; Concept of Gene, Gene regulation, e.g., Operon concept; *(3 Lectures)*

**Module 9B:** Biotechnology covering, Basic concepts: Totipotency and Cell manipulation; Plant & Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNA Technology- Techniques and applications; *(3 Lectures)*

**Module 10A:** Biostatistics covering, Introduction to Biostatistics:-Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor) *(4 Lectures)*
ORGANISATION OF COURSE (2-0-0)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Module</th>
<th>No of Lectures</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Understanding the Importance of Civil Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Infrastructure</td>
<td>8</td>
<td></td>
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<tr>
<td>4</td>
<td>Environment</td>
<td>7</td>
<td></td>
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<tr>
<td>5</td>
<td>Built Environment</td>
<td>5</td>
<td></td>
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<tr>
<td>6</td>
<td>Civil Engineering Projects</td>
<td>4</td>
<td></td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>30</strong></td>
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</table>

Text/Reference Books:


Mechanical Engineering
IV Semester
Branch Code - 102

<table>
<thead>
<tr>
<th>PCC-ME 203</th>
<th>Fluid Mechanics</th>
<th>3L:0T:3P</th>
<th>4.5 Credits</th>
</tr>
</thead>
</table>

Objectives:
1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines.

Contents:
Module: 1
Definition of fluid, Units and dimensions, Newton’s law of viscosity, Properties of fluids, mass, density, specific volume, specific gravity, viscosity, surface tension and capillarity, vapor pressure, compressibility and bulk modulus. Hydrostatics; fluid force on plane and curved surfaces, manometers, buoyancy, uniformly accelerated motion.

Module: 2

Module: 3
Dynamics of fluid flow: Control volume and control surface, application of continuity equation and momentum equation, Bernoulli’s equation and its applications.

Module: 4
Concept of boundary layer, boundary layer thickness, Displacement thickness, momentum thickness, energy thickness.

Module: 5
Laminar viscous flow through circular conduits, Couette and Poisuielle flow, Turbulent flow through pipes, Darcy Weisbach equation, friction factor for smooth and rough pipes, Moody’s diagram.

Module: 6
Need for dimensional analysis, methods of dimension analysis, Similitude and types of similitude, Dimensionless parameters, application of dimensionless parameters Model analysis.

Module: 7
Forces on immersed bodies, concepts of separation, drag force, circulation and lift force.

Text Books:
3. Som and Biswas; Fluid Mechanics and machinery; TMH
Practical:

1. Determination of density & viscosity of oil.
2. To determine the meta-centric height of a floating body.
3. Measurement of Coefficient of Discharge of given Orifice and Venturimeter
4. To determine the coefficient of discharge of Notch (Vand Rectangular types)
5. To determine the friction factor for the pipes.
6. To verify the Bernoulli’s Theorem.
7. To find critical Reynolds number for a pipe flow.
8. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
9. To show the velocity and pressure variation with radius in a free and forced vortex

*Atleast 8 experiments should be performed from above list*

Course Outcomes:

1. State the Newton’s law of viscosity and explain the mechanics of fluids at rest and in motion by observing the fluid phenomena.
2. Compute force of buoyancy on a partially or fully submerged body and analyze the stability of a floating body.
3. Derive Euler’s Equation of motion and deduce Bernoulli’s equation.
4. Examine energy losses in pipe transitions and sketch energy gradient lines.
5. Evaluate pressure drop in pipe flow using Hagen-Poiseuille’s equation.
6. Distinguish the types of flows.
Objectives:

1. To learn about the 1st law for reacting systems and heating value of fuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To understand about the properties of dry and wet air and the principles of psychometric
4. To learn about gas dynamics of air flow and steam through nozzles
5. To learn about reciprocating compressors with and without intercooling
6. To analyze the performance of steam turbines

Contents:

Module 1: (8 lectures)

Module 2: (10 lectures)

Module 3: (6 lectures)

Module 4: (8 lectures)

Module 5: (5 lectures)
Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Module 6: (5 lectures)
Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Text Books:

Outcomes:

1. After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
3. They will be able to understand phenomena occurring in high speed compressible flows.

<table>
<thead>
<tr>
<th>PCC-ME 205</th>
<th>Strength of Materials</th>
<th>3L:0T:3P</th>
<th>4.5 credits</th>
</tr>
</thead>
</table>

**Objectives:**

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

**Contents:**

**Module :1**
Deformation in solids- Hooke’s law, stress and strain- tension, compression and shear stresses-elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr’s circle, theories of failure,

**Module :2**
Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

**Module :3**
Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell’s reciprocal theorems.

**Module :4**
Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

**Module :5**
Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

**Text Books:**


**Practical:**

1. Hooke’s Law
2. Hardness Test: Rockwell, Brinell, Vicker
3. Izod & Charpy Impact Test
4. Bending Test
5. Torsion Test
6. Shear test
7. Compressive strength test
8. Fatigue Test
9. Verification of Maxwell’s reciprocal theorem
10. Continuous beam deflection test
11. Strain Measurement

*Atleast 8 experiments should be performed from above list

Course Outcomes:
1. After completing this course, the students should be able to recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

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<table>
<thead>
<tr>
<th>PCC-ME 206</th>
<th>Engineering Materials</th>
<th>3L:1T:0P</th>
<th>4 Credits</th>
</tr>
</thead>
</table>

Objectives:
1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams and Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Contents
Module: 1 (6 lectures)
Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Module: 2 (8 lectures)
Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Module: 3 (10 lectures)
Mechanical Property measurement: Tensile, compression and torsion tests; Young’s modulus, relations between true and engineering stress-strain curves, generalized Hooke’s law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength, Introduction to non-destructive testing (NDT).

Module: 4 (10 lectures)

Module: 5 (8 lectures)
Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupronickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.

Text Books:

Course Outcomes:
1. Student will be able to identify crystal structures for various materials and understand the defects in such structures
2. Understand how to tailor material properties of ferrous and non-ferrous alloys
3. How to quantify mechanical integrity and failure in materials

PCC-ME 207 Instrumentation and Control 3L:1T:0P 4 credits

Objectives:
1. To provide a basic knowledge about measurement systems and their components
2. To learn about various sensors used for measurement of mechanical quantities
3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control

Module: 1 (10 lectures)
Measurement systems and performance - configuration of a measuring system, Methods for correction for interfering and modifying inputs—accuracy, range, resolution, error sources, precision, error sensitivity etc. Classification of errors and statistical analysis of experimental data.

Module: 2 (8 lectures)
Instrumentation system elements - sensors for common engineering measurements. Transducers based on variable resistance, variable induction, variable capacitance and piezo-electric effects, Displacement transducer.

Module: 3 (6 lectures)
Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric.

Module: 4 (10 lectures)
Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers.

Module: 5 (6 lectures)
System models, transfer function and system response, frequency response; Nyquist diagrams and their use.
Practical group based project utilizing above concepts.

Text Books:
1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 2000

Course Outcomes:
Upon completion of this course, the students will be able to understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

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**Electrical Engineering**

**IV Semester**

**Branch code - 103**

| PCC-EE08 | Digital Electronics | 3L:0T:0P | 3 credits |

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

**Module 1: Fundamentals of Digital Systems and logic families (7 Hours)**
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems—binary, signed binary, octal, hexadecimal, number, binary arithmetic, one’s and two’s complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

**Module 2: Combinational Digital Circuits (7 Hours)**
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don’t care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

**Module 3: Sequential circuits and systems (7 Hours)**
A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D-types flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC’s, asynchronous sequential counters, applications of counters.
Module 4: A/D and D/A Converters (7 Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltagetofrequencyandvoltagetotimeconversion, specifications ofots ofA/D converters, example of A/D converter ICs

Module 5: Semiconductor memories and Programmable logic devices. (7 Hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/References:

PCC-EE09: Digital Electronics Laboratory (0:0:2 – 1 credit)
Hands-on experiments related to the course contents of EE07.

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand the concepts of rotating magnetic fields.
- Understand the operation of ac machines.
- Analyse performance characteristics of ac machines.

Module 1: Fundamentals of AC machine windings (8 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil – active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding: concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module 2: Pulsating and revolving magnetic fields (4 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module 3: Induction Machines (12 Hours)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum

Module 4: Single-phase induction motors (6 Hours)
Constructional features, double revolving field theory, equivalent circuit, determination of parameters.
Split-phase starting methods and applications. Methods of starting using auxiliary winding, development of equivalent circuit. No-Load and Blocked Rotor tests.

Module 5: Special Machines (10 Hours)
Basics of Hysteresis motor, Switched Reluctance motor, Stepper motor, Brushless DC motor

Text/References:

PCC-EE11: Electrical Machines Laboratory– II (0:0:2 – 1 credit)
Hands-on experiments related to the course contents of EE10.

| PCC-EE12 | Electrical and Electronic Measurement | 3L:0T:0P | 3 credits |

Course Outcomes:
At the end of this course, students will demonstrate the ability to:
- work on of various instruments and equipments used for the measurement of various electrical engineering
- analyze and solve the varieties of problems and issues coming up in the vast field of electrical measurements
- to think in terms of innovative ideas to improve the existing technology in the field of measurements in terms of accuracy, cost, durability and user friendliness

Module 1: Measurement and Error (8 Hours)
Measurement and Error: Definition, Accuracy and Precision, Significant Figures, Types of Errors.

Module 2: Measurement of Resistance, Inductance and Capacitance: (8 Hrs)

Module 3: (8 Hrs)

Module 4: (8 Hrs)
Current Transformer and Potential Transformer : (3 Hrs) Construction, Theory, Characteristics and Testing of CTs and PTs. Electronic Instruments for Measuring Basic Parameters: (2 Hrs) Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q-meter Oscilloscope: (3 Hrs) Block Diagrams, Delay Line, Multiple Trace, Oscilloscope Probes, Oscilloscope Techniques, Introduction to Analog and Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay using Oscilloscope

Text/References:
Course Outcomes:
At the end of this course, students will demonstrate the ability to

1. Design and validate DC and AC bridges.
2. Analyze the dynamic response and the calibration of few instruments.
3. Learn about various measurement devices, their characteristics, their operation and their limitations.
4. Understand statistical data analysis.
5. Understand computerized data acquisition.

Lectures/Demonstrations:
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Experiments
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
7. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
8. Usage of DSO to capture transients like a step change in R-L-C circuit.

PCC-EE14 Signals and Systems 2L:1T:0P 3 credits

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand the concepts of continuous time and discrete time systems.
- Analyze systems in complex frequency domain.
- Understand sampling theorem and its implications.
Module 1: Introduction to Signals and Systems (3 hours):
Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Module 2: Behavior of continuous and discrete-time LTI systems (8 hours)

Module 3: Fourier, Laplace and Z- Transforms (10 hours)
Fourier series representation of periodic signals, Wave form Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval’s Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z- domain analysis.

Module 4: Sampling and Reconstruction (4 hours)

Text/References:
## Electronics & Communication Engineering
### IV Semester
#### Branch Code – 104

<table>
<thead>
<tr>
<th>EC104</th>
<th>Digital Circuits</th>
<th>3L:1T:0P</th>
<th>3 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sl. No.</td>
<td>Contents</td>
<td>Contact Hours</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Digital Principle: Analog vs Digital, Number system, Computer Codes, Digital Signals, Waveforms Positive and Negative logic, Logic Gate: basic, universal and others, Truth Table, Logic functions, IC Chips, Timing Diagram, Electrical analogy.</td>
<td>5</td>
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<tr>
<td>2</td>
<td>Boolean laws and theorems: Logic functions, Conversion of logic functions into truth table and vice versa. SOP and POS forms of representation, Canonical form, minterms and maxterms, Simplification of logic functions by theorems and Karnaugh’s map, don’t care conditions.</td>
<td>5</td>
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<tr>
<td>3</td>
<td>Analysis and synthesis of Combinational logic circuits: Comparators, Multiplexers, Encoder, Decoder, 7 Segment Display, Half Adder and Full Adder, Subtractors, Serial and Parallel Adders, BCD Adder</td>
<td>6</td>
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<tr>
<td>4</td>
<td>Sequential circuit blocks and latches: Flip-Flops-Race around condition, Master-Slave and Edge triggered SR, JK, D and T Flip Flop, Shift registers, Counters-Synchronous and Asynchronous: Design of ripple counter</td>
<td>10</td>
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<td>5</td>
<td>Timing circuit: Multivibrators, Monostable and Astable timer: LM555</td>
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<tr>
<td>6</td>
<td>Integrated circuit logic families: RTL, DTL, TTL, CMOS, IIL/I2L (Integrated Injection logic and Emitter Coupled logic).</td>
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<tr>
<td>7</td>
<td>Use of building blocks: Designing larger systems such as Digital-to-Analog Converters (DAC): Weighted resistors and R-2R, Analog-to-Digital(ADC)-converter, counter and succession.</td>
<td>5</td>
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<td><strong>Total</strong></td>
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<tr>
<th>Sl. No.</th>
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<tbody>
<tr>
<td>1</td>
<td>“Digital Fundamentals”, Floyd and Jain., Pearson</td>
</tr>
<tr>
<td>2</td>
<td>“Digital Logic and Computer Design”, M.Morris Mano, Pearson</td>
</tr>
<tr>
<td>3</td>
<td>“Fundamentals of Digital Circuits”, A.Anand Kumar, PHI</td>
</tr>
<tr>
<td>4</td>
<td>“Digital Systems”, Ronald J.Tocci, Neal S.Widmer, Pearson</td>
</tr>
</tbody>
</table>

Digital Circuits and Systems Lab are according to the theory mentioned above.

<table>
<thead>
<tr>
<th>0L: 0T: 2P</th>
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<tr>
<td>Sl. No.</td>
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<tr>
<td>1</td>
<td>Small signal amplifiers: CB, CE, CC configurations, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid band model, gain and impedance, comparisons of different configurations, Emitter follower, Darlington pair (derive voltage gain, current gain, input and output impedance). Hybrid-model at high frequencies (pi-model).</td>
</tr>
<tr>
<td>3</td>
<td>Field Effect Transistor: Introduction, Classification, FET characteristics, Operating point, Biasing, FET small signal Model, Enhancement and Depletion type MOSFETs, FET Amplifier configurations (CD, CG and CS).</td>
</tr>
<tr>
<td>4</td>
<td>Oscillators: Barkhausen criterion, Sinusoidal Oscillators, the RC phase-shift oscillator, resonant circuit Oscillators, a general form of oscillator circuit, the Wien -bridge oscillator, Crystal oscillators, Hartley, Colpitt’s and Clapp’s Oscillator.</td>
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<tr>
<td>1</td>
<td>“Electronic Devices and Circuit Theory”, Boylestad and Nashelsky, PEARSON PUBLICATION.</td>
</tr>
<tr>
<td>2</td>
<td>“Electronic devices and circuits”, Salivahanan, Suresh Kumar, Vallavaraj, TMH, 1999</td>
</tr>
<tr>
<td>4</td>
<td>“Micro Electronic Circuits”, Sedra and Smith, Oxford University Press, 2000</td>
</tr>
<tr>
<td>5</td>
<td>“Electronic Devices and Circuits”, David A Bell, Oxford University Press, 2000</td>
</tr>
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</table>

**Analog Circuits Lab are according to the theory mentioned above.**
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Contents</th>
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<tbody>
<tr>
<td>1</td>
<td>Basics of Semiconductor Physics: Semiconductor carrier modelling - Bonding model, Energy band model, Carriers, Band gap, Carrier properties (Effective mass, Intrinsic carrier concentration, Doping), Density of states, Fermi function, Equilibrium carrier concentration (formula for n and p and np product), Charge neutrality relationship, Determination of Fermi level, Carrier concentration, Temperature dependence. Carrier Action - Drift, Mobility, Drift Current, Resistivity, Diffusion Current, Total current, Relation between the diffusion constants and mobility (Einstein’s relationship), Recombination-Generation (Band-to-Band, R-G Centres, Auger, Impact Ionization). Equation of state, Continuity equation, Minority Carrier Diffusion Equation.</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>PN Junction Diode: Step junction, Built-in potential, Depletion width, Depletion Approximation, Electrostatic relationship (Charge density, Depletion width, Potential, Electric field) for ( V_a = 0 ), ( V_a &gt; 0 ) and ( V_a &lt; 0 ), Ideal Diode Equation (Qualitative and Quantitative derivation: Band Model, Assumptions, Approximation, Boundary condition), Deviation from Ideal (R-G Current, Series resistance, High Level Injection), Junction Breakdown (Avalanche and Zener), Reverse Bias Junction Capacitance, forward Bias Diffusion Capacitance, Qualitative understanding of Turn on and Turn-off transients. Zener Diode, Tunnel diode, Varactor diode, Schottky diode.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Physics and technologies of BJT: Operational considerations, Modes and Configurations, Performance Parameters (Emitter Efficiency, Base Transport Factor, Common Base Current Gain, Common Emitter Current Gain and their derivation for an ideal transistor, Deviation from ideal (Base Width Modulation Punch Through, Avalanche Breakdown, Geometrical effects, R-G current), Small signal modelling.</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Physics and technologies of FET: JUNCTION FET (Theory of operation, I-V relationship), MOS CAPACITOR (Energy Band diagram, Gate-Voltage relationship, Capacitance-Voltage characteristics), MOSFET (Theory of operation, Threshold voltage, I-V characteristics), NON IDEAL MOS (M-S work function difference, oxide charges, threshold adjustment and considerations)</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Introduction to UJT, SCR, Triac and Diac (Construction, Working, Characteristics and Application), UJT Relaxation oscillator. Optoelectronic Devices: Photo diodes (PIN and Avalanche), Solar cell, LED, Solid State LASER diodes.</td>
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<tbody>
<tr>
<td>1</td>
<td>“Semiconductor Device Fundamentals”, by R. F. Pierret, Addison-Wesley publishing company, 1996</td>
</tr>
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</table>

**Semiconductor Physics Lab are according to the theory mentioned above.**

| 0L: 0T: 2P | 1 Credit |
### EC107 | Analog Communication | 3L:0T:0P | 3 Credits

<table>
<thead>
<tr>
<th>Sl. No.</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to the communication system: Block diagram of communication system and comparative study of analog and digital communication.</td>
<td>3</td>
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<tr>
<td>2</td>
<td>Modulation (upward frequency translation) and demodulation (downward frequency translation) and the need for modulation: broad classification of modulation [linear (amplitude-AM) and exponential (frequency-FM and phase-PM)]</td>
<td>7</td>
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<tr>
<td>3</td>
<td>Generation of double side band (DSB) with carrier, double side band with suppressed carrier (DSB-SC) and single side band with suppressed carrier: Demodulation of double side band with carrier –incoherent detector or envelope detector, peak diode detector, coherent or synchronous detection of DSBSC and single side band with suppressed carrier.</td>
<td>8</td>
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<tr>
<td>4</td>
<td>Superheterodyne Receivers: Characteristics, Intermediate Frequency and its advantages, image rejection of the Receiver.</td>
<td>5</td>
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<tr>
<td>5</td>
<td>Generation of FM signals (direct and indirect methods) and Demodulation.</td>
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<td>6</td>
<td>Noise: Different types of Noise, SNR in AM, FM and PM System and use of emphasis Circuit in FM for SNR optimization.</td>
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<td>7</td>
<td>Analog pulse modulation: PAM, PWM, PPM and demodulation; comparative study of various analog pulse modulation</td>
<td>8</td>
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<tr>
<td>1</td>
<td>“Electronic Communication system”, by Kennedy. TMH.</td>
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<td>2</td>
<td>“Communication system”, by Haykin, Wiley</td>
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<tr>
<td>3</td>
<td>“Communication system”, by Bruce carison. TMH.</td>
</tr>
<tr>
<td>4</td>
<td>“Modern Digital And Analog Communication”, B.P.LATHI Oxford</td>
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</table>

Analog Communication Lab are according to the theory mentioned above. | 0L: 0T: 2P | 1 Credit |

### EC108 | Electromagnetic Theory | 3L:1T:0P | 3 Credits

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<tr>
<th>Sl. No.</th>
<th>Contents</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to Vector Algebra, Coordinate Systems and Transformation, Vector Calculus. Electrostatics: Coulomb’s law, Gauss’s law and its applications, the potential functions, Equipotential surface, Poisson’s and Laplace’s equation, Applications (solution for some simple cases), Capacitance, Electrostatic energy, Conductor properties and boundary conditions between dielectrics and dielectric-conductor interface, Uniqueness Theorem.</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Magnetostatics: Biot-Savart law, Ampère’s circuital law, Curl, Stoke’s theorem, Magnetic flux and magnetic flux density, Energy stored in magnetic field, Ampère’s force law, Magnetic vector potential, Analogy between electric and magnetic field.</td>
<td>6</td>
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</table>
Maxwell’s equations, Equation of Continuity for time varying field. Inconsistency of Ampere’s circuital law, Maxwell’s equations in differential and integral form.
Electromagnetic waves: Solution of wave equation in free space, Uniform plane wave propagation, Uniform plane waves, the wave equation for conducting medium, Wave propagation in lossless medium and in conductive medium, Conductors and dielectrics, Polarization

3


4

Transmission Lines: Transmission line theory, low loss radio-frequency and UHF transmission line. UHF line as a transformer, voltage step up of the quarter wave transformer. Transmission line chart (Smith Chart).

5

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Computer Science Engineering
IV Semester
Branch Code - 105

| PCC CS 401 | Discrete Mathematics | 3L:1T:0P | 4 Credits |

Objectives of the course

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

1. Use mathematically correct terminology and notation.
2. Construct correct direct and indirect proofs.
3. Use division into cases in a proof.
4. Use counter examples.
5. Apply logical reasoning to solve a variety of problems.

Detailed contents:
Module 1

Lecture 6 hrs.


Module 2

Lecture 8 hrs.


Basic counting techniques—inclusion and exclusion, pigeon-hole principle, permutation and combination.

Module 3

Lecture 8 hrs.


Module 4

Lecture 8 hrs.

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Module 5

Lecture 10 hrs.

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Coloring maps and Planar Graphs, Coloring Vertices, Coloring Edges, List Coloring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.
Suggested books:


Suggested reference books:


Course Outcomes

1. For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives.
2. For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference.
3. For a given a mathematical problem, classify its algebraic structure
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
5. Develop the given problem as graph networks and solve with techniques of graph theory.

PCC CS 402  |  Computer Organization  |  3L:0T:4P  |  5 Credits
--- | --- | --- | ---
Computer Architecture  |  &  |  |

Objectives of the course:

To expose the students to the following:

1. How Computer Systems work & the basic principles
2. Instruction Level Architecture and Instruction Execution
3. The current state of art in memory system design
4. How I/O devices are accessed and its principles.
5. To provide the knowledge on Instruction Level Parallelism

6. To impart the knowledge on microprogramming

7. Concepts of advanced pipelining techniques.

Detailed contents

Module 1          Lecture 10 hrs.

**Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

**Data representation:** signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Module 2          Lecture 14 hrs.

**Introduction to x86 architecture. CPU control unit design:** hardwired and microprogrammed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization.

**Peripheral devices and their characteristics:** Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB.

Module 3          Lecture 10 hrs.

**Pipelining:** Basic concepts of pipelining, throughput and speedup, pipeline hazards.

**Parallel Processors:** Introduction to parallel processors, Concurrent access to memory and cache coherency.

Module 4          Lecture 6 hrs.

**Memory organization:** Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. Block size, mapping functions, replacement algorithms, write policies.

Suggested books:


**Suggested reference books:**


**Course outcomes:**

1. Draw the functional block diagram of a single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.

2. Write assembly language program for specified microprocessor for computing 16 bit multiplication, division and I/O device interface (ADC, Control circuit, serial port communication).

3. Write a flowchart for Concurrent access to memory and cache coherency in Parallel Processors and describe the process.

4. Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.

5. Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology.

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**PCC CS 402P**

**Computer Organization & Architecture Lab**

Hands-on experiments related to the course contents of PCC CS 402.

******************************************************************

**PCC CS 403**

**Operating Systems**

**3L:0T:4P**

**5 Credits**

**Objectives of the course**

1. To learn the fundamentals of Operating Systems.

2. To learn the mechanisms of OS to handle processes and threads and their communication.
3. To learn the mechanisms involved in memory management in contemporary OS

4. To gain knowledge on distributed operating system concepts that includes architecture, mutual exclusion algorithms, deadlock detection algorithms and agreement protocols

5. To know the components and management aspects of concurrency management

6. To learn to implement simple OS mechanisms

Detailed Contents

Module 1          Lecture 4
hrs.


Module 2          Lecture 10
hrs.


Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Module 3          Lecture 6
hrs.


Module 4          Lecture 4
hrs.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: Banker’s algorithm, Deadlock detection and Recovery.
Module 5  
Lecture 9
hrs.

**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging and Segmentation: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Advantages and Disadvantages of paging and segmentation.

**Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Module 6  
Lecture 9
hrs.

**File Management:** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

**Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

**I/O Hardware:** I/O devices, Device controllers, Direct memory access, Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure.

**Suggested books:**


**Suggested reference books:**


5. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Outcomes

After the completion of course, students can able to able to:

2. Develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.
3. Understand and implement file management system
4. Understand the I/O management functions in OS by performing operations for synchronization between CPU and I/O controllers.

<table>
<thead>
<tr>
<th>PCC CS 403P</th>
<th>Operating Systems Lab</th>
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Hands-on experiments related to the course contents of PCC CS 403.

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PCC CS 404 | Design and Analysis of Algorithms | 3L:0T: 4P | 5 Credits
--- | --- | --- | ---
Pre-requisites | PCC CS 301 and Programming for Problem Solving |

Objectives of the course

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Detailed contents:

Module 1  Lecture 10
hrs.


Module 2  Lecture 10
hrs.

**Introduction to Divide and Conquer paradigm**: Binary Search, Quick and Merge sorting techniques, linear time selection algorithm, Strassen’s Matrix Multiplication, Karatsuba Algorithm for fast multiplication etc. Introduction to Heap: Min and Max Heap, Build Heap, Heap Sort

Module 3  Lecture 10
hrs.


Dynamic Programming, difference between dynamic programming and divide and conquer, Applications: Fibonacci Series, Matrix Chain Multiplication, 0-1 Knapsack Problem, Longest Common Subsequence, Travelling Salesman Problem, Rod Cutting, Bin Packing.

Heuristics – characteristics and their application domains.

Module 4  Lecture 8
hrs.

**Graph and Tree Algorithms**: Representational issues in graphs, Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms: Bellman-Ford algorithm, Dijkstra’s algorithm & Analysis of Dijkstra’s algorithm using heaps, Floyd-
Warshall’s all pairs shortest path algorithm. Transitive closure, Topological sorting, Network Flow Algorithm, Connected Component

**Module 5**

**Lecture 5**

hrs.

**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook’s theorem, Standard NP-complete problems and Reduction techniques.

Approximation algorithms, Randomized algorithms

**Suggested books:**


**Suggested reference books**


**Course Outcomes**

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.
6. Explain the ways to analyze randomized algorithms (expected running time, probability of error).
7. Explain what an approximation algorithm is. Compute the approximation factor of an
approximation algorithm (PTAS and FPTAS).

PCC CS 404P Design and Analysis of Algorithms Lab

Hands-on experiments related to the course contents of PCC CS 404.

ESC 401 Digital Electronics 3L:0T:4P 5 Credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use Programmable logic devices to implement the given logical problem.

Module 1 Lecture: 7 hrs.

Fundamentals of Digital Systems and logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one’s and two’s complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICS, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri - state logic.

Module 2 Lecture: 7 hrs.

Combinational Digital Circuits: Standard representation for logic functions K-map representation, simplification of logic functions using K-map, minimization of logical functions.
Don’t care conditions, Multiplexer, DeMultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3  
Lecture: 7 hrs.

Sequential circuits and systems: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC’s, asynchronous sequential counters, applications of counters.

Module 4  
Lecture: 7 hrs.

A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using
Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Module 5  
Lecture: 7 hrs.

Semiconductor memories and Programmable logic devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Suggested books:


ESC 401P  Digital Electronics Lab

Hands-on experiments related to the course contents of ESC 401.

******************************************************************

HSMC 401  Human Resource Development and Organizational Behavior

3L:0T:0P  3 Credits

Module 1  Lecture:  8 hrs.

Introduction: HR Role and Functions, Concept and Significance of HR, Changing role of HR managers - HR functions and Global Environment, role of a HR Manager. Human Resources Planning: HR Planning and Recruitment: Planning Process - planning at different levels - Job Analysis

Module 2  Lecture:  8hrs.

Recruitment and selection processes - Restructuring strategies - Recruitment-Sources of Recruitment-Selection Process-Placement and Induction-Retention of Employees. Training and Development: need for skill upgradation - Assessment of training needs - Retraining and Redeployment methods and techniques of training employees and executives - performance appraisal systems.

Module 3  Lecture:  8hrs.


Module 4  Lecture:  8hrs.
Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.

Module 5

Lecture: 8hrs.


Suggested books:


Suggested reference books:

3. Luis R. Gomez, Mejia, Balkin and Cardy, Managing Human Resources PHI, New Delhi
5. Shukla, Madhukar: Understanding Organizations - Organizational Theory & Practice in India, PHI
We as human beings are not an entity separate from the environment around us; rather, we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it; rather, we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity-based course on environment protection is to sensitize the students on the above issues through following two types of activities:

(a) **Awareness Activities:**

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste

ii) Slogan making events

iii) Poster making events

iv) Cycle rally

v) Lectures from experts

(b) **Actual Activities:**

i) Plantation

ii) Gifting a tree to see its full growth

iii) Cleanliness drive

iv) Drive for segregation of waste

v) To live some big environmentalist for a week or so to understand his work

vi) To work in kitchen garden for mess

vii) To know about the different varieties of plants

viii) Shutting down the fans and ACs of the campus for an hour or so

******************************************************************
Information Technology
IV Semester
Branch code 106

<table>
<thead>
<tr>
<th>PCC CS 502</th>
<th>Formal Language &amp; Automata Theory</th>
<th>3L: 1T:0 P</th>
<th>4 Credits</th>
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</thead>
</table>

Objectives of the course

- To develop a formal notation for strings, languages and machines.
- To design finite automata to accept a set of strings of a language.
- To prove that a given language is regular and apply the closure properties of languages.
- Design context free grammars to generate strings from a context free language and convert them into normal forms.
- Prove equivalence of languages accepted by Push Down Automata and languages generated by context free grammars.
- Identify the hierarchy of formal languages, grammars and machines.
- Distinguish between computability and non-computability and Decidability and undesirability.

Detailed contents

Module 1 Lecture 10 hrs.
Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.
Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.

Module 2 Lecture 10 hrs.
Context-free languages and pushdown automata: Context-free grammars (CFG) and Context-free languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.

Module 3 Lecture 2 hrs.
Context-sensitive languages: Context-sensitive grammars (CSG) and Context-sensitive languages, linear bounded automata and equivalence with CSG.

Module 4 Lecture 10 hrs.
Turing machines: The basic model for Turing machines (TM), Turing recognizable
(Recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Module 5  
Lecture 8 hrs.

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice’s theorem, undecidable problems about languages.

Suggested books


Suggested reference books:


Course Outcomes:

After the completion of course, students can able to:

1. Write a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. For a given language determine whether the given language is regular or not.
4. Design context free grammars to generate strings of context free language.
5. Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars.
6. Write the hierarchy of formal languages, grammars and machines.
7. Distinguish between computability and non-computability and Decidability And undecidability.
Objectives of the course
To expose the students to the following:
- How Computer Systems work & the basic principles
- Instruction Level Architecture and Instruction Execution
- The current state of art in memory system design
- How I/O devices are accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism
- To impart the knowledge on microprogramming
- Concepts of advanced pipe lining techniques.

Detailed contents: Module 1:

Module 1: Lecture 10


Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic—integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication—shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Module 2: Lecture 14

Introduction to x86 architecture.

CPU control unit design: hardwired and micro-programmed design approaches, Case study—design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers—program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes—role of interrupts in process state transitions, I/O device interfaces—SCII, USB.

Module 3: Lecture 10

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.
Module 4: Lecture 6

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. Block size, mapping functions, replacement algorithms, write policies.

Suggested books:


Suggested reference books:


Course outcomes

1. Draw the functional block diagram of a single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.
2. Write assembly language program for specified microprocessor for computing
3. 16 bit multiplication, division and I/O device interface (ADC, Control circuit, serial port communication).
4. Write a flowchart for Concurrent access to memory and cache coherency in Parallel Processors and describe the process.
5. Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.
6. Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology.
Objectives of the course

- To learn the concept of how to learn patterns and concept from data.
- Design and analyze various machine learning algorithms and their applications in recent trends.
- Evaluate the various factors of machine learning to measure the performance.
- Understand basic of machine learning’s application in recent trend of technology.

UNIT 1:
Introduction: Basic definitions, Linear Algebra, Statistical learning theory, types of learning, hypothesis space and Inductive bias, evaluation and cross validation, Optimization.

UNIT 2:
Statistical Decision Theory, Bayesian Learning (ML, MAP, Bayes estimates, Conjugate priors), Linear Regression, Ridge Regression, Lasso, Principal Component Analysis, Partial Least Squares

UNIT3:
Linear Classification, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Perceptron, Support Vector Machines + Kernels, Artificial Neural Networks + Back Propagation, Decision Trees, Bayes Optimal Classifier, Naive Bayes.

UNIT 4:
Hypothesis testing, Ensemble Methods, Bagging Adaboost Gradient Boosting, Clustering, K-means, K-medoids, Density-based Hierarchical, Spectral.

UNIT 5:
Expectation Maximization, GMMs, Learning theory Intro to Reinforcement Learning, Bayesian Networks.

Suggested books:
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin

Suggested Reference Books:
- The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman.
Objectives of the course

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
- To understand and use data manipulation language to query, update, and manage a database.
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Detailed contents

**Module 1:** Lecture 6

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

**Module 2:** Lecture 10

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

Relational database design: Domain and data dependency, Armstrong’s axioms, Normal forms, Dependency preservation, Lossless design.

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

**Module 3:** Lecture 4

Storage strategies: Indices, B-trees, hashing.
Module 4: Lecture 8

Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

Module 5: Lecture 6


Module 6: Lecture 6

Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Suggested books:

Suggested reference books

Course Outcomes
1. For a given query write relational algebra expressions for that query and optimize the developed expressions
2. For a given specification of the requirement design the databases using E R method and normalization.
3. For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.
4. For a given query optimize its execution using Query optimization algorithms
5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.
PCC-LT202 | Theory & Practices of preservation and pre tanning processes | 3L: 0T:3 P | 4.5 Credits

Module 1: Preservation of Hides and Skins (5 Hours)
Principles and practice involved in long and short term preservation techniques for hides and skin, Preservation, defects.

PRETANNING PROCESSES:
Module 2. Soaking (4 Hours)
Physico-chemical explanation of wetting, objectives materials, methods and different controls in soaking operation

Module 3: Liming (6 Hours)
Chemistry of Unhairing, Unhairing by different methods, Objectives of liming, Effects of liming in collagen, controls in liming operation to achieve different physical properties of leather.

Module 4: Deliming and Drenching (3 Hours)
Objectives, Principles and controls of deliming and drenching.

Module 5: Bating (5 Hours)
Chemistry of proteolytic enzymes used for bating, Necessity of bating, its necessity and controls for desired properties of leather.

Module 6: Pickling (4 Hours)
Acid binding capacity of collagen, use of organic acids or salts in pickling, its necessity and controls, concept of De-pickling.

Module 7: Degreasing (3 Hours)
Objectives and necessity of Degreasing, different degreasing systems and methods.

Module 8: Cleaner processing practices in beam house (10 Hours)
Salt free curing option, Sulfide free unhairing system, ammonia free deliming, salt free pickling system, eco friendly degreasing system, strategies to bring down BOD, COD and TDS of tannery effluents.
Text Books :-


<table>
<thead>
<tr>
<th>PCC-LT203</th>
<th>Biochemistry of protein</th>
<th>3L: 0T:0 P</th>
<th>3 Credits</th>
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</thead>
</table>

Module 1:
**Fundamentals of Biochemistry**
*(5Hours)*
The molecular logic of life, strong and weak interactions, introductory concept of cell, biomolecules and water.

Module 2: *(3Hours)*
Histology and fibre packing in commercially viable hides/skins.

Module 3:
**Amino acids, peptides and proteins** *(8Hours)*
Chemistry, Classification determination of amino acids, Qualitative and Quantitative determinations, Structure of Various amino acids, formation of peptides, polypeptides and separation of proteins, covalent structure of proteins, Reaction of Proteins with acid, bases and salts

Module 4: *(12Hours)*
Polarity of amino acids and ionization of proteins, electro-phoresis, hydration, solubility of proteins, dielectric properties, intermolecular forces of proteins cross linking in collagen, Isoelectric point of collagen and its manipulation in various stages of leather manufacture. Acid and base binding capacity of collagen, reversible and irreversible acid and base binding capacity of collagen, Effects of anions, swelling (osmotic and lyotropic) and phase transition in collagen, helix-coil transition, Denaturation and melting of collagen. Glass transition of collagen, Shrinkage denaturation and optical birefringence of collagen.
Module 5: (9 Hours)
Structure, function and chemical features of collagen reactive groups and Cross linking, Tropo collagen molecules, Sub-units of collagen, Types of collagen, Structure and function, Fibril formation, Precipitated forms of collagen, Electron microscopy of the collagen fibre, Bio-Synthesis.

Module 6: (6 Hours)
Structure and functional role of other skin proteins like keratin, Reticelain and Elastic, albumin, globulin and mucine etc.

Text Book/Reference
5. Hames, B.D., Hooper, N.M. and Houghton, J.D. (1999), Instant notes on Biochemistry,Viva Books Pvt. Ltd. N.D.

<table>
<thead>
<tr>
<th>PCC-LT204</th>
<th>Chemical Engineering – I</th>
<th>3L: 0T:0P</th>
<th>3.0 Credits</th>
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</table>

Module 1: (8 hours)
Introduction to process fluid mechanics; Fundamental concepts: Definition of a fluid; Continuum hypothesis; Velocity field; Stress field; Newtonian and non-Newtonian fluids, Fluid statics: pressure variation in a static fluid, hydrostatic forces on submerged surfaces, buoyancy. Manometers.

Module 2: (8 hours)
Macroscopic Balances: derivation of integral balances for mass, energy and momentum; Derivation of engineering Bernoulli equation with losses, Application of macroscopic balances: Losses in expansion. Flow measurement: Orifice meter, venturi meter, Pitot tube, and Rotameter.

**Module 3:**

Differential balances of fluid flow: derivation of continuity and momentum (Navier-Stokes) equations for a Newtonian fluid, Boundary layer theory, Pipe flows and fittings: laminar and turbulent flows; friction factor charts, losses in fittings, Fluid transportation: Valves and Pumps and Compressors.

**Module 4:**

Flow through packed and fluidized beds: Flow through beds of solids, motion of particles through the fluid, Particle settling, Fluidization, minimum fluidization velocity, Mixing and Agitation- power consumption, mixing times, scale up

**Module 5:**

Filtration: Governing equations, constant pressure operation, constant flow operation, cycle time, types of filters. Centrifuges and Cyclones: Gravity settling, centrifugal separation, cyclones separations, separation efficiency, pressure loss,

**Text/References:**


<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>3L: 0T:03P</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>PCC-LT205</td>
<td>Analytical Chemistry of Leather</td>
<td>3L: 0T:03P</td>
<td>4.5</td>
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</tbody>
</table>

**Module 1.** Analysis of Lime

Principles underlying determination of following in lime

(a) Available lime

(b) Total based by titration method

(c) Iron by colorimetric method
Module 2. Analysis of Na$_2$S (02 hours)
Principles underlying analysis of Na$_2$S by official international method.

Module 3. (03 hours)
Analysis of lime liquors (Fresh & used)
Principles underlying determination of following in line liquor :-
(a) Total Alkalinity   (b) Total lime   (c) Total nitrogen
(d) Hide substance   (e) Amino acids

Module 4. Analysis of limed pelt (03 hours)
Principles underlying determination of following in limed pelt
(a) Total Alkalinity   (b) Total Ammonia   (c) Hide Substance

Module 5. (07 hour)
Analysis of Boric acid, Analysis of deliming agent (Ammonium chloride and Ammonium sulfate), Analysis of enzyme bates, Analysis of used pickle liquors for following – (a) Determination of acid, (b) Determination of salt, Analysis of Sodium formate

Module 6. (06 hour)
Analysis of Chrome liquor to determine- (a) Basic chromium, (b) Basicity of chrome liquor (c) Degree of Olation. Analysis of basic chromium sulfate for following :- (Power of Crystal) (a) Moisture (b) Chromium

Module 7. (06 hour)

Module 8. (03 hour)
Analysis of followings of Veg. tanned leather :- Moisture, ash, Water soluble matter, Solvent extractable substances and difference figure, Degree of tannage.

Module 9. (04 hour)

Module 10. (08 hour)
Analysis of followings of combined tanned leather :- Moisture, Ash, Solvent Extractable substances, Water soluble matter and difference figure, Chromic oxide content, Degree of
tannage. Analytical Chemistry of Post tanning and Finishing agent. Analysis of lipids for following:

(a) Acid value
(b) Saponification value by reflux method.
(c) Iodine value by Hanus method.
(d) Unsaponifiables by extraction method.
(e) Analysis of sulfated oils and ready made fat liquors.

Module 11. (04 hours)
Principles underlying examination and analysis of dyes used in leather manufacture. Principles underlying examination and analysis of readymade finishes and finishing materials used in leather manufacture.

Texts/References:
4. Different standards issued by BIS from time to time.

<table>
<thead>
<tr>
<th>PCC-LT206</th>
<th>Principles of Inorganic tanning</th>
<th>3L: 0T:03P</th>
<th>4.5 Credits</th>
</tr>
</thead>
</table>

Module 1. Tanning (10 hours)
Theory, Chemistry, Factors and objectives of following inorganic tanning operations :- (a) Chrome Tannage (b) Aluminum Tannage (c) Iron Tannage (d) Zirconium Tannage (e) Titanium Tannage (f) Poly Phosphate Tannage and (g) Silica Tannage.

Module 2. Introduction to Co-ordination Chemistry, metal ion in tanning (10 hours)
Historical introduction to mineral tanning, Introduction of factors controlling molecular stability of transition metal complexes, Werner’s theory of Co-ordination, Role of d and f orbitals, Definition of ligands, Ligand Bond in Collage, Chelation, Masking agent :- Their requirement for use in chrome tanning, Effect of masking on chrome tanned leather & as chrome liquor.

Module 3. Aqueous Chemistry of Chromium (07 hours)
Electric configuration, common oxidation states of chromium, stabilities of Chromium (IV) and Chromium (III) salt, Basicity, Olation, Oxolation and polymerization, complexity of chrome complexes.
Module 4. Factor Controlling Chrome tanning (07hours)
Single and double bath chrome tannage and their relative merits and demerits, preparation of
Basic chromium sulphate salt, Effects of float Volume, PH, basicity, Masking temperature,
Drum speed, ageing chrome tanned substrate.

Module 5. Mechanism of chrome tanning (07hours)
Theories of chrome tanning, Absorption, Coating, Electrostatic and hydrogen bond
interaction and co-ordinative forces involved in chrome tanning, hydro thermal stability of
chrome-collagen compound.

Texts/References:

   ILTA, Kolkata
2. Theory & Practice of Leather Manufacture. By – K. T. Sarkar, Macmillan India Press,
   Chennai.

Electrical & Electronics Engineering
IV Semester
Branch Code – 110

PCC-EEE06 | Analog Electronic Circuits | 3L:0T:0P | 3 credits
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Course Outcomes:
At the end of this course, students will demonstrate the ability to
- Understand the characteristics of transistors.
- Design and analyze various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Module 1: Diode circuits (4 Hours)
P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers,
Zener diodes, clamping and clipping circuits.

Module 2: BJT circuits (8 Hours)
Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal
model, biasing circuits, current mirror; common-emitter, common-base and common-collector
amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits
Module 3: MOSFET circuits (8 Hours)
MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: smallsignal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 4: Differential, multi-stage and operational amplifiers (8 Hours)
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product), Frequency Response of the amplifier.

Module 5: Linear applications of op-amp (8 Hours)

Module 6: Nonlinear applications of op-amp (6 Hours)
Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Text/References:

PCC-EEE07: Analog Electronic Circuits Laboratory (0:0:2 – 1 credit)
Hands-on experiments related to the course contents of PCC-EEE06.

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<tr>
<th>Course Code</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>PCC-EEE08</td>
<td>Electrical Machines – II</td>
<td>3L:0T:0P</td>
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</table>

Course Outcomes:

At the end of this course, students will demonstrate the ability to
- Understand the concepts of rotating magnetic fields.
- Understand the operation of ac machines.
- Analyse performance characteristics of ac machines.
Module 1: Fundamentals of AC machine windings (8 Hours)
Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module 2: Pulsating and revolving magnetic fields (4 Hours)
Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module 3: Induction Machines (12 Hours)

Module 4: Single-phase induction motors (6 Hours)
Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module 5: Synchronous machines (10 Hours)
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/References:

PCC-EEE09: Electrical Machines Laboratory– II (0:0:2 – 1 credit)
Hands-on experiments related to the course contents of PCC-EEE08.
Course Outcomes:

At the end of this course, students will demonstrate the ability to
- Do assembly language programming.
- Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
- Develop systems using different microcontrollers.

Module 1: Fundamentals of Microprocessors: (7 Hours)

Module 2: The 8051 Architecture (8 Hours)
Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Module 3: Instruction Set and Programming (8 Hours)

Module 4: Memory and I/O Interfacing (6 Hours):
Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.

Module 5: External Communication Interface (6 Hours)
Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Module 6: Applications (6 Hours)
LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

Text / References:

**PCC-EEE11: Digital & Microprocessor Laboratory (0:0:2– 1 credit)**

Hands-on experiments related to the course contents of PCC-EEE02 & PCC-EEE10.

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**PCC-EEE12  Signals and Systems  2L:1T:0P  3 credits**

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understand the concepts of continuous time and discrete time systems.
- Analyse systems in complex frequency domain.
- Understand sampling theorem and its implications.

**Module 1: Introduction to Signals and Systems (3 hours):**

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

**Module 2: Behavior of continuous and discrete-time LTI systems (8 hours)**


**Module 3: Fourier, Laplace and z- Transforms (10 hours)**

Module 4: Sampling and Reconstruction (4 hours)

Text/References:

Module 1: Basic Probability (12 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Module 2: Continuous Probability Distributions (4 hours)
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3: Bivariate Distributions (4 hours)
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Basic Statistics (8 hours)
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Module 5: Applied Statistics (8 hours)
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.
Module 6: Small samples (4 hours)

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Text / References:

Module 1: Introduction (2 hours)

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2: Classification (3 hours)

Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure-prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitatata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3: Genetics (4 hours)

Purpose: To convey that “Genetics is to biology what Newton's laws are to Physical Sciences”. Mendel’s laws, Concept of segregation and independent assortment. Concept of allele.
Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4: Biomolecules (4 hours)
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5: Enzymes (4 Hours)
Purpose: To convey that without catalysis life would not have existed on earth.

Module 6: Information Transfer (4 hours)

Module 7: Macromolecular analysis (5 hours)
Purpose: To analyse biological processes at the reductionistic level. Proteins— structure and function. hierarchy in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8: Metabolism (4 hours)
Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of $K_{eq}$ and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO$_2$ + H$_2$O (Glycolysis and Krebs cycle) and synthesis of glucose from CO$_2$ and H$_2$O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Module 9. Microbiology (3 hours)

Text / References:
Course Outcomes
After studying the course, the student will be able to:

- Describe how biological observations of 18th Century that lead to major discoveries.
- Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological.
- Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring.
- Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine.
- Classify enzymes and distinguish between different mechanisms of enzyme action.
- Identify DNA as a genetic material in the molecular basis of information transfer.
- Analyse biological processes at the reductionistic level.
- Apply thermodynamic principles to biological systems.
- Identify and classify microorganisms.