IV SEMESTER
Branch/Course Civil Engineering (101)

sr. no.	CODE	Course Title	L	T	P		Credit
1		Mechanical Engineering	2	1	0		3
2		Engineering Geology	2	0	2		3
3		Disaster Preparedness & Planning	1	1	0		2
4		Introduction to Fluid Mechanics	3	0	2		4
5		Introduction to Solid Mechanics	3	0	0		3
6		Structural Analysis	3	1	0		4
7		Materials, Testing & Evaluation	1	1	2		3
8		Civil Engineering - Societal & Global Impact	2	0	0		2
9		Open Elective-I (Humanities) MOOC	2	0	0		2
10		Management I (Organizational Behaviour)	3	0	0		0
			TOTAL				26

IV SEMESTER
Branch/Course: Mechanical Engineering (102)

sr. no.	CODE	Course Title	L	T	P	H	Credit
1		Fluid Mechanics	3	0	3	6	4.5
2		Applied Thermodynamics	3	1	0	4	4
3		Strength of Materials	3	0	3	6	4.5
4		Engineering Materials	3	0	0	4	4
5		Instrumentation & Control	3	0	0	4	4
6		Environmental Science	2	-	-	2	0
7		From Mechanical Engineering	8 weeks				2
8		Professional Courses (Spoken Tutorial, KYP, etc.)	9				0
			TOTAL				23

103 – ELECTRICAL ENGINEERING
Semester IV [Second year] Branch/Course: Electrical Engineering

sr. no.	CODE	Course Title	L	T	P	H	Credit
1		Digital Electronics	3	0	0	3	3
2		Digital Electronics Laboratory	0	0	2	2	1
3		Electrical Machines – II	4	0	0	4	4
4		Electrical Machines Laboratory - II	0	0	2	2	1
5		Electrical and Electronics Measurement	3	0	0	3	3
6		Electrical and Electronics Measurement laboratory	0	0	2	2	1
7		Signals and Systems	2	1	0	3	3

8		Mathematics – III (Probability and Statistics)	3	1	0	4	4
9		Biology-I	2	1	0	3	3
10		Essence of Indian Knowledge Tradition/Indian Constitution				4	0
			TOTAL				23

104 – ELECTRONICS & COMMMUNICATION ENGINEERING

Semester IV [Second year] Branch/Course Electronics & Communication Engineering

sr. no.	CODE	Course Title	L	T	P	H	Credit
1		Digital Circuits	3	1	0	4	4
2		Digital Circuits Lab	0	0	2	2	1
3		Analog Circuits	3	0	0	3	3
4		Analog Circuits Lab	0	0	2	2	1
5		Semiconductor Physics and Devices	3	0	0	3	3
6		Semiconductor Physics and Devices Lab	0	0	2	2	1
7		Analog Communication	3	0	0	3	3
8		Analog Communication Lab	0	0	2	2	1
9		Electromagnetic Theory	3	1	0	4	4
10		OpenElective-1 / MOOC/SWAYAM Courses	3	0	0	3	2
11		Stress Management by Yoga (Non-Credit)	2	0	0	2	0
			TOTAL				23

105 – COMPUTER SCIENCE & ENGINEERING

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

sr. no.	CODE	Course Title	L	T	P	H	Credit
1		Discrete Mathematics	3	1	0		4
2		Computer Organization & Architecture	3	0	4		5
3		Operating Systems	3	0	4		5
4		Design & Analysis of Algorithms	3	0	4		5
5		Digital Electronics	3	0	4		5
6		Human Resource Development and Organizational Behavior	3	0	0		3
7		Environmental Science	3	0	0		0
			TOTAL				27

106 – INFORMATION TECHNOLOGY

Semester IV [Second year] Branch/Course: INFORMATION TECHNOLOGY

sr. no.	CODE	Course Title	L	T	P	H	Credit
1		Formal Language & Automata Theory	3	1	0		4
2		Computer Organization & Architecture	3	0	4		5
3		Machine Learning	3	0	4		5
4		Database management System	3	0	4		5
5		Management I(Organizational Behavior/ Finance & Accounting)	3	0	0		3
6		Environmental Science	-	-	-		0
7							
			TOTAL				22

107 – LEATHER TECHNOLOGY

Semester IV [Second year] Branch/Course: LEATHER TECHNOLOGY

sr. no.	**CODE**	**Course Title**	**L**	**T**	**P**	**H**	**Credit**
1		Theory & Practices of preservation and pre tanning processes	3	0	3	6	4.5
2		Biochemistry of protein	3	0	0	3	3
3		Chemical Engineering – I	3	0	0	3	3
4		Analytical Chemistry of Leather	3	0	3	6	4.5
5		Principles of Inorganic Tannage	3	0	0	3	3
6		Open Elective-I (MOOC)	2	0	0		2
7		Environmental Science	-	-	-	-	0
			TOTAL				20

110 – Electrical & Electronics Engineering

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

sr. no.	CODE	Course Title	L	T	P	H	Credit
1		Analog Electronics	3	0	0	3	3
2		Analog Electronics Laboratory	0	0	2	2	1
3		Electrical Machines – II	3	0	0	3	3
4		Electrical Machines Laboratory- II	0	0	2	2	1
5		Microprocessors	3	0	0	3	3
6		Digital Electronics and Microprocessor Laboratory	0	0	2	2	1
7		Signals and Systems	2	1	0	3	3

8		Mathematics–III (Probability and Statistics)	3	1	0	4	4
9		Biology-I	2	1	0	3	3
10		HSMC Elective Courses	3	0	0	3	3
11		Environmental Science	3	0	0	3	0
12		Capstone Design Project	3	0	0	3	0
13		NCC/ NSS/ other Clubs & Society Activity/ Sports	3	0	0	3	0
			TOTAL				25

CIVIL ENGINEERING

IV SEMESTER

Branch Code - 101

ESC209	**Mechanical Engineering**	**2L:1T:0P**	**3 credits**

Module 1: Basic Concepts- Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases.

Module 2: First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady- Flow

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 4: Properties Of Pure Substance- Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.

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.

Module 6: Ideal and Real Gases and Thermodynamic Relations- Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's law of partial pressure. Exact differentials, T-D relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient.

Module 7: Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour-compression refrigeration cycle, actual vapor-compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.

Text/Reference Books:

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi.
2. Cengel, Thermodynamics – An Engineering Approach *Tata McGraw Hill, New* Delhi. Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. Fundamentals of thermodynamics: Wiley.
3. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of Engineering
4. Thermodynamics: John Wiley & Sons.
5. Jones, J. B., & Dugan, R. E. Engineering thermodynamics: Prentice Hall.
6. Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill.

PCC-CE202	**Engineering Geology**	**2L:0T:2P**	**3 credits**

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 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 2: Petrology-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

Module3: Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

Module 4: Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Module 5: Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

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 9nvestigations 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.
5. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte.
6. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties , Laterite, Limestone and its varieties, Shales and its varieties.
7. Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
8. Study of topographical features from Geological maps. Identification of symbols in maps.

Text/Reference Books:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.

Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

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 vi) To understand Impacts of Disasters 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 non-structural 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)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003

Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

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.

Module5: Laminar Flow-Laminar flow through :circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity

Module6: 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 ReynoldsNumber, Froude Number, MachNumber, Weber *Number and EulerNumber.*

Module7: 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

Module8: 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

7. Orifice meter
8. Impacts of jets
9. Flow Visualisation -Ideal Flow
10. Length of establishment of flow
11. Velocity distribution in pipes
12. Laminar Flow

Text/Reference Books:

1. Fluid Mechanics and Machinery, C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

PCC-CE205	Introduction to Solid Mechanics	3L:0T:0P	3 credits

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

Module1: *Simple Stresses and Strains*- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.

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 4: *Flexural Stresses-Theory of simple bending* – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

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:

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.

Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

PCC-CE208	Structural Analysis	3L:1T:0P	4 credits

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 ant symmetry, sway correction, Lateral load analysis: Portal and Cantilever methods, Matrix method of structural analysis, Displacement/Stiffness methods.

Text books:

1. C.S. Reddy, Basic Structural Analysis, Second Edition, Tata McGraw Hill, 2005.
2. R.C. Hibbeler, Structural Analysis, Pearson Education, 6th edition, 2009.
3. C.K. Wang, Intermediate Structural Analysis, Tata McGraw Hill, 1984.

PCC-CE207	Materials, Testing & Evaluation	1L:1T:2P	3 credits

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 – fundaments 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.

Tutorials *from the above modules covering*, understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.

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:

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition
3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materialsused for Civil Engineering applications
4. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
5. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition
6. American Society for Testing and Materials (ASTM), *Annual Book of ASTM Standards* (post 2000)
7. Related papers published in international journals

HSMC252	**Civil Engineering – Societal & Global Impact**	**2L:0T:0P**	**2 credits**

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)

S. No.	Module	No of Lectures	Details
1	Introduction	3	
2	Understanding the Importance of Civil Engineering	3	
3	Infrastructure	8	
4	Environment	7	
5	Built Environment	5	
6	Civil Engineering Projects	4	
	TOTAL	**30**	

Text/Reference Books:

1. *Žiga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht

2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition

3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
7. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
8. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130
9. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.
10. Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE Engineering Sustainability 163. June Issue ES2 p61-63
11. Brown R R., Ashley R M., Farrelly M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research**.** Water Resources Management. Vol. 23, No.4. European Water Resources Association (EWRA) ISSN 0920-4741.

12. Brugnach M., Dewulf A., Pahl-Wostl C., Taillieu T. (2008) Toward a relational concept of uncertainty: about knowing too little, knowing too differently and accepting not to know. Ecology and Society 13 (2): 30
13. Butler D., Davies J. (2011). Urban Drainage. Spon. 3rd Ed.

14. Cavill S., Sohail M. (2003) Accountability in the provision of urban services. Proc. ICE. Municipal Engineer 156. Issue ME4 paper 13445, p235-244.
15. Centre for Water Sensitive Cities (2012) Blueprint for a water sensitive city. Monash University.
16. Charles J A. (2009) Robert Rawlinson and the UK public health revolution. Proc ICE Eng History and Heritage. 162 Nov. Issue EH4. p 199-206

Mechanical Engineering

IV Semester

Branch Code - 102

PCC-ME 203	Fluid Mechanics	3L:0T:3P	4.5 Credits

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 **(8 lectures)**

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 **(4 lectures)**

Kinematics of fluid flow: Generalized continuity equation, Irrotational motion and solution to Laplace equation. Concept of stream lines, Equipotential Lines, Flow Nets.

Module: 3 **(6 lectures)**

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

Module: 4 **(4 lectures)**

Concept of boundary layer, boundary layer thickness, Displacement thickness, momentum thickness, energy thickness.

Module: 5 **(8 lectures)**

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 **(6 lectures)**

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

Module: 7 **(6 lectures)**

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

Text Books:

1. Frank M. White, Fluid Mechanics (Sixth Edition), Tata McGraw-Hill, New Delhi (2008).
2. J. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall (1999).
3. Som and Biswas; Fluid Mechanics and machinery; TMH

4. Cengal; Fluid Mechanics; TMH
5. Modi & Seth; Fluid Mechanics; Standard Book House, Delhi

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.

PCC-ME 204	Applied Thermodynamics	3L:1T:0P	4 credits

Objectives:

1. To learn about of I 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 the about reciprocating compressors with and without intercooling
6. To analyze the performance of steam turbines

Contents:

Module 1: **(8 lectures)**

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysisof combustion reactions. Heat calculations using enthalpy tables. Adiabatic flame temperature. Chemical equilibrium and equilibrium composition calculations using free energy.

Module 2: **(10 lectures)**

Thermodynamic cycles, Gas power cycles: Air standard Otto, Diesel and Dual Cycles. Air standard Brayton cycle, effect of reheat, regeneration and intercooling. Combined gas and vapor power cycles. Vapor compression refrigeration cycles cycle and comparison with Carnot cycle, refrigerants and their properties.

Module 3: **(6 lectures)**

Vapor power cycles: Basic Rankine cycle, Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super- critical and ultra-super-critical Rankine cycle.

Module 4: **(8 lectures)**

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation-compressible flow in diffusers, efficiency of nozzle and diffuser.

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:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley andSons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley andSons.
4. Nag, P. K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd

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.

PCC-ME 205	Strength of Materials	3L:0T:3P	4.5 credits

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 **(8 lectures)**

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 **(8 lectures)**

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 **(8 lectures)**

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 **(8 lectures)**

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 **(8 lectures)**

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:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi,2001.
2. R. Subramanian, Strength of Materials, Oxford University Press,2007.
3. Ferdinand P. Been, Russel Johnson Jr. and John J. Dewole, Mechanics of Materials, Tata GrawHill Publishing Co. Ltd., New Delhi2005.

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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PCC-ME 206	**Engineering Materials**	**3L:1T:0P**	**4 Credits**

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 microstrctural 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)**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves, T-T-T diagram and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

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 cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.

Text Books:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

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

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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
2. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York, 1999.

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.

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 (7Hours)

Digitalsignals,digitalcircuits,AND,OR,NOT,NAND,NORandExclusive-ORoperations,Boolean algebra,examplesofICgates,numbersystems-binary,signedbinary,octalhexadecimalnumber,binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, 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, Sub tractors, BCD arithmetic, carry look ahead adder, serialadder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method off unction 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 andD-typesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialtoparallel 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 lCs, 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,specificationsofA/Dconverters, 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), 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:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.

PCC-EE09: Digital Electronics Laboratory (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of EE07.

PCC-EE10	**Electrical Machines – II**	**4L:0T:0P**	**4 credits**

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 acmachines.
- Analyse performance characteristics of acmachines.

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, Additionofpulsatingmagneticfields,Threewindingsspatiallyshiftedby120degrees(carryingthree-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

Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Blocked rotor test, No- Load test, Determination of Parameters and power flow diagram. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

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 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:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education,2013.
2. M. G. Say, “Performance and design of AC machines”, CBS Publishers,2002.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers,2011.
4. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education,2010.
5. A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education,1984.
6. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons,2007.

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.

Standards of Measurement: Classification of Standards, Electrical Standards, IEEE Standards. Types of measuring instrument: Ammeter and Voltmeter: Derivation for Deflecting Torque of; PMMC, MI (attraction and repulsion types), Electro Dynamometer and Induction type Ammetersand Voltmeters. Energy meters and wattmeter.: Construction, Theory and Principle of operation of Electro-Dynamometer and Induction type wattmeter, compensation, creep, error, testing, Single Phase and Poly phase Induction type Watt-hour meters. Frequency Meters: Vibrating reed type, electrical resonance type, Power Factor Meters.

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

Resistance: Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Portable Resistance Testing set (Megohmmeter), Measurement of Insulation Resistance when Power is ON, Measurement of Resistance of Earth Connections. Inductance: Measurement of Self Inductance by Ammeter and Voltmeter, and AC Bridges(Maxwell's, Hay's, & Anderson Bridge), Measurement of Mutual Inductance by Felici's Method, and as Self Inductance. Capacitance: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen's, Schering & Wien's Bridge), Screening of Bridge Components and Wagnor Earthing Device.

Module 3: (8 Hrs)

Galvanometer: (5 Hrs) Construction, Theory and Principle of operation of D'Arsonval, Vibration(Moving Magnet & Moving Coil types), and Ballistic Galvanometer, Influence of Resistance on Damping, Logarithmic decrement, Calibration of Galvanometers, Galvanometer Constants, Measurement of Flux and Magnetic Field by using Galvanometers. Potentiometer: Construction, Theory and Principle of operation of DC Potentiometers(Crompton, Vernier, Constant Resistance, & Deflection Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer).

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:

1. Electrical Measurements and Measuring Instruments – Golding & Widdis – 5th Edition, Reem Publication.
2. Modern Electronic Instrumentation and Measurement Techniques – Helfrick & Cooper – Pearson Education.
3. A Course in Electrical and Electronic Measurements and Instrumentation – A K Sawhney – Dhanpat Rai & Co.
4. Electronic Instrumentation – H C Kalsi – 2nd Edition, Tata McGraw Hill.
5. Electronic Measurement and Instrumentation – Oliver & Cage – Tata McGraw Hill.

PCC-EE13	Electrical and Electronic Measurement Laboratory	2L:0T:2P	3 credits

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:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Experiments

1. Measurement of a batch of resistors and estimating statistical parameters.
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.
4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DS of orsteadystateperiodicwaveformsproducedbyafunctiongenerator.Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
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.
9. Current Measurement using Shunt, CT, and Hall Sensor.

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.
- 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)

Impulse response and step response, convolution, input-output behavior with a periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

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)

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text/References:

1. A. V. Oppenheim, A. S. Willskyand S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

Electronics & Communication Engineering
IV Semester
Branch Code – 104

EC104	Digital Circuits	3L:1T:0P	3 Credits

Sl. No.	Contents	Contact Hours
1	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.	5
2	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.	5
3	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	6
4	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	10
5	Timing circuit : Multivibrators, Monostable and Astable timer: LM555	4
6	Integrated circuit logic families : RTL, DTL, TTL, CMOS, IIL/I2L (Integrated Injection logic and Emitter Coupled logic).	5
7	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.	5
	Total	40

Sl. No.	Name of Authors / Books /Publishers
1	"Digital Fundamentals", Floyd and Jain., Pearson
2	"Digital Logic and Computer Design", M.Morris Mano, Pearson
3	"Fundamentals of Digital Circuits", A.Anand Kumar, PHI
4	"Digital Systems", Ronald J.Tocci, Neal S.Widmer, Pearson

Digital Circuits and Systems Lab are according to the theory mentioned above.	**0L: 0T: 2P**	**1 Credit**

EC105	Analog Circuits	3L:0T:0P	3 Credits

Sl. No.	Contents	Contact Hours
1	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).	7
2	Multistage Amplifiers : Cascade and Cascode amplifiers, Calculations of gain, impedance and bandwidth. Design of multistage amplifiers. Feedback Amplifiers: Feedback concept, Classification of Feedback amplifiers, Properties of negative Feedback amplifiers, Impedance considerations in different configurations. Analysis of feedback Amplifiers.	11
3	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).	7
4	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.	8
5	Power Amplifiers : Power dissipations in transistors, Amplifiers Classification, (Class-A, Class-B, Class-C, Class-AB) Efficiency analysis, Push-Pull and Complementary Push-pull amplifiers, Cross over distortion and Harmonic distortion in Push-Pull amplifier. Tuned amplifiers (single, double and stagger tuned amplifier).	6
	Total	40

Sl. No.	Name of Authors / Books /Publishers
1	"Electronic Devices and Circuit Theory", Boylestad and Nashelsky, PEARSON PUBLICATION.
2	"Electronic devices and circuits", Salivahanan, Suresh Kumar, Vallavaraj, TMH, 1999
3	"Integrated Electronics, Analog and Digital Circuits and Systems", J. Millman and Halkias, TMH, 2000
4	"Micro Electronic Circuits", Sedra and Smith, Oxford University Press, 2000
5	"Electronic Devices and Circuits", David A Bell, Oxford University Press, 2000

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

EC106	Semiconductor Physics and Devices	3L:0T:0P	3 Credits

Sl. No.	Contents	Contact Hours
1	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.	10
2	PN Junction Diode : Step junction, Built-in potential, Depletion width, Depletion Approximation, Electrostatic relationship (Charge density, Depletion width, Potential, Electric field) for Va = 0, Va ¡ 0 and Va ¿ 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.	10
3	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.	6
4	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)	6
5	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.	8
	Total	40

Sl. No.	Name of Authors / Books /Publishers
1	"Semiconductor Device Fundamentals", by R. F. Pierret, Addison-Wesley publishing company, 1996
2	"Semiconductor Physics and Devices: Basic Principles", by Donald A. Neamen, 3rd Edition, 2003
3	"Physics of Semiconductor Devices" S. M. Sze, 2nd edition, 1981

Semiconductor Physics Lab are according to the theory mentioned above.	**0L: 0T: 2P**	**1 Credit**

EC107	Analog Communication	3L:0T:0P	3 Credits

Sl. No.	Contents	Contact Hours
1	Introduction to the communication system : Block diagram of communication system and comparative study of analog and digital communication.	3
2	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)]	7
3	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.	8
4	Superhetrodyne Receivers : Characteristics , Intermediate Frequency and its advantages, image rejection of the Receiver.	5
5	Generation of FM signals(direct and indirect methods) and Demodulation.	5
6	Noise: Different types of Noise, SNR in AM, FM and PM System and use of emphasis Circuit in FM for SNR optimization.	4
7	Analog pulse modulation : PAM, PWM, PPM and demodulation; comparative study of various analog pulse modulation	8
	Total	40

Sl. No.	Name of Authors / Books /Publishers
1	“Electronic Communication system”, by Kennedy. TMH.
2	“Communication system”, by Haykin, Wiley
3	“Communication system”, by Bruce carison . TMH.
4	“Modern Digital And Analog Communication”, B.P.LATHI Oxford

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

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

Sl. No.	Contents	Contact Hours
1	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.	10
2	Magnetostatics : Biot-Savart law, Ampere’s circuital law, Curl, Stoke’s theorem, Magnetic flux and magnetic flux density, Energy stored in magnetic field, Ampere’s force law, Magnetic vector potential, Analogy between electric and magnetic field.	6

3	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	10
4	Reflections and Refractions : Reflection by a perfect conductor with normal as well as oblique incidence. Reflection and refraction by perfect dielectrics with normal and oblique incidence. Surface impedance. Poynting vector : Poynting theorem, Instantaneous, Average and Complex Poynting vector, Power loss in a plane conductor.	8
5	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).	8
	Total	40

Sl. No.	Name of Authors / Books /Publishers
1	"Time-harmonic Electromagnetic Fields", R. F. Harrington, Wiley-IEEE Press, 2001
2	"Fields and Waves in Communication Electronics", Ramo, S., Whinnery, J.R., and Van Duzer, T., 3rd Ed., John Wiley and Sons, 1994
3	"Advanced Engineering Electromagnetics", Balanis, C.E., Wiley India Pvt. Ltd., Reprint, 2008
4	"Microwave Engineering", Pozar, D.M., 3rd Ed., John Wiley and Sons, 2004

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.**

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Module 2 **Lecture 8 hrs.**

Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

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

Module 3 **Lecture 8 hrs.**

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. **Proof Techniques:** Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

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 Algebraand 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:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw –Hill
2. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Wadsworth Publishing Co.Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw –Hill.

Suggested reference books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMGEdition,TataMcgraw-Hill
2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schaum's Outlines Series, Seymour Lipschutz, MarcLipson,
3. Discrete Mathematics, Tata McGraw -Hill

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.

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

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 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 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:

1. “Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

2. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

Suggested reference books:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill

2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

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.

PCC CS 402P	**Computer Organization & Architecture Lab**

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

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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.**

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module 2 **Lecture 10 hrs.**

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.

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.**

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer - Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Shared Memory, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

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:

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating Systems: Design and Implementation 3rd Edition, 3rd Edition, Andrew S. Tanenbaum

Suggested reference books:

1. Modern Operating Systems, 4th Edition, Andrew S. Tanenbaum
2. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing

3. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley

4. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India

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:

1. Understand algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.
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.

PCC CS 403P	**Operating Systems Lab**

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.**

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

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.**

Overview of Brute-Force, GreedyProgramming, Dynamic Programming, Branch- and-Bound and Backtrackingmethodologies. Greedy paradigm examples of exact optimization solution: Minimum Cost Spanning Tree, Knapsack problem, Job Sequencing Problem, Huffman Coding, Single source shortest path problem.

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:

1. Introduction to Algorithms, 4th Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MITPress/McGraw-Hill.
2. Horowitz & Sahani, "Fundamental of Computer Algorithm", Galgotia.
3. Basse, "Computer Algorithms: Introduction to Design & Analysis", Addision Wesley.

Suggested reference books

1. Algorithm Design, 1st Edition, Jon Kleinberg and Éva Tardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms—A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

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.

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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 lCs, 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-2RLadder D/A converter, specifications for D/A converters, examples of D/A converter lCs, 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:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

ESC 401P	**Digital Electronics Lab**

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

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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 andRecruitment: 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.**

Performance Management System: Definition, Concepts and Ethics-Different methods of Performance Appraisal- Rating Errors Competency management. Industrial Relations : Factors influencing industrial relations - State Interventions and Legal Framework - Role of Trade unions - Collective Bargaining - Workers; participation in management.

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.**

Leadership: Definition, Importance, Theories of Leadership Styles. Organizational Politics: Definition, Factors contributing to Political Behavior. Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation - Bargaining Strategies, Negotiation Process.

Suggested books:

1. Gary Dessler, "Human Resource Management" - (8th ed.,) Pearson Education, Delhi.
2. Robbins, S.P., Judge &T.A., "Organizational Behavior", Pearson Education, 15th Edn.

Suggested reference books:

1. Decenzo& Robbins, Personnel Human Resource Management, 3rd ed., John Wiley & Sons (Pvt.) Ltd.
2. BiswajeetPatanayak, Human Resource Management, PHI, New Delhi
3. Luis R. Gomez, Mejia, Balkin and Cardy, Managing Human Resources PHI, New Delhi
4. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.
5. Shukla, Madhukar: Understanding Organizations - Organizational Theory & Practice in India, PHI

MC 401	Environmental Science	3L : 0T : 0P	0 Credits (Mandatory non-credit course)

We as human being 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 type 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

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Information Technology
IV Semester
Branch code 106

PCC CS 502	**Formal Language & Automata Theory**	**3L: 1T:0 P**	**4 Credits**

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 andlanguages 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

- John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Suggested reference books:

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson EducationAsia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and the Theory of Computation, Tata McGraw Hill.

Course Outcomes:

After the completion of course, students can able to 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.

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PCC-IT402	Computer Organization & Architecture	3L:0T:4P	5 Credits

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**

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**

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:

- "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
- "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

Suggested reference books:

- "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
- "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
- "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

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.

PCC-IT403	Machine Learning	3L: 1T:0 P	4 Credits
Pre-requisites	PCC-CS 504		

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:

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin

Suggested Reference Books:

- J. Shavlik and T. Dietterich (Ed), Readings in Machine Learning, Morgan Kaufmann, 1990.
- P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
- Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017. [SS-2017]
- The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman.

Second Edition. 2009. [TH-2009]

PCC-IT404	**Database Management Systems**	**3L:0T:4 P**	**5 Credits**
Pre-requisites	**PCC-CS 403**		

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**

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

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:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill

Suggested reference books

2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education
4. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

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.

Leather Technology
IV Semester
Branch Code - 107

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 (6Hours)

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 :-

1. Introduction to the Principles of Leather Manufacture. By – S. S. Dutta, 4th Edition, ILTA, Kolkata.
2. Chemistry & Technology of Leather. By – Roddy, O' Flahorty&Lollar, Vol – 2 &3, Robert E. Kreiger. Publishing Co., N.Y.
3. Theory & Practice of Leather Manufacture. By – K. T. Sarkar, Macmillan India Press, Chennai.
4. Fundamentals of Leather Manufacture. By- EckentHidem
5. Chemistry of Tanning Processes. By – K. H. Gustavson, Academic Press, N.Y.

PCC-LT203	**Biochemistry of protein**	**3L: 0T:0 P**	**3 Credits**

Module 1:
Fundamentals of Biochemistry
(5Hours)

The molecular logic of life, strong and weak interactions, introductory concept of cell, bio-molecules 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, Iso-electric 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 birefrigence of collagen.

Module 5: **(9Hours)**

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 collegen, Electron microscopy of the collagen fibre, Bio-Synthesis.

Module 6: **(6Hours)**

Structure and functional role of other skin proteins like keratin, Reticelin and Elastic, albumin, globulin and mucine etc.

Text Book/Reference

1. Nelson, D.L. and Cox, M.M. (2000), Lehninger principles of biochemistry, 3rd Edn. WorthPublishers, N.Y.
2. Gilbert, F.G. (1997) Development Biology, 5th Edn. Sinauer Associates, Massachusetts.
3. Kleinsmith, L.J. and Kish, V.M. (1998), Principles of cell biology, Harpar& Row publishers,N.Y.
4. Gustavson, K.H. (1956), The chemistry and reactivity of collagen, Academic press, N.Y.
5. Hames, B.D., Hooper, N.M. and Houghton, J.D. (1999), Instant notes on Biochemistry,Viva Books Pvt. Ltd. N.D.
6. Turner, P.C., McLennan, A.G., Bates, A.D. and White, M.R.H. (1999), Instant notes onMolecular Biology, Viva Books Pvt. Ltd. N.D.
7. Elden, H.R. Biophysical properties of skins, vol.1 of treatise of skin, Wiley Interscienceadivn. of John Wiley & sons. N.Y.
8. Dutta, S.S. (2000), An introduction to the principles of leather manufacture, 4th Edn. Indian Leather Technologists Association, Calcutta

PCC-LT204	**Chemical Engineering – I**	**3L: 0T:0P**	**3.0 Credits**

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: **(10 hours)**

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 Pumpsand Compressors.

Module 4: **(8 hours)**

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: **(10 hours)**

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

Text/References:

1. Frank M. White, Fluid Mechanics (Sixth Edition), Tata McGraw-Hill, New Delhi (2008).
2. J. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall (1999).
3. W. L. McCabe, W. L. Smith, and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill International Edition (Sixth edition) (2001).
4. R. B. Bird, W. L. Stewart and E. L. Lightfoot, Transport Phenomena (Second edition),Wiley Singapore (2002).
5. M. M. Denn, Process Fluid Mechanics, Prentice Hall (1980).

PCC-LT205	**Analytical Chemistry of Leather**	**3L: 0T:03P**	**4.5 Credits**

Module 1. Analysis of Lime **(03 hours)**

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_2S **(02 hours)**

Principles underlying analysis of Na_2S 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)**

Analysis of acids & salts in vegetable tannin extracts by different methods. Analysis of Zirconium and Alum. Tanning agents. Analysis of Formaldehyde. Analysis of chrome tanned leather for following :-Moisture, ash, Chromic oxide content, Solvent extractable substances, Water soluble matter and difference figure.

Module 08. **(03 hour)**

Analysis of followings of Veg. tanned leather :-Moisture, ash, Water soluble matter, Solvent extractable substances and difference figure, Degree of tannage.

Module 09. **(04 hour)**

Analysis of followings of Alum. Tanned leather moisture, total ash, Solvent extractable substances, Aluminium as Alumina. Analysis of followings of Zirconium tanned leather:- Moisture, Ash, Solvent extractable substances, Zirconium content.

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. **(04hour)**

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:

1. Analytical Chemistry of leather manufacture - P. K. Sarkar, ILTA, Kolkata.
2. The Chemistry and Technology of leather – F – O Flaharty, Roddy, Lollar. Krieger Publishing Co. Florida USA.
3. Official methods of Analysis SLTC, U.K.
4. Different standards issued by BIS from time to time.

PCC-LT206	**Principles of Inorganic tanning**	**3L: 0T:03P**	**4.5 Credits**

Module 1. Tanning **(10hours)**

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 (10hours)

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 **(07hours)**

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, preperation 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:

1. Introduction to the Principles of Leather Manufacture. By – S. S. Dutta, 4th Edition, 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

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: 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), Frequency Response of the amplifier.

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, Feedback amplifiers and Oscillators design (Wein bridge and phase shift). Analog 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:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

PCC-EEE07: Analog Electronic Circuits Laboratory (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of PCC-EEE06.

PCC-EEE08	**Electrical Machines – II**	**3L:0T:0P**	**3 credits**

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 Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

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:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

PCC-EEE09:* *Electrical Machines Laboratory– II (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of PCC-EEE08.

PCC-EEE10	Microprocessors	3L:0T:0P	3 credits

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)

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

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)

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

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:

1. M . A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education,2009.

4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996
5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.

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

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

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)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

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

Fourier series representation of periodic signals, Waveform 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)

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text/References:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

BSC 401	**Mathematics-III (Probability and Statistics)**	**3L:1T:0P**	**4 credits**

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:

1. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
3. S. Ross, “A First Course in Probability”, Pearson Education India, 2002.
4. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 1968.
5. N.P. Bali and M. Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 2010.
6. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 2000.
7. T. Veerarajan, “Engineering Mathematics”, Tata McGraw-Hill, New Delhi, 2010.

	Biology-I	**2L:1T:0P**	**3 credits**

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 18^{th} 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) Habitata- 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 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.
Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6: Information Transfer (4 hours)

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 hours)

Purpose: To analyse biological processes at the reductionistic level. Proteins- structure and function. Hierarch 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_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Module 9. Microbiology (3 hours)

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Text / References:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.
3. D. L. Nelson and M. M. Cox, “Principles of Biochemistry”, W.H. Freeman and Company, 2012.
4. G. S. Stent and R. Calendar, “Molecular Genetics”, Freeman and company, 1978.

5. L. M. Prescott, J. P. Harley and C. A. Klein, “Microbiology”, McGraw Hill Higher Education, 2005.

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.
