Semester V (Third year]
Branch/Course Civil Engineering

V SEMESTER						
Branch/Course Civil Engineering - 101						
sr. no.	CODE	Course Title	L	T	P	Credit
1		Mechanics of Materials	3	0	0	3
2		Hydraulic Engineering	2	0	2	3
3		Analysis and Design of Concrete Structure	2	1	0	3
4		Geotechnical Engineering -I	3	0	2	4
5		Hydrology & Water Resources Engineering	2	0	2	3
6		Environmental Engineering -I	3	0	2	4
7		Transportation Engineering	3	0	2	4
8		Environmental Science	3	0	0	0
9		Summer Entrepreneurship-II	0	0	12	6
			TOTAL CREDIT			30

Semester V (Third year]
Branch/Course Mechanical Engineering

Semester V						
Branch/Course: Mechanical Engineering (102)						
sr. no.	CODE	Course Title	L	T	P	Credit
1		Heat Transfer	3	0	3	4.5
2		Fluid Machinery	3	0	3	4.5
3		Manufacturing Processes	3	0	3	4.5
4		Kinematics of Machine	3	1	0	4
5		Constitution of India/Essence of Indian Knowledge Tradition	3	0	0	0
6		Summer Entrepreneurship-II	0	0	12	6
7		Open Elective- I (MOOCs / SWAYAM / NPTEL Courses – 2)	3	0	0	3
8		Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0
			TOTAL			26.5

Semester V (Third year]
Branch/Course ELECTRICAL ENGINEERING

103 – ELECTRICAL ENGINEERING						
Semester V Branch/Course: Electrical Engineering						
sr. no.	**CODE**	**Course Title**	**L**	**T**	**P**	**Credit**
1		Power Systems–I (Apparatus and Modeling)	3	0	0	3
2		Power Systems Laboratory - I	0	0	2	1
3		Control Systems	3	0	0	3
4		Control Systems Laboratory	0	0	2	1
5		Microprocessors	3	0	0	3
6		Microprocessors Laboratory	0	0	2	1
7		Power Electronics	3	0	0	3
8		Power Electronics Laboratory	0	0	2	1
9		Program Elective - 1	3	0	0	3
10		OE-1(MOOC) MOOCs / SWAYAM / NPTEL Courses - 1	3	0	0	3
11		Summer Entrepreneurship-II	0	0	12	6
12		Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0
			TOTAL			33

Semester V (Third year]
Branch/Course Electronics & Communication Engineering

Semester V - 104, Electronics & Communication Engineering						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	EC109	Digital Signal Processing	3	0	0	3
2	EC109P	Digital Signal Processing Lab	0	0	2	1
3	EC110	Microprocessors and Microcontrollers	3	0	0	3
4	EC110P	Microprocessors and Microcontrollers Lab	0	0	2	1
5	EC111	Linear Control Systems	3	1	0	4
6	EC112	Linear Integrated Circuits and Applications	3	0	0	3
7	EC112P	Linear Integrated Circuits and Applications Lab	0	0	2	1
8	EC113	Probability Theory and Stochastic Processes	3	0	0	3

9	EC114	Computer Networks and Security	3	0	0	3
10		Environmental Science	3	0	0	0
11		Summer Entrepreneurship-II	0	0	12	6
		Constitution of India/Essence of Indian Knowledge Traditional	3	0	0	0
		TOTAL				26

Semester V (Third year]
Branch/Course COMPUTER SCIENCE & ENGINEERING

105 – COMPUTER SCIENCE & ENGINEERING						
Semester V COMPUTER SCIENCE & ENGINEERING						
SI.	Code	Course Title	Hours per week			Credits
			L	T	P	Credit
1		Database Management Systems	3	0	4	5
2		Formal Language & Automata Theory	3	1	0	4
3		Artificial intelligence	3	0	0	3
4		Software Engineering	3	0	0	3
5		Professional Skill Development	3	0	0	3
6		Software Training	3	0	0	0
7		Constitution of India/Essence of Indian Knowledge Traditional	3	0	0	0
8		MOOCs / SWAYAM / NPTEL etc. Courses - 1	3	0	0	3
9		Summer Entrepreneurship-II	0	0	12	6
10		Seminar	0	0	2	1
			Total credits			26

Semester V (Third year]
Branch/Course INFORMATION TECHNOLOGY

Semester V INFORMATION TECHNOLOGY						
Sl No.	Code	Course Title	Hours per week			Credit
			L	T	P	
1	ESC501	Microprocessor	3	0	4	5
2	PCC-IT501	Design Analysis of Algorithm	3	0	0	3
3	PCC-IT502	Compiler Design	3	1	0	4
4	PCC-IT503	Operating System	3	0	4	5
5	HSMC 501	Professional Skill Development	3	0	0	3

6	MCSI 501	Constitution of India/Essence of Indian Knowledge Traditional	3	0	0	0
7	PNS IT 501	Seminar	0	0	2	1
8		Software Training	3	0	0	0
Total Credit						25

Semester V (Third year]
Branch/Course Leather Technology

Branch/Course Leather Technology						
Sl. No.	code	Course Title	Hours per week			Credits
			L	T	P	
1		Chemical Engineering - II	3	0	0	3
2		Principles of Organic Tannage	3	0	0	3
3		Practices of Leather Manufacturing - I	3	0	3	4.5
4		Leather Product Technology- I	3	0	3	4.5
5		Principles of Post Tanning Operation	3	0	3	4.5
6		Economics (Humanities)	3	0	0	3
7		Essence of Indian Traditional	0	0	0	0
8		Summer Entrepreneurship-II	0	0	12	6
9		Constitution of India/Essence of Indian Knowledge Traditional	3	0	0	0
			Total credits			**28.5**

Semester V (Third year]
Branch/Course Electrical Electronics & Engineering

Sl. No.	Code	Course Title	Hours per week			Credit
			L	T	P	
1		Analog & Digital Communication System	3	0	2	4
2		Capstone Design Project	3	0	0	0
3		Constitution of India/Essence of Indian Knowledge Traditional	3	0	0	0
4		Control Systems	3	0	2	4
5		MOOCs / SWAYAM / NPTEL Courses - 2	2	0	0	2
6		Power Electronics	3	0	2	4
7		Power Systems–I (Apparatus and Modelling)	3	0	2	4
8		Professional Elective Laboratory-1	0	0	2	1
9		Summer Entrepreneurship-II	0	0	12	6

Civil Engineering
V Semester

PCC-CE301	**Mechanics of Materials**	**3L:0T:0P**	**3 credits**

The objective of this Course is to introduce to continuum mechanics and material modeling 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 behavior 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 behavior is carefully observed and measured (learnt in the previous course on Materials, Testing & Evaluation). For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analytical mechanics.

What will I learn?

- Understand the deformation and strains under different load action and response in terms of forces and moments
- Understand the behaviour under different loading actions
- Application of engineering principles to calculate the reactions, forces and moments
- Understand the energy methods used to derive the equations to solve engineering problems
- Make use of the capabilities to determine the forces and moments for design

Proposed Syllabus

Module 1: Deformation and Strain covering description of finite deformation, Infinitesimal deformation; Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis of thin, thick and compound cylinder;

Module 2: Generalized state of stress and strain: Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.

Module 3: Momentum Balance and Stresses covering Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion

Module 4: Mechanics of Deformable Bodies covering Force-deformation Relationships and Static Indeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations, Statically Determinate and Indeterminate Trusses,

Module 5: Force-Stress-Equilibrium covering Multiaxial Stress and Strain
Module 6: Displacement – Strain covering Multiaxial Strain and Multiaxial Stress-strain Relationships

Module 7: Elasticity and Elasticity Bounds covering Stress-strain-temperature Relationships and Thin-walled Pressure Vessels, Stress and strain Transformations and Principal Stress, Failure of Materials,

Module 8: Bending: Stress and Strains; Deflections and Torsion covering Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelasticity, Energy methods, Variational Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.

Module 9: Structural stability; Stability of columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design

Text/Reference Books:

1. Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc Graw Hill, Tokyo, Japan.
2. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
3. Kazmi, S. M. A., 'Solid Mechanics" TMH, Delhi, India.
4. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
5. 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
6. Gere, J. M., and S. P. Timoshenko. Mechanics of Materials. 5th ed. Boston: PWS Kent Publishing, 1970.
7. Ashby, M. F., and D. R. H. Jones. Engineering Materials, An Introduction to their Properties and Applications. 2nd ed. Butterworth Heinemann.
8. Collins, J. A. Failure of Materials in Mechanical Design. 2nd ed. John Wiley & Sons, 1993.
9. Courtney, T. H. Mechanical Behavior of Materials. McGraw-Hill, 1990.
10. Hertzberg, R. W. Deformation and Fracture Mechanics of Engineering Materials. 4th ed. John Wiley & Sons, 1996.
11. Nash, W. A. Strength of Materials. 3d ed. Schaum's Outline Series, McGraw-Hill, 1994.

PCC-CE302	Hydraulic Engineering	2L:0T:2P	3 credits

Objectives:
To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering

Module 1: Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

Module 2: Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

Module 3: Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n .Most economical section of channel. Computation of Uniform flow, Normal depth.

Module 4: Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.

Module 5: Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types,applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges.

Module 6: Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web based modeling in water resources engineering.

Practical Work:

1. Flow Visualization
2. Studies in Wind Tunnel
3. Boundary Layer
4. Flow around an Aerofoil / circular cylinder
5. Uniform Flow
6. Velocity Distribution in Open channel flow
7. Venturi Flume
8. Standing Wave Flume
9. Gradually Varied Flow

10. Hydraulic Jump
11. Flow under Sluice Gate
12. Flow through pipes
13. Turbulent flow through pipes
14. Flow visualization
15. Laminar flow through pipes
16. Major losses / Minor losses in pipe

Text/Reference Books:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Open channel Flow, K. Subramanya, Tata McGraw Hill.
4. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
5. Burnside, C.D., " Electromagnetic Distance Measurement," Beekman Publishers, 1971.

PCC-CE303	Analysis and design Of Concrete structure	2L:1T:0P	3 credits

Objectives:

This course aims at providing students with a solid background on principles of structural engineering design. Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project. An understanding of real-world open-ended design issues will be developed. Weekly recitations and project discussions will be held besides lectures.

Module 1: Introduction- concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design

Module 2: Introduction to reinforced concrete structures, Basic material properties: stress-strain relation of concrete and reinforcing steel

Module 3:, Planning and Design Process; Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads Design philosophy: assumptions and code of practice,

Module 4: Theory of singly reinforced members in bending, Design of simply supported and continuous beams with rectangular and flanged section,

Module 5: Limit state of collapse in shear, Design for bond, Design of one-way and two-way slab systems

Module 6: Design of columns under uniaxial and biaxial bending, Design of footings and staircase

Text/Reference Books:

1. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004
2. McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J., 2003.
3. Galambos, T.V., Lin, F.J., Johnston, B.G., Basic Steel Design with LRFD, Prentice Hall, 1996
4. Segui, W. T., LRFD Steel Design, 2nd Ed., PWS Publishing, Boston.
5. Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper & Row, Publishers, New York, 1990.
6. MacGregor, J. G., Reinforced Concrete: Mechanics and Design, 3rd Edition, Prentice Hall, New Jersey, 1997.
7. Nawy, E. G., Reinforced Concrete: A Fundamental Approach, 5th Edition, Prentice Hall, New Jersey.
8. Wang C-K. and Salmon, C. G., Reinforced Concrete Design, 6th Edition, Addison Wesley, New York.

9. Nawy, E. G. Prestressed Concrete: A Fundamental Approach, Prentice Hall, NJ, (2003).
10. Related Codes of Practice of BIS
11. Smith, J. C., Structural Analysis, Harpor and Row, Publishers, New York.
12. W. McGuire, R. H. Gallagher and R. D. Ziemian. “Matrix Structural Analysis", 2nd Edition, John Wiley and Sons, 2000.
13. NBC, National Building Code, BIS (2017).
14. ASCE, Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American Society of Civil Engineers, Virginia, 2002.
15. S. U. Pillai and D. Menon, Reinforced Concrete Design, Tata McGraw-Hill, 3rd edition, 2009.
16. P. C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall India, 2nd edition, 2008

PCC-CE304	Geotechnical Engineering -I	3L:0T:2P	4 credits

Module 1: Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method,nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.

On completion of this module, the students must be able to:

- Understand the different types of soil based on their formation mechanism;
- Understand the various phase diagrams and derive various phase relationships of the soil; Perform various laboratory experiments to determine moisture content, specific gravity; Perform field experiments to estimate the field density of the soil mass.

Module 2: Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system.

Identification: field identification of soils, general characteristics of soil in different groups.

On completion of this module, the students must be able to:

- Understand the behaviour of soils based on their moisture contents;
- Perform laboratory experiments to estimate various Atterberg limits and evaluate index properties of soils;
- Classify any soils based on their particle size distribution and index properties;

Module 3: Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.

On completion of this module, the student must be able to:

- Determine the permeability of soils through various laboratory and field tests;
- Analytically calculate the effective permeability of anisotropic soil mass;
- Determine the seepage quantities and pore water pressures below the ground;
- Graphically plot the equipotential lines and flow lines in a seepage flow.

Module 4: Effective Stress Principle - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.

On completion of this module, the student must be able to:

- Understand the physical significance of effective stress and its relation with pore pressure;
- Plot various stress distribution diagrams along the depth of the soil mass;
- Understand the effect of capillary action and seepage flow direction on the effective stress at a point in the soil mass.

Module 5: Compaction of Soil-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.

On completion of this module, the student must be able to:

- Perform laboratory test to determine the maximum dry density and optimum moisture content of the soil;
- Variation in compaction curve with compaction effort and soil type;
- Determine the compactive effort required to obtain necessary degree of compaction in-situ;
- Differentiate among various field methods of compaction and their usage based on the type of soil.

Module 6: Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory. On completion of this module, the student must be able to:

- Analytically compute the vertical stress in a semi-infinite soil mass due to various loading conditions; Plot isobars due various loading conditions.

Practical Work: List of tests on-

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine Grained soils.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis.

7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
9. Consistency limits by Plastic limit
10. Consistency limits by Shrinkage limit.
11. Permeability test using Constant-head test method.
12. Permeability test using Falling-head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation Test.
17. Triaxial Test (UU)
18. Vane shear test
19. Direct Shear Test
20. Unconfined Compression Strength Test.

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
4. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
5. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy
7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.
8. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy

PCC-CE305	**Hydrology and Water Resources Engineering**	**2L:0T:2P**	**3 credits**

Module 1: Introduction - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data.

Module 2: Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, deptharea-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

Module 3: Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.

Module 4: Runoff - runoff volume, SCS-CN method of estimating runoff volume, flowduration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.

Module 5: Ground water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

Module 6: Water withdrawals and uses – water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

Module 7: Distribution systems - canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

Module 8: Dams and spillways - embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

Text/Reference Books:

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata McGraw Hill.
4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.
6. J D Zimmerman, Irrigation, John Wiley & Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

Outcomes:

At the end of the course, students must be in a position to:

- Understand the interaction among various processes in the hydrologic cycle
- Apply the application of fluid mechanics and use of computers in solving a host of problems in hydraulic engineering
- Study types and classes of hydrologic simulation models and design procedures for safe and effective passage of flood flows for design of hydraulic structures
- Understand the basic aquifer parameters and estimate groundwater resources for different hydro-geological boundary conditions
- Understand application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field of water resources
- Apply the principles and applications of remote sensing, GPS and GIS in the context to hydrological extreme flood and drought events in water resources engineering

PCC-CE306	Environmental Engineering-I	3L:0T:2P	4 credits

Module 1: Water: -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module 2: Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Module 3: Noise- Basic concept, measurement and various control methods.

Module 4: Building Plumbing-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

Practical Work: List of Experiments

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride and sulfate
5. Optimum coagulant dose
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
8. Break point Chlorination
9. Bacteriological quality measurement: MPN,
10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
11. Ambient noise measurement

Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw Hill International Editions, New York 1985.
4. MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.

5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
7. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

PCC-CE307	Transportation Engineering	3L:0T:2P	4 credits

Module 1: Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

Module 2: Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

Module 3:Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems

Module 4: Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems

Module 5: Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems

Text/Reference Books:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley
5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

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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Mechanical Engineering
V Semester

PCC-ME 301	Heat Transfer	3L:0T:3P	4.5 Credits

Objectives:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Contents:

Module: 1 **(12 lectures)**

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Module:2 **(8 lectures)**

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Module: 3 **(8 lectures)**

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

Module: 4 **(6 lectures)**

Types of heat exchangers, Analysis and design of heat exchangers using bothLMTD and ε-NTU methods.

Module: 5 **(3 lectures)**

Boiling and Condensation heat transfer, Pool boiling curve.

Module: 6 **(3 lectures)**

Introduction mass transfer, Similarity between heat and mass transfer

Text Books:

1. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002

Practical:

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.
4. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length
5. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube.
6. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.
7. Determination of Emissivity of a Surface.
8. Determination of Stefan Boltzmann's Constant.
9. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers.

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
2. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
3. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

PCC-ME 302	Fluid Machinery	3L:0T:3P	4.5 Credits

Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Contents:

Module: 1

Introduction – Classification of fluid machinery. **(Lectures: 2)**

Module: 2

Dynamic action of fluid jet – Impact of fluid jet on fixed and moving flat places, impact of jet on fixed and moving curved vanes, flow over radial vanes, jet propulsions. **(Lectures: 4)**

Module: 3

Euler's fundamental equation, degree of reaction. **(Lectures:2)**

Module: 4

Hydraulic turbines, introduction, classification, impulse turbine, construction details, velocity triangles, power and efficiency calculations, reaction turbines; constructional details, working principle, velocity triangles, power and efficiency calculations, draft tube, cavitation, governing. **(Lectures: 10)**

Module: 5

Principle of similarity in fluid machinery; unit and specific quantities, testing models and selection of hydraulic turbines. **(Lectures: 3)**

Module: 6

Positive displacement pumps: Reciprocating pump; working principle, classification, slip, indicator diagram, effect of friction and acceleration, theory of air vessel, performance characteristics gas gear oil pump and screw pump. **(Lectures: 4)**

Module: 7

Rotodynamic pumps: Introduction, classification, centrifugal pump; main components, working principle velocity triangle, effect of shape of blade specific speed, heats, power and efficiency, calculations minimum steering speed, multi stage pumps, performance characteristic, comparison with reciprocating pump. **(Lectures: 7)**

Course Outcomes:

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

Text Books:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press,2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.
4. Hydrantic Machine by Jagdish Lal
5. Hydraulics & Hydraulic Machines by Vasandari
6. Hydrantic Machine by RD Purohit

Practical:

1. Performance on hydraulic turbines:
    a. Pelton wheel
    b. Francis turbine
    c. Kaplan turbine.
2. Performance on hydraulic pumps:
    a. Single stage and multi stage centrifugal pumps
    b. Reciprocating pump.
3. Performance test of a two stage reciprocating air compressor
4. Performance test on an air blower

OPTIONAL

1. Visit to hydraulic power station/Municipal water pump house and case studies.
2. Demonstration of cut section models of hydraulic turbines and pumps.

PCC-ME 303	Manufacturing Processes	3L:0T:3P	4.5 Credits

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

Contents:

Module: 1

Conventional Manufacturing processes: Casting and Moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(Lectures6)**

Module: 2

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy. **(Lectures6)**

Module: 3

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining. **(Lectures8)**

Module: 4

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Additive manufacturing: Rapid prototyping and rapid tooling **(Lectures5)**

Module:5

Machine Tools:

(a) Lathe: Principle, types, operations, turret/capstan, semi/automatic, Tool layout.

(b) Shaper, slotted, planer, operation, drive.

(c) Milling, Milling cutter, up & down milling, dividing head indexing, Max chip thickness,

power required.

(d) Drilling and boring, reaming tools, Geometry of twist drill, Grinding, Grinding wheel, Abrasive, cutting action, grinding wheel specification, Grinding wheel wear, alterations, wear, fracture wear, dressing and trimming. Max chip thickness and guest criteria, Flat and cylindrical grinding, Centerless grinding, Super finishing, Honing lapping, Polishing

(Lectures15)

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

Practical:

Minimum of 10 Experiment need to be performed

I. Metal Casting Lab:

1. Pattern Design and making – for one casting drawing.
2. Sand properties testing (strengths and permeability)
3. Moulding, Melting and Casting

II. Welding Lab:

1. ARC Welding Lap & Butt Joint
2. Spot Welding
3. Gas Welding

III. Mechanical Press Working:

1. Blanking & Piercing operation and study of simple, compound and progressivepress tool.
2. Bending and other operations

IV. Machining Lab:

1. Cutting operation (Orthogonal & Oblique) on lathe machine
2. Bolt making on lathe machine
3. Facing, plain turning and step turning knurling

4. Boring and internal thread cutting.
5. Finishing of a surface on surface –grinding machine
6. Gear cutting on milling machine (Spur Gear).
7. Machining a block on shaper machine.
8. Drilling holes on drilling machine

PCC-ME 304	Kinematics of Machine	3L:1T:0P	4 credits

Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To be able to design some linkage mechanisms and cam systems to generate specified output motion
4. To understand the kinematics of gear trains

Contents:

Module 1

Introduction: Classification of mechanisms: -Basic kinematic concepts and Definitions- Degree of freedom, mobility-Grashof's law, Kinematic inversions of four bar chain and slider crank chains. **(Lectures 5)**

Module 2

Kinematic analysis of plane mechanism: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coriolis component of acceleration. **(Lectures 6)**

Module 3

Friction devices: Belt drive, Clutch, Shoe brakes, Band and block brakes. **(Lectures 6)**

Module 4

Gear: gear terminology, Involute and Cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting.

Gear Train: Analysis of simple, compound, reverted and epicyclic gear train with problems.

(Lectures 10)

Module 5

Balancing of rotating masses: Balancing of rotating masses in the same plane by a single revolving mass. Balancing of several rotating masses in the same plane. Balancing of several rotating masses in different planes by two revolving masses in suitable planes.

(**Lectures8**)

Module 6

Governors: Watt, Porter, Proel & Hartnell Governors, Effect of friction, controlling force, governor effort and power, sensitivity and isochronisms.

(Lectures 6)

Course Outcomes:

- After completing this course, the students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning

Text Books:

[1.] Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.

[2.] CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.

[3.] Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.

[4.] Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

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103 - Electrical Engineering
V Semester

PCC-EE15	**Power Systems-I**	**3L:0T:0P**	**3 credits**

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

- Understand the concepts of power systems.
- Understand the various power system components.
- Evaluate fault currents for different types offaults.
- Understand the generation of over-voltages and insulation coordination.
- Understand basic protection schemes.
- Understand concepts of HVdc power transmission and renewable energy generation.

Module 1: Basic Concepts (4 hours)
EvolutionofPowerSystemsandPresent-DayScenario.Structureofapowersystem: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power. Skin effect and Ferranti effect

Module 2: Power System Components (15 hours)
Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, auto-transformers, Neutral Grounding transformers. Tap-Changing in transformers.
Transformer Parameters. Single phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Module 3: Over-voltages and Insulation Requirements (4 hours)
Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Module 4: Introduction to DC Transmission & Renewable Energy Systems (9 hours)

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

Text/References:

- J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
- O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
- A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
- D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
- B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley,2012.

PCC-EE16: Power Systems – I Laboratory (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of EE14. Visits to power system installations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis and Electro- magnetic transient program (EMTP) and Numerical Relays are suggested.

PCC-EE17	Control Systems	3L:0T:0P	3 credits

Course Outcomes:

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

- Understand the modelling of linear-time-invariant systems using transfer function and state- space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

Module 1: Introduction to control problem (4 hours)
Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra. Signal flow graph

Module 2: Time Response Analysis (10 hours)
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.
Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module 3: Frequency-response analysis (6 hours)
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module 4: Introduction to Controller Design (10 hours)
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.
Analog and Digital implementation of controllers.

Module 5: State variable Analysis (6 hours)
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Text/References:

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International,2009

PCC-EE18: Control Systems Laboratory (0:0:2 – 1 credit)

Hands-on/Computer experiments related to the course contents of EE17.

PCC-EE19	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 microcontroller sin embedded Systems. Overview of the 8051family.

Module 2: The 8051 Architecture (8 Hours)
InternalBlockDiagram,CPU,ALU,address,dataandcontrolbus,Workingregisters,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:

- M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education,2007.
- K. J. Ayala, "8051 Microcontroller", Delmar CengageLearning,2004.
- R. Kamal, "Embedded System", McGraw HillEducation,2009.
- R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing,1996

- D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/
- D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education,1991.

PCC-EE20: Microprocessor Laboratory (0:0:2 – 1 credit)
Hands-on experiments related to the course contents ofEE19.

PCC-EE21	**Power Electronics**	**3L:0T:0P**	**3 credits**

Course Outcomes:

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

- Understand the differences between signal level and power leveldevices.
- Analyse controlled rectifier circuits.
- Analyse the operation of DC-DC choppers.
- Analyse the operation of voltage source inverters.

Module 1: Power switching devices (8 Hours)
Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers (7 Hours)
Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC converter (10 Hours)
Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.
Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 4: Single-phase and 3-phase voltage source inverter (14 Hours)
Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation. Current Source Inverter

Text/References:

- M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India, 2009.
- N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
- R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science& Business Media, 2007.
- L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

PCC-EE22: Power Electronics Laboratory (0:0:2 – 1credit)
Hands-on experiments related to the course contents ofEE21.

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104 - Electronics & Communication Engineering
V Semester

EC111 Linear Control System 3L: 1T: 0P 3 Credits

1. Control Systems: Basics & Components, Introduction to basic terms, Classifications and types of Control Systems, Block diagrams & Signal flow graphs. Transfer function, Determination of transfer function using Block diagram re-duction techniques and Mason's Gain formula. Control system components: Electrical, Mechanical, Electronic, AC/DC Servo Motors, Stepper Motors, Tacho Generators, Synchros, Magnetic Amplifiers, Servo Amplifiers 8 Hrs.
2. Time-Domain Analysis : Time domain performance specifications, Transient response of first and second order systems, Steady state errors and Static error constants in unity feedback control systems, response with P, PI and PID controllers, Limitations of time domain analysis. 8 Hrs.
3. Frequency Domain Analysis : Polar and inverse polar plots, Frequency domain specifications and Performance of LTI systems, Logarithmic plots (Bode plots), Gain and Phase Margins, Relative stability. Correlation with time domain performance, Closed loop frequency responses from Open loop response. Limitations of frequency domain analysis, Minimum/Non-minimum phase sys- tems 8 Hrs.
4. Stability and Compensation Techniques : Concepts, absolute, Asymptotic, Conditional and Marginal stability, Routh–Hurwitz and Nyquist stability criterion, Root locus technique and its application. Concepts of compensation, series/parallel/series-parallel/feedback compensation, Lag/Lead/Lag- Lead networks for compensation, Compensation using P, PI, PID controllers 8 Hrs.
5. Control System Analysis using State Variable Methods Control Systems Engineering Syllabus State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback. 8 Hrs.

Sl. No. Name of Authors / Books /Publishers

1 "Automatic Control System", B. C. Kuo, Prentice Hall of India, 7th edition, 2001
2 "Control Systems Engineering -Principles and Design", Nagraath and Gopal New Age Publishers
3 "Control systems engineering", Norman S. Nise, John Wiley and Sons (Asia) Singapore
4 "Design of Feedback Control System", Raymond T. Stefani, Oxford University Press
5 "Modern control engineering", K. Ogata, Pearson, 2002

EC112 Linear Integrated Circuits and Applications 3L: 1T: 0P 3 Credits

(Paper Code: - 104504)

1 IC Fabrication: IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs 9 Hrs.

2 Characteristics of OPAMP : Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP- AMP; Basic applications of Op-Amp – Inverting and Non-inverting Amplifiers, V/I and I/V converters, Summer, Differentiator and Integrator 9 Hrs.

3 Applications of OPAMP : Instrumentation amplifier, Log and Antilog Amplifiers, first and second order active filters, comparators, multivibrators, wave- form generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using Op-Amps. 9 Hrs.

4 Special ICs: Functional block, characteristics and application circuits with 555 Timer IC-566 voltage controlled oscillator IC; 565-phase lock loop IC, Ana- log multiplier ICs. 9 Hrs.

5 Application ICs : IC voltage regulators –LM78XX, 79XX Fixed voltage regulators- LM317, 723 Variable voltage regulators, switching regulator- SMPS- LM 380 power amplifier-ICL 8038 function generator IC. 9 Hrs.

Sl. No. Name of Authors / Books /Publishers

1 “Op-amp and Linear ICs”, David A. Bell, Oxford, 2013

2 “Linear Integrated Circuits”, D. Roy Choudhary, Sheil B. Jani, II edition, New Age, 2003

3 “Op-amps and Linear Integrated Circuits”, Ramakant A. Gayakward, IV edition, Pearson Education, PHI, 2000

4 “Opamps and Linear Integrated Circuits Concepts and Applications”, Fiore, Cengage, 2010

5 “Fundamentals of Analog Circuits”, Floyd and Buchla, Pearson, 2013

6 “Integrated Electronics - Analog and Digital circuits system”, Jacob Millman, Christos C.Halkias, Tata McGraw Hill, 2003

7 “Op-amp and Linear ICs”, Robert F. Coughlin, Fredrick F. Driscoll, PHI Learning, 6th edition, 2012

Linear Integrated Circuits and Applications Lab are according to the theory mentioned above. 0L: 0T: 2P 1 Credit

EC113 Probability Theory and Stochastic Processes 3L:0T:0P 3 Credits

1. Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models. 4 Hrs.
2. Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions; 6 Hrs.
3. Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds. 8 Hrs.
4. Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem. 10 Hrs.
5. Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density, Markov chain and Markov processes.
   10 Hrs.

Sl. No. Name of Authors / Books /Publishers

1 "Probability and Random Processes with Applications to Signal Processing," H. Stark and J. Woods, Third Edition, Pearson Education

2 "Probability, Random Variables and Stochastic Processes", A.Papoulis and S. Unnikrishnan Pillai, Fourth Edition, McGraw Hill.

3 "Introduction to Probability Theory with Stochastic Processes", K. L. Chung, Springer International

EC109 Digital Signal Processing **3L: 0T:0P** **3 Credits**

1	Overview of DSP, Basic Elements of DSP system, Advantages of DSP over Analog, Classification of signals, Concept of frequency in continuous time and discrete time, Continuous time and Discrete time sinusoidal signals.	7 Hrs.
2	Discrete time systems : Linear time invariant, Response of LTI system convolution sum, description of discrete time system by difference equation and complete solution of difference equation, Implementation of discrete time systems, Correlation of discrete time signals	6 Hrs.
3	Transform and its applications to the analysis of LTI Systems	3 Hrs.
4	Discrete Time Fourier Transform, Properties of DTFT	4 Hrs.
5	Frequency domain representation of LTI Systems	5 Hrs.
6	Sampling and reconstruction of Analog signals	5 Hrs.
7	Discrete Fourier series, Discrete Fourier transform, Properties of DFT, FFT	5 Hrs.
8	Digital filter structure: FIR and IIR designs	5 Hrs.

Name of Authors / Books /Publishers

a. "Digital Signal Processing" by Proakis and Manolakis, Pearson
b. "Digital Signal Processing" by Ingle and Proakis, Thomson
c. "Digital Time Signal Processing" by Oppenheim and Schafer, Pearson
d. "Digital Signal Processing : Computer Based Approach" by Mitra, TMH

Digital Signal Processing Lab 0L: 0T: 2P 1 Credit

List of Experiments

1. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
2. To develop program for discrete convolution
3. To develop program for discrete correlation
4. To understand stability test
5. To understand sampling theorem
6. To design analog filters (low-pass, high pass, band pass, band stop)
7. To design digital filters (low-pass, high pass, band pass, band stop)
8. To design fir filters using windows techniques

EC110 Microprocessors and Microcontrollers 3L: 0T: 0P 3 Credits

1 Introduction to Microprocessor Systems: Architecture and Pin diagram of 8085, Timing Diagram, Memory organization, Addressing modes, Interrupts. Assembly Language Programming, 8085 interrupts, Additional I/O concepts and processes. 8 Hrs.

2 Interfacing of 8085 with 8255, 8254/ 8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and- Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor. 12 Hrs.

3 Introduction to 8086, 80286, 80386 and 80486 Microprocessor: 8086 Architecture, Generation of physical address, Pin diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts. Introduction of 80286, 80386, and 80486 microprocessor 9 Hrs.

4 Overview of Microcontroller 8051: Introduction to 8051 Microcontroller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer and Counter Programming, Interrupt Programming. 11 Hrs.

Name of Authors / Books /Publishers

1 "Microprocessors and Microcontrollers", Muhammad Ali Mazidi, Pearson, 2006
2 "Microprocessors and Interfacing, Programming and Hardware", Douglas V Hall, Tata McGraw Hill, 2006
3 "MicroProcessor Architecture, Programming and Applications with the 8085", Ramesh Gaonkar, PHI
4 "The 8051 Microcontroller and Embedded Systems", Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay, 2nd Edition, Pearson Education, 2008
5 "The 8086 Microprocessor: Programming and Interfacing The PC", Kenneth J. Ayala, Delmar Publishers, 2007
6 "Advanced Microprocessors and Peripherals", A K Ray, K M Bhurchandi, Tata McGraw Hill, 2007

Microprocessors and Microcontrollers Lab are according to the theory mentioned above.

0L: 0T: 2P 1 Credit

EC114 Computer Networks and Security 3L: 0T: 0P 3 Credits

1 **Data communication Components:** Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum 10 Hrs.

2 **Data Link Layer and Medium Access Sub Layer:** Error Detection and Error Correction Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back - N ARQ, Se- lective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA 10 Hrs.

3 **Network Layer :** Switching, Logical addressing – IPv4, IPv6; Address mapping –ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols. Transport Layer: Process to Process Communication, User Datagram Proto- col (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm. 8 Hrs.

4 **Application Layer:** Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography 6 Hrs.

5 **Network Security:** Passive and Active Attacks, Symmetric Encryption, Encryption Algorithms, Key Distribution, Traffic Padding, Message Authen- tication, Hash function, Secure Hash function, Public-key Encryption, Digital Signature, RSA Public Key Encryption algorithm, Key Management, Secure Socket Layer and Transport layer Security, SSL Architecture, SSL Record Pro- tocol, Change Cipher Spec Protocol, Alert Protocol, handshake Protocol, IP level security IPSEC, Application layer security PGP, Firewall, Virtual Private Networks. 8 Hrs.

Name of Authors / Books /Publishers

1 "Data Communication and Networking", 4th Edition, Behrouz A. Forouzan, McGraw-Hill

2 "Data and Computer Communication", 8th Edition, William Stallings, Pearson Prentice Hall India

3 "Computer Networks", 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

4 "Internetworking with TCP/IP", Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.

5 "TCP/IP Illustrated", Volume 1, W. Richard Stevens, Addison-Wesley, United States of America

6 "Network Security Bible", by Cole, Krutz and Conley, Wiley dreamtech

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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105 – Computer Science & Engineering
V Semester

PCC CS 501	Database Management Systems	3L:0T:4 P	5 Credits

Objectives of the course

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3. To understand and use data manipulation language to query, update, and manage a database
4. 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.
5. 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 hrs.**

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 hrs.**

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 hrs.**

Storage strategies: Indices, B-trees, hashing.

Module 4 **Lecture 8 hrs.**

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 hrs.**

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

Module 6 **Lecture 6 hrs.**

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:

1. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer SciencePress.
2. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education
3. "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.

PCC CS 501P	Database Management Systems Lab

Hands-on experiments related to the course contents of PCC CS 501.

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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 and languages generated by context free grammars
- Identify the hierarchy of formal languages, grammars and machines.
- Distinguish between computability and non-computability and Decidability and undesirability

Detailed contents

Module 1 **Lecture 10 hrs.**

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.

Module 2 **Lecture 10 hrs.**

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

Module 3 **Lecture 2 hrs**

Context-sensitive languages: Context-sensitive grammars (CSG) and Context-sensitive languages, linear bounded automata and equivalence with CSG.

Module 4 **Lecture 10 hrs.**

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

Module 5 **Lecture 8 hrs.**

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

Suggested books

1. 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.

PCC CS 503	Artificial Intelligence	3L: 0T:0 P	3 Credits

Objectives of the course

- Understand the broader context of Artificial Intelligence
- Develop a basic understanding of the building blocks of AI such as intelligent agents, search, inference, logic, and learning.
- Learn core concepts in artificial intelligence, such as heuristic search, game playing, formal logic, knowledge representation, knowledge discovery, decision theory, machine learning, and natural language processing.

Detailed contents

Module 1 **Lecture 10 hrs.**

Introduction: Overview, Turing test, Intelligent agents. **Problem Solving**: Solving Problems by Searching: Uninformed search - Depth First Search, Breadth First Search, DFID, Heuristic search - Generate and Test, Best First Search, Beam Search, Hill Climbing, A*, Problem reduction search – AND/OR Graphs, AO*, Constraint satisfaction, Means-ends analysis, Stochastic search methods - Simulated Annealing, Particle Swarm Optimization, Game Playing - Minimax algorithm, Alpha-beta pruning

Module 2 **Lecture 10 hrs.**

Knowledge and Reasoning: Building a knowledge base - Propositional logic, first order logic, Inference in first order logic, Resolution – refutation proofs, Theorem Proving in First Order Logic; Planning, partial order planning, Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks

Module 3 **Lecture 10 hrs.**

Learning: Overview of different forms of learning: unsupervised, supervised, semi-supervised, K-means clustering algorithm, Decision Trees, Neural Networks, Deep Learning.

Module 4 **Lecture 10 hrs.**

Advanced topics: Introduction to Computer Vision, Natural Language Processing, Expert Systems, Robotics, Genetic Algorithm,

Text Books

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach,” Prentice Hall
2. E. Rich, K. Knight and S. B. Nair, “Artificial Intelligence,” TMH

References

1. C. Bishop,“Pattern Recognition and Machine Learning," Springer

3. D. W. Patterson, “Introduction to artificial intelligence and expert systems,” Prentice Hall
4. A. C.Staugaard, Jr., “Robotics and AI: An Introduction to Applied Machine Intelligence,” Prentice Hall
5. I. Bratko, “Prolog Programming for Artificial Intelligence,” Addison-Wesley
6. S. O. Haykin, “Neural Networks and Learning Machines,” Prentice Hall
7. D.Jurafsky and J. H. Martin,“Speech and Language Processing,” Prentice Hall

Course Outcomes:

After undergoing this course, the students will be able to:

- Build intelligent agents for search and games
- Solve AI problems through programming with Python
- Learning optimization and inference algorithms for model learning
- Design and develop programs for an agent to learn and act in a structured environment.

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PCC CS 504	Software Engineering	3L:0T:0P	3 Credits

Detailed contents

Module 1 **Lectures: 8 hrs.**

Introduction: What is Software Engineering and its history, software crisis, Evolution of a Programming System Product, Characteristics of Software, Brooks' No Silver Bullet, and Software Myths, Software Development Life Cycles: Software Development Process, The Code-and-Fix model, The Waterfall model, The Evolutionary Model, The Incremental Implementation, Prototyping, The Spiral Model, Software Reuse, Critical Comparisons of SDLC models, An Introduction to Non-Traditional Software Development Process: Rational Unified Process, Rapid Application Development, Agile Development Process.

Module 2 **Lectures: 8 hrs.**

Requirements: Importance of Requirement Analysis, User Needs, Software Features and Software Requirements, Classes of User Requirements: Enduring and Volatile, Sub phases of Requirement Analysis, Functional and Nonfunctional requirements, Barriers to Eliciting User requirements, The software requirements document and SRS standards, Requirements Engineering, Case Study of SRS for a Real Time System. Tools for Requirements Gathering: Document Flow Chart, Decision Table, Decision Tree, Introduction to nontraditional Requirements.

Module 3 **Lectures: 6 hrs.**

Software Design: Goals of good software design, Design strategies and methodologies, Data oriented software design, Coupling, Cohesion, Modular structure, Packaging, Structured Analysis: DFD, Data Dictionary, Structured Design: Structure chart, Object oriented design, Top-down and bottom-up approach, UML, UML Diagrams, Design patterns,.

Module 4 **Lectures: 6 hrs.**

Software Project Management: Overview of Project Manager Responsibilities & project planning, Software Measurement and Metrics: Line of Code (LOC), Function Point (FP) based measures, Various Size Oriented Measures: Halstead's software science, Project Size estimation Metrics Project Estimation, Techniques, COCOMO, Staffing Level Estimation, Scheduling, Organization & Team Structures Staffing, Risk Management.

Module 5 **Lectures: 5 hrs.**

Software Coding & Testing: Development: Selecting a language, Coding guidelines, Writing code, Code documentation. Testing process, Design of test cases, Functional Testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing, Cyclomatic Complexity Measures: Control flow graphs, Path

testing, Data flow and mutation testing, Unit testing, Integration and system testing, Debugging, Alpha & beta testing, testing tools & standards.

Module 6 **Lectures: 4 hrs.**

Software Maintenance: Management of maintenance, Maintenance process, Maintenance models, Regression testing, Reverse engineering, Software reengineering, Configuration management, documentation.

Module 7 **Lectures: 3 hrs.**

Software Reliability & Quality Management**:** Introduction to reliability and metrics to reliability measure, Overview of S/W Quality management System ISO 9000, SEI CMM.

Text Book:

1. Software Engineering: A Practitioner's Approach, R. S. Pressman, McGraw Hill
2. Fundamental of Software Engg. By Rajib Mall 4th edition PHI
3. A Concise Introduction to Software Engineering By Pankaj Jalote

Reference Book:

1. Zero Defect Software, G. G. Schulmeyer, McGraw-Hill
2. Object Oriented Modeling and Design, J. Rumbaugh, Prentice Hall
3. Software Engineering, K.K. Aggarwal, Yogesh Singh, New Age International Publishers

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HSMC 501	Professional Skill Development	3L:0T: 0P	3 credits
Pre-requisites	HSMC 301		

Objectives of the course:

1. To learn various interpersonal skills
2. To help in developing various professionals skills.
3. To cover the facets of verbal and non-verbal languages, public speech, reading gestures and body languages, preparing for group discussion and enhancing presentations skills.
4. To enable learners to speak fluently and flawlessly in all kinds of communicative Contexts with speakers of all nationalities.

Detail contents:

Module 1 **Lecture 10 hrs.**

Communication skills: Public speaking, Group discussion, Gestures and body language & professional presentation skills

Module 2 **Lecture 10 hrs.**

Interpersonal skills: Group dynamics, Negotiation skills, Leadership, Emotional intelligence

Module 3 **Lecture 10 hrs.**

Employability and Corporate Skills: Time management and effective planning, Stress management, People skills, Team work, development of leadership qualities, Decision making and Negotiation skills, Positive attitude, Self-motivation, Professional ethics, Business etiquettes, balancing board room.

Module 4 **Lecture 10 hrs.**

Business writing skills, Resume Writing. Interview Skills, Technical Presentation, Guest Lecture, Professional Ethics, Project Management, Entrepreneurship.

Suggested reference books:

1. "Personality Development and Soft Skills", Barun Mitra, Oxford University Press.
2. "Managing Soft Skills for Personality Development", B.N. Ghosh, McGraw Hill.
3. "Communication Skills and Soft Skills: An Integrated Approach", E. Suresh Kumar, Pearson
4. "Communication to Win", Richard Denny, Kogan Page India Pvt. Ltd.

Course outcomes

1. Student can able to write their resume and can prepare for presentation, group

discussion and interview.

2. Student can develop interpersonal skills like negotiation and leadership skills.
3. Students can develop Employability and Corporate Skills with proper time management and stress management.
4. Students learn to practice the professional ethics, project management and Entrepreneurship.

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MC 501	Constitution of India – Basic features and fundamental principles	3L : 0T : 0P	0 Credits (Mandatory non-credit course)

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
4. Salient features and characteristics of the Constitution of India
5. Scheme of the fundamental rights
6. The scheme of the Fundamental Duties and its legal status

7. The Directive Principles of State Policy – Its importance and implementation
8. Federal structure and distribution of legislative and financial powers between the Union and the States
9. Parliamentary Form of Government in India – The constitution powers and status of the President of India
10. Amendment of the Constitutional Powers and Procedure
11. The historical perspectives of the constitutional amendments in India
12. Emergency Provisions: National Emergency, President Rule, Financial Emergency
13. Local Self Government – Constitutional Scheme in India
14. Scheme of the Fundamental Right to Equality
15. Scheme of the Fundamental Right to certain Freedom under Article 19
16. Scope of the Right to Life and Personal Liberty under Article 21.

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106 – Information Technology
V Semester

PCC-IT501	**Design and Analysis of Algorithms**	**3L:0T: 4P**	**5 Credits**
Pre-requisites	**ESC 201**		

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.

Module 1: **Lecture 10**

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**

Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Module 3: **Lecture 10**

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Module 4: **Lecture 6**

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.

Module 5: **Lecture 4**

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Suggested books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MITPress/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz etal.

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, 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-CS601	**Complier Design**	**3L:1T: 0P**	**4 Credits**
Pre-requisites	**PCC-CS 302, PCC-CS 502**		

Objectives of the course

- To understand and list the different stages in the process of compilation.
- Identify different methods of lexical analysis
- Design top-down and bottom-upparsers
- Identify synthesized and inherited attributes
- Develop syntax directed translation schemes
- Develop algorithms to generate code for a target machine
- The aim is to learn how to design and implement a compiler and also to study the underlying theories.
- The main emphasis is for the imperative language.

Detailed contents

Module 1 **Lecture: 6**

Introduction: Phases of compilation and overview.

Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, from regular expressions to finite automata, scanner generator (lex, flex).

Module 2 **Lecture: 9**

Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) gram-mars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

Module 3 **Lecture: 10**

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree.

Symbol Table: Its structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope.

Module 4 **Lecture: 10**

Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

Code Improvement (optimization) Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc.

Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Module 5 **Lecture: 5**

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Suggested Books:

1. CompilersPrinciples.Techniques.AndToolsbyAlfredV.Aho.RaviSethiJefferyD.Ullman.PearsonEducation.

Suggested Reference Book

1. Compiler Design by Santanu Chattopadhyay. PHI
2. Modern Compiler Design by Dick Grune . E. Bal. Ceriel J. H. Jacobs. And Koen G. Langendoen Viley Dreamtech.

Course Outcomes

1. For a given grammar specification develop the lexical analyser
2. For a given parser specification design top-down and bottom-up parsers
3. Develop syntax directed translation schemes

Develop algorithms to generate code for a target machine

PCC- IT503	Operating Systems	3L:0T:4P	5 Credits
Pre-requisites	PCC – CS402		

Objectives of the course

To learn the fundamentals of Operating Systems.

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management
5. To learn to implement simple OS mechanisms

Module 1: **Lecture 4**

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**

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 5**

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, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problemetc.

Module 4: **Lecture 5**

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Module 5: **Lecture 8**

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: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages ofpaging.

Virtual Memory: Basics ofVirtual 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 6**

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: Disk structure, Disk scheduling algorithms

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 andperformance.

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

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, MarcoCesati, O'Reilly and Associates

Course Outcomes

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization

and for improving the access time.

4. Design and implement file management system
5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

PCC-EE19	Microprocessors	3L:0T:4P	5 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 microcontroller sin embedded Systems. Overview of the 8051family.

Module 2: The 8051 Architecture (8 Hours)
InternalBlockDiagram,CPU,ALU,address,dataandcontrolbus,Workingregisters,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:

- M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education,2007.
- K. J. Ayala, "8051 Microcontroller", Delmar CengageLearning,2004.
- R. Kamal, "Embedded System", McGraw HillEducation,2009.
- R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing,1996

- D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/
- D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education,1991.

MC 501	Constitution of India – Basic features and fundamental principles	3L : 0T : 0P	0 Credits (Mandatory non-credit course)

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status

6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

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107 – Leather Technology
V Semester

HSMC03	ECONOMICS	3L:0T:0P	3 Credits

Objective: The objective of this course is to give the working engineer an overview of the economics principles often employed in effective engineering decisions as related to the designing, planning and implementation of successful civil engineering projects.

Module 1

Engineering economics and its definition, Nature and scope, Overview of Indian Financial Scenario. Utility, Theory of demand, law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply, Determination of equilibrium price under perfect competition. Time value of money-Simple and Compound Interest, Cash Flow Diagram, Principle of Economic Equivalence Evaluation of Engineering projects, Concept of Internal rate of return (IRR). **(10 lectures)**

Module 2

Cost Concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs, Break-even Analysis-Linear Approach. Engineering Accounting, Manufacturing Cost, Manufacturing Cost Estimation, Preparing Financial Business Cases, Profit and loss A/c Balance sheet. Asset Depreciation and its Impact on Economic Analyses, Depreciation Policy, Straight line method and declining balance method, Economic Justification of Asset Replacements. **(10 lectures)**

Module 3

Types of business ownership: Private ownership- individual, Partnership, Joint stock companies, Co-operative societies, State ownership-government departmental organization, Public corporations, Government companies, Public Private Partnership (PPP) and its management. Store keeping, Elements of Materials management and control polices.

Banking: Meaning and functions of commercial banks, Function of Reserve Bank of India.

(10 lectures)

Module 4

Asset Depreciation and its Impact on Economic Analyses, Depreciation Policy, Straight line method and declining balance method, Economic Justification of Asset Replacements.

Development of business case analyses for new product development projects and the impact of taxes on engineering economic decisions. Inflation and its impact on economy.

(10 lectures)

Course Outcomes:

1. Apply the concept of opportunity cost
2. Employ marginal analysis for decision making
3. Analyze operations of markets under varying competitive conditions
4. Analyze causes and consequences of unemployment, inflation and economic growth

Text Books/References Books:

1. Sullivan, Wicks, Koelling, “Engineering Economy”, Pearson Education
2. S.C. Sharma and T.R. Banga, “Industrial organization and engineering economics”
3. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
4. C. T. Horngreen, “Cost Accounting”, Pearson Education India.
5. R. R. Paul, “Money banking and International Trade”, Kalyani Publuisher, New-Delhi.
6. Engineering Economics by Tahir Hussain, University Science Press, 2010
7. Engineering Economics by Dr. Rajan Mishra – University Science Press, 2009
8. H.L. Ahuja, “Principle of Economics”, S. Chand
9. Khan, Siddiquee, Kumar, “Engineering Economy” Pearson Education

PCC-LT301	Chemical Engineering -II	3L: 0T:0P	3 Credits

Module.1: Basic Concepts, Conduction (8hours)

Modes of heat transfer, conduction, convection and radiation, analogy between heat flow and electrical flow. Conduction: One dimensional steady state heat conduction, the Fourier heat conduction equation, conduction through plane wall, conduction through cylindrical wall, spherical wall, variable thermal conductivity, conduction through composite slab, cylinder and sphere, thermal contact resistance, critical radius of insulation, Extended surfaces: heat transfer from a fin, fin effectiveness and efficiency, Introduction to unsteady state heat conduction.

Module 2: Convection (10hours)

The convective heat transfer coefficient, thermal boundary layers for the cases of flow of fluid over a flat plate and flow through pipe, dimensionless numbers in heat transfer and their significance, dimensional analysis, application of dimensional analysis to forced convection and natural convection. Forced Convection: Correlation equations for heat transfer in laminar and turbulent flows in a Circular tube and duct, heat transfer to liquid metals and heat transfer to tubes in cross flow. Natural Convection: Natural convection from vertical and horizontal surfaces, Grash of and Rayleigh numbers.

Module 3: Heat transfer by radiation (8hours)

Basic Concepts of radiation from surface: black body radiation, Planks law, Wien's displacement law, Stefan Boltzmann's law, Kirchhoff's law, grey body, Radiation intensity of black body, View factor, emissivity, radiation between black surfaces and grey surfaces. Solar radiations

Module 4: Boiling and Condensation (8hours)

Pool boiling, pool boiling curve for water, maximum and minimum heat fluxes, correlations for nucleate and film pool boiling, drop wise and film wise condensation, Nusselt analysis for laminar film wise condensation on a vertical plate, film wise condensation on a horizontal tube. Evaporation: Types of evaporators, boiling point elevation and Duhring's rule, material and energy balances for single effect evaporator, multiple effect evaporators: forward, mixed and backward feeds, capacity and economy of evaporators

Module 5: Heat Exchangers (10hours)

Types of heat exchangers, Principal Components of a Concentric tube & Shell-and Tube Heat Exchanger, Baffles, Tubes and Tube Distribution, Tubes to Tube sheets Joint, Heat Exchangers with Multiple Shell & tube Passes, Fixed-Tube sheet and Removable-Bundle Heat Exchangers, log-mean temperature difference, overall heat transfer coefficient, fouling factors .

Texts/References:

1. "Heat transfer principles and applications" Dutta, B.K., PHI

2. "Heat Transfer" Holman J.P., 9th Ed., McGraw Hill.

3. "Chemical Engineering: Vol-1", Coulson, J. M. & Richardson, J. F., 6 th ed. Butterworth-Heinemann

4. "Principles of Heat Transfer", Kreith F. and Bohn M., 6th Ed., Brooks Cole

5. "Process Heat Transfer", Kern, D. Q McGraw Hill Book.

6. "Fundamentals of Heat and Mass Transfer", Incropera F.P. and Dewitt D.P 5th Ed., John Wiley

PCC-LT302	**Principles of Organic Tannage**	**3L: 0T:0P**	**3 Credits**

Module 1: **Vegetable Tannins (12 hours)**

Classification of Vegetable tannins – Structural aspects, Analysis of Chemistry of Hydrolysable & Condensed tannins, Manufacture of vegetable tannin extract use of additive for product notification, Reactions of vegetable tannins with collagen, Principle of vegetable tanning, Factors affecting tannin diffusion & factors affecting tannin fixation with collagen, Principle of Rapid tanning methods.

Module 2: Synthetic tannins (12 hours)

Chemistry & Multifunctional properties of syntans, Nontans in synthetic tannins, General Manufacturing methods of Phenol, Formaldehyde Naphthalene, Formaldehyde and Naphthol, Formaldehyde condensates, Supra Syntans, Use of Syntans for the Manufacture of various

Leathers & for chemical modifications for specific objectives, use of Lignosulfonic acids in Leather processing.

Module 3. Resin Syntans **(08 hours)**

Urea, Formaldehyde & Melamine, Formaldehyde condensates as tanning agents for leather, their chemistry & structure, Property, Relationship, Polyacrylates & Polyurethanes as Resin tanning agent Principles of their use.

Module 4. Aldehydes as tannins **(08 hours)**

Formaldehyde and other mono, difunctional ablehydes their chemistry, Structure and general properties, Reaction of aldehydes with different functional groups of protein. Tanning faculty at different pH reactions, oil, sulphony/chloride quinone tannage.

Module 5. Combination tannages **(08 hours)**

Deficiencies of single tannage, Machanistic classification of tannages. All chrome based combination tannages, semi-chrome & semi – alum tannages.

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.

PCC-LT304	Leather Product Technology- I	3L: 0T:3P	4.5 Credits

Module1: Introduction (03hours)

History of Footwear industry, Functions of footwear, Different parts of Footwear (Upper, Bottom and hidden components)

Module 2: Anatomy of Human foot (05hours)

Bones, Joints, Muscles, Ligaments, arches of skin of human foot, Internal and external changes of human foot from infant to adult stage, Analysis of human locomotion, Common foot abnormalities and their remedies. Foot comfort and foot care.

Module 3: Last (04hours)

Definition, Classification of last, Different parts of last, Seasoning of wood for wooden last, Last measurement, Comparison of last with human foot.

Module 4: Shoe Sizes and Fittings (04hours)

Relation between foot sizes and fittings and shoe, sizes and fittings, English, American, French, Continental and mondopoint shoe sizes and fittings system.

Module 5: Designing (12hours)

Introduction, Classification of Basic design, Elements of Design, Elements of Fashion design procedure, Concept of inside form, outside form and mean form, Making standard of oxford and derby shoe, different pattern making allowances, lasting margin, folding ,underlay and seam margin, Grading (Grading m/c)

Module6: Footwear materials (09hours)

Upper and Lining materials – Different natural and synthetic materials. Adhesive – Definition, Different types of adhesives use in footwear industry and their relative advantages and disadvantages. Sole, Insole, Toe puff, Stiffner. Different types of sole material and their properties. Different types of thread and its properties. Footwear accessories.

Module7: Footwear Costing (04hours)

Material, Labour and Overhead cost, Determining the material consumption, Leather consumption – One pair by tracing methods, calculation by Russ & Small method (0 & 180^0 Adhesive and thread consumption etc.

Texts/References:

1. Manual of Shoe making –Clark
2. The text book of Footwear menu – J. H. Throntin.
3. Principle of Footwear Manufacture – Somnath ganguly.

PCC-LT305	Principles of Post Tanning Operation	3L: 0T:3P	4.5 Credits

Module 1: Neutralisation (03hours)

Its objectives, necessities and control to achieve desired uptake of dyes and fat liquors.

Module 2: Bleaching (03hours)

Definition, Theory, Mechanism of chemical bleaching, classification and application of different methods of bleaching to leathers.

Module 3: DYEING (10hours)

Classification of dyes based on their chemical nature and also according to their application, Theory of colour, Manual colour matching, Theory and mechanism of dyeing, Chemistry and application of dyeing auxiliaries such as levelling agents, wetting agents, dispersing agents and dye fixative, Metal complex dye.

Module 4: FAT LIQUORING (10hours)

Theory of stability of Emulsion (Surface tension theories and Electrical theories), Fatliquor based on natural oils, their chemistry and preparation, Oxidation, Sulphation, Sulphonation, Bisulphitation and their properties, Synthetic Fat liquor :- Preparation and Properties, Principles and objectives of fatliquoring, Differences between synthetic and natural fat & oils concept of curring.

Module 5: RETANNING SYNTANS AND RETANNING (07hours)

Classification of retanning syntans, Tanning power of retanning syntan, Dipole theory of syntan tanning, General method of manufacture of aromatic syntans their general properties, Objective of retanage, Effect of different retanning agents on properties of leather principle of bondage of retanning material.

Module 6: THEORY OF LEATHER DRYING (07hours)

principles of energy and mass transfer, Physio-Chemical aspect of leather drying, Different methods of drying followed in leather Industry

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.

MC 501	Constitution of India – Basic features and fundamental principles	3L : 0T : 0P	0 Credits (Mandatory non-credit course)

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The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status

6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

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110 – Electrical Electronics Engineering
V Semester

PCC-EEE13	Power Systems-I	3L:0T:2P	4 credits

Course Outcomes:

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

- Understand the concepts of power systems.
- Understand the various power system components.
- Evaluate fault currents for different types of faults.
- Understand the generation of over-voltages and insulation coordination.
- Understand basic protection schemes.
- Understand concepts of HVDC power transmission and renewable energy generation.

Module 1: Basic Concepts (4 hours)

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power
Grids and Micro-grids.
Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy
Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Module 2: Power System Components (15 hours)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power.
Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, auto-transformers, Neutral Grounding transformers. Tap-Changing in transformers.
Transformer Parameters. Single phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Module 3: Over-voltages and Insulation Requirements (4 hours)

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Module 4: Fault Analysis and Protection Systems (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Module 5: Introduction to DC Transmission & Renewable Energy Systems (9 hours)

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc
transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

PCC-EEE14: Power Systems – I Laboratory (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of PCC-EEE13. Visits to power system installations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis and Electro- magnetic transient program (EMTP) and Numerical Relays are suggested.

PCC-EEE15	Control Systems	3L:0T:2P	4 credits

Course Outcomes:

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

- Understand the modelling of linear-time-invariant systems using transfer function and state- space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

Module 1: Introduction to control problem (4 hours)

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.
Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Module 2: Time Response Analysis (10 hours)

Standard test signals. Time response of first and second order systems for standard test inputs.
Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.
Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module 3: Frequency-response analysis (6 hours)

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module 4: Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.
Root-loci method of feedback controller design.
Design specifications in frequency-domain. Frequency-domain methods of design.
Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Module 5: State variable Analysis (6 hours)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.
Pole-placement by state feedback.
Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems.
Stability of linear discrete-time systems.

Module 6: Introduction to Optimal Control and Nonlinear Control (5 hours)

Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Text/References:

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009

PCC-EEE16: Control Systems Laboratory (0:0:2 – 1 credit)

Hands-on/Computer experiments related to the course contents of PCC-EEE15.

PCC-EEE17	Power Electronics	3L:0T:2P	4 credits

Course Outcomes:

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

- Understand the differences between signal level and power level devices.
- Analyse controlled rectifier circuits.
- Analyse the operation of DC-DC choppers.
- Analyse the operation of voltage source inverters.

Module 1: Power switching devices (8 Hours)

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers (7 Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly
inductive load; Input current wave shape and power factor.

Module 3: DC-DC buck converter (5 Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage,
power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module 4: DC-DC boost converter (5 Hours)

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 5: Single-phase voltage source inverter (10 Hours)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage,
square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Module 6: Three-phase voltage source inverter (8 Hours)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Module 7: A.C. to A.C. Converter (8 Hours) [14]

Classification, principle of operation of step up and step down cyclo-converter, single phase to single phase cyclo-converter with resistive and inductive load, three phase to single phase cyclo-converter, half wave and full wave, cosine wave crossing technique. three phase to three phase cyclo-converter. output voltage equation of cyclo-converter.

Text/References:

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer

Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

PCC-EEE18: Power Electronics Laboratory (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of PCC-EEE17.

PCC-EEE19	**Analog & Digital Communication System [2]**	**3L:0T:2P**	**4 credits**

Course Outcome:

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

- Understand the basics of communication system, analog and digital modulation techniques.
- Apply the knowledge of digital electronics and understand the error control coding techniques.
- Summarize different types of communication systems and its requirements.

Module 1: Basic blocks of Communication System. Analog Modulation - Principles of Amplitude Modulation, DSBSC, SSB-SC and VSB-SC. AM transmitters and receivers.

Module 2: Angle Modulation - Frequency and Phase Modulation. Transmission Bandwidth of FM signals, Methods of generation and detection. FM Transmitters and Receivers.

Module 3: Sampling theorem - Pulse Modulation Techniques - PAM, PWM and PPM concepts - PCM system – Data transmission using analog carriers (ASK, FSK, BPSK, QPSK).

Module 4: Error control coding techniques – Linear block codes- Encoder and decoder. Cyclic codes – Encoder, Syndrome Calculator. Convolution codes.

Module 5: Modern Communication Systems – Microwave communication systems - Optical communication system - Satellite communication system - Mobile communication system.

Text / References:

1. Simon Haykins, 'Communication Systems', John Wiley, 3rd Edition, 1995.
2. D.Roddy & J.Coolen, 'Electronic Communications', Prentice Hall of India, 4th Edition, 1999.
3. Kennedy G, 'Electronic Communication System', McGraw Hill, 1987.

PCC-EEE20: Analog & Digital Communication System Laboratory (0:0:2 – 1 credit)

Hands-on/Computer experiments related to the course contents of PCC-EEE19.

MC 501	Constitution of India – Basic features and fundamental principles	3L : 0T : 0P	0 Credits (Mandatory non-credit course)

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status

6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

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Program Elective - 1

Sl. No.	Course Code	Course Title	L	T	P	Credit
1	100903	Information Theory and Coding	3	0	0	3
2	100904	Speech and Audio Processing	3	0	0	3
3	100905	Introduction to MEMS	3	0	0	3
4	100908	Bio-Medical Electronics	3	0	0	3
5	100913	CMOS Design	3	0	0	3
6	100914	Power Electronics	3	0	0	3
7	100919	Nano electronics	3	0	0	3
8	100921	Scientific computing	3	0	0	3

100903 Information Theory and Coding 3L: 0T:0P 3 credits

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.

Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

Text/Reference Books:

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Course Outcomes:

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

1. Understand the concept of information and entropy
2. Understand Shannon’s theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

100904 Speech and Audio Processing 3L: 0T: 0P 3 credits

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non- stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students" Edition), 2004.
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, Wiley Inter science, 2003.

Course Outcomes:

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

1. Mathematically model the speech signal
2. Analyze the quality and properties of speech signal.
3. Modify and enhance the speech and audio signals.

100905 Introduction to MEMS 3L: 0T: 0P 3 credits

Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview: Case studies. Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface
Micromachining, sacrificial layer processes, Stiction; Bulk
Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding. Mechanics of solids in
MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear
Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E. Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano- and Micro engineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Micro fabrication, CRC Press, 1997.
5. G. Kovacs, Micro machined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

100908 Bio-Medical Electronics 3L:0T:0P 3 credits

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc.

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X- ray and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Text/Reference Books:

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Course Outcomes:

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

1. Understand the application of the electronic systems in biological and medical applications.
2. Understand the practical limitations on the electronic components while handling bio- substances.
3. Understand and analyze the biological processes like other electronic processes.

100913 CMOS Design 3L: 0T: 0P 3 credits

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor. Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout. Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

Text/Reference Books:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4thEdition, Pearson Education India, 2011.
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.

100914 Power Electronics 3L: 0T:0P 3 credits

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE

and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter – series loaded half bridge DC-DC converter.
Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Text /Reference Books:

1. Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
3. P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.
4. V.R.Moorthi, "Power Electronics", Oxford University Press.
5. Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

Course Outcomes:

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

1. Build and test circuits using power devices such as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

100919 Nano electronics 3L: 0T: 0P 3 credits

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig- Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron

transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand
1. Novel Devices), Wiley-VCH, 2003.
2. K.E. Drexler, Nanosystems, Wiley, 1992.
3. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
4. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Course Outcomes:

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

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and theprocesses involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

100921 Scientific computing 3L: 0T:0P 3 credits

Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy

Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating- Point Arithmetic, Cancellation

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

Eigenvalues and singular values: Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD

Nonlinear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation Method **Optimization:** One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation Numerical Integration And Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation

Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

Text/ Reference Books:

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Ed., 2006
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

Course Outcomes:

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

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.

Semester VI (Third year]
Branch/Course Civil Engineering

Course Code	Course Title	L	T	P	Credit	Branch
	Constitution of India/Essence of Indian Knowledge Traditional	3	0	0	0	101
	Construction Engineering & Management	2	1	0	3	101
	Design of Steel Structure	3	0	0	3	101
	Engineering Economics, Estimation & Costing	2	0	2	3	101
	Environmental Engineering-II	3	0	0	3	101
	Geotechnical Engineering -II	3	0	0	3	101
	Industrial Visit	0	0	2	1	101
	MOOCs / SWAYAM / NPTEL Courses - 2	2	0	0	2	101
	Program Elective- I	3	0	0	3	101

Semester VI (Third year]
Branch/Course Mechanical Engineering

Course Code	Paper Title	L	T	P	Credits	branch
	Design of Machine Elements	3	1	2	5	102
	Dynamics of Machinery	3	0	3	4.5	102
	Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0	102
	Manufacturing Technology	3	0	3	4.5	102
	Open Elective- I	3	0	0	3	102
	Program Elective- I	3	0	0	3	102
	Program Elective- II	3	0	0	3	102

Semester VI (Third year]
Branch/Course Electrical Engineering

Course Code	Paper Title	L	T	P	Credits	branch
	Electronics Design Laboratory	1	0	4	3	103
	MOOCs / SWAYAM / NPTEL Courses - 2	3	0	0	3	103
	Power Systems – II (Operation and Control)	3	0	0	3	103
	Power Systems Laboratory – II	0	0	2	1	103
	Professional Skill Development	3	0	0	3	103
	Program Elective – III	3	0	0	3	103
	Program Elective- II	3	0	0	3	103
	Workshop/heads on Training/Soft Skill	3	0	0	0	103

Semester VI (Third year]
Branch/Course Electronics & Communication Engineering

Course Code	Paper Title	L	T	P	Credits	branch
	Biology for Engineers	2	1	0	3	104
	Computer Organization and Architecture	3	0	0	3	104
	Digital Communication	3	1	2	5	104
	Disaster Management	3	0	0	0	104
	Electronics Instruments and Measurement	3	1	2	5	104
	MOOCs / SWAYAM / NPTEL Courses - 2	2	0	0	2	104
	Program Elective- I	3	0	0	3	104
	Workshop/heads on Training/Soft Skill	3	0	0	0	104

Semester VI (Third year]
Branch/Course Computer Science & Engineering

Course Code	Paper Title	L	T	P	Credits	branch
	Compiler Design	3	0	4	5	105
	Computer Networks	3	0	4	5	105
	Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0	105
	Machine Learning	3	1	0	4	105
	MOOCs / SWAYAM / NPTEL Courses - 2	3	0	0	3	105
	Professional Elective Lab-I	0	0	2	1	105
	Program Elective- I	3	0	0	3	105
	Program Elective- II	3	0	0	3	105
	Project – I	0	0	4	2	105

Semester VI (Third year]
Branch/Course Information Technology

Course Code	Paper Title	L	T	P	Credits	branch
	Computer Networks	3	0	4	5	106
	Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0	106
	MOOCs / SWAYAM / NPTEL Courses - 2	3	0	0	3	106
	Professional Elective Lab-I	0	0	2	1	106
	Program Elective- I	3	0	0	3	106
	Program Elective- II	3	0	0	3	106
	Project-I	0	0	6	3	106
	Software Engineering	3	0	4	5	106

Semester VI (Third year]
Branch/Course Leather Technology

Course Code	Paper Title	L	T	P	Credits	branch
	Biology for Engineers	2	1	0	3	107
	Chemical Engineering –III	3	0	0	3	107
	Finance and accounting (Humanities)	3	0	0	3	107
	Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0	107
	Induction Program	3	0	0	0	107
	Leather finishing materials and Auxiliaries	3	0	0	3	107
	MOOCs / SWAYAM / NPTEL Courses - 2	2	0	0	2	107
	Practices of Leather manufacturing -II	3	0	3	4.5	107
	Principles of material testing	3	0	3	4.5	107

Semester VI (Third year]
Branch/Course Electrical Electronics Engineering

Course Code	Paper Title	L	T	P	Credits	branch
	Digital Signal Processing	3	0	2	4	110
	Electronics Design Laboratory	1	0	4	3	110
	Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0	110
	Introduction to VLSI Design	3	0	2	4	110
	Measurements and Instrumentation	3	0	2	4	110
	Professional Skill Development	3	0	0	3	110
	Program Elective- I	3	0	0	3	110
	Program Elective- II	3	0	0	3	110

Semester VI (Third year]
Branch/Course Civil Engineering

PCC-CE308	**Construction Engineering & Management**	**2L:1T:0P**	**3 credits**

Module 1: Basics of Construction- Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution;

Module 2: Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks.PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Module 3: Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

Module 4: Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities

Module 5: Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction

Module 6: Project Monitoring & Control- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project

management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Module 7: Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

Module 8: Construction Costs: Make-up of construction costs; Classification of costs, timecost trade-off in construction projects, compression and decompression.

Text/Reference Books:

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

S. No	Module (No of Lectures in brackets)	Tutorials
1	Basics of Construction (2)	
2	Construction Planning (6)	Develop a WBD structure for the construction of one storeyed building; Develop a bar chart for the construction of this building, including finishing activities, assuming reasonable activity durations.
3	Construction Methods basics (6)	Develop a CPM chart for a 5 span bridge on open foundations. Develop a comparative table for a 10-storeyed building constructed by at least three different methods, listing their pros and cons.

4	Construction Equipment Basics (3)	Develop a Gantt Chart for the construction of a two storeyed precast framed structure, including open foundations, along with list of equipment resources, assuming reasonable quantities and productivities. Develop a bar chart for concreting 1500 sq.m. of a 15cm. thick slab using various equipment for production to placing of concrete at 3m height above ground level; show all equipment resources required, along with a site layout.
5	Planning and Organizing Construction Site and Resources (4)	For the construction of a typical 3 storeyed, framed structure with 400 sq.m. area per floor develop the histograms for the various resources required, showing all intermediate calculations; also, draw S-curves for concrete placing and blockwork done over the period.
6	Project Monitoring and Control (4)	Write a 500-word note on the advantages of Lean Construction method over conventional project management systems. Write a 500-word note on the Safety and Health precautions you would take for a typical 3 storeyed building with 400 sq. m. plinth area.
7	Contract Management basics (3)	Assuming a 4 month delay in a construction contract of 24 months duration, form 3 groups for arguing the case for or against levying penalty on the contractor; Group A to formulate the contract conditions, Group B to act as Client and Group C to act as the Contractor. One person to act as Arbitrator/ Judge.
8	Construction Costs (2)	Refer to a Standard Schedule of Rates of any PWD (available on the Net), develop the approximate cost of a 3 storey, 400 sqm plinth area building.
	Total: 30 Lectures	15 Tutorials

PCC-CE309	Engineering Economics, Estimation & Costing	2L:0T:2P	3 credits

Module 1:Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes (3 lectures)

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve. (2 lectures)

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method. (3 lectures)

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized,

Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. (2 lectures)

Module 5: Estimation / Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying (7 lectures)

Module 6: Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. (3 lectures)

Module 7: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. (3 lectures)

Module 8: Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management (6 lectures)

Module 9: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture)

Term Work Assignments may include:

1. Deriving an approximate estimate for a multistoried building by approximate methods.
2. Detailed estimate for the following with the required material survey for the same.
    a. Ground plus three storied RCC Framed structure building with blockwork walls
    b. bridge with minimum 2 spans
    c. factory building
    d. road work
    e. cross drainage work
    f. Ground plus three storied building with load-bearing walls g Cost of finishes, MEP works for (f) above
3. Preparation of valuation report in standard Government form.
4. Assignments on rate analysis, specifications and simple estimates.
5. Detailed estimate of minor structure.
6. Preparation of Bar bending schedule.

Text/Reference Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan 7. B.S. Patil, Building & Engineering Contracts 8. Relevant Indian Standard Specifications.
9. World Bank Approved Contract Documents.
10. FIDIC Contract Conditions.
11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration

12. Typical PWD Rate Analysis documents.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

PCC-CE303	Design Of Steel Structure	3L:0T:0P	3 credits

Module 1: Introduction: Steel structures, material properties, Limit states and design philosophies; analysis and design methods, Loads, partial safety factors and load combinations, analysis of roof for wind loads. Codes and standards. Section Classification: Plastic, compact, semi-compact, and slender sections.

Module 2: Connections: Structural fasteners - Rivets, bolts and welds, strength under combined stresses, Bolted and Welded Connections - Simple and Eccentric and Column bases.I

Module 3: Tension members: Design based on net section including shear lag effects and block shear, lug angles. Compression members:

Module 4: Design for flexural and flexural-torsional buckling, Effective length factor: Sway and Non-sway frames, Local buckling, Built-up columns - Battens and lacings. Laterally Supported and Unsupported Beams:

Module 5: Design strength using shear-moment interaction; Built-up beams, Shear buckling strength, Plate girders and design of stiffeners, Lateral torsional buckling, Effect of restraints and effective length.

Module 6: Beam-Columns: Effect of axial load on flexure behaviour, P-M interaction and moment amplification, Flexural torsional buckling and Bi-axial bending.

Text/Reference Books:

1. McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J., 2003.
2. Galambos, T.V., Lin, F.J., Johnston, B.G., Basic Steel Design with LRFD, Prentice Hall, 1996
3. Segui, W. T., LRFD Steel Design, 2nd Ed., PWS Publishing, Boston.
4. Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper & Row, Publishers, New York, 1990.
5. Related Codes of Practice of BIS
6. NBC, National Building Code, BIS (2017).
7. ASCE, Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American Society of Civil Engineers, Virginia, 2002.
8. Subramanian, N. (2010). Steel Structures: Design and Practice, Oxford University Press.
9. Duggal, S.K. (2014). Limit State Design of Steel Structures, McGraw Hill.

PCC-CE304	Geotechnical Engineering -II	3L:0T:0P	3 credits

Module 1: Consolidation of Soil - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

On completion of this module, the student must be able to:

- Understand the basic mechanism of consolidation of soil;
- Determine various consolidation parameters of soil through laboratory test; Evaluate ground settlements against time.

Module 2: Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters unconfined compression test, vane shear test On completion of this module, the student must be able to:

- Determine graphically and analytically the stress state in any plane of the soil mass; Perform various shear strength tests and appreciate the different field conditions which they simulate;
- Understand the significance of shear strength parameters in various geotechnical analyses;
- Evaluate the stiffness of soil using shear strength parameters

Module 3: Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. On completion of this module, the student must be able to:

- Differentiate various modes of slope failure;
- Evaluate factor of safety of infinite slopes based on different ground conditions; Understand various methods for computation of factor of safety for finite slopes.

Module 4: Soil Exploration- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.

On completion of this module, the student must be able to:

- Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground;
- Understand various site investigation techniques and their in-situ applications; Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT, etc.

Module 5 Application of soil mechanics to determine earth pressures, analysis of retaining walls, cuts & excavations and sheet piles, stability of slopes, instrumentation.

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
4. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
5. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy
7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.
8. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy

PCC-CE306	Environmental Engineering-II	3L:0T:0P	3 credits

Module 1: Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module2: Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module 3: Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Practical Work: List of Experiments

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride and sulfate
5. Optimum coagulant dose
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
8. Break point Chlorination
9. Bacteriological quality measurement: MPN,
10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
11. Ambient noise measurement

Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw Hill International Editions, New York 1985.
4. MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.
5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
7. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

Semester VI (Third year]
Branch/Course Mechanical Engineering

PCC-ME 306	Dynamics of Machinery	3L:0T:3P	4.5 Credits

Objectives:

1. To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2. Develop knowledge of analytical and graphical methods for calculating balancing of reciprocating masses.
3. Develop understanding of vibrations and its significance on engineering design.
4. Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

Contents:

Module: 1

Force analysis of mechanism: Dynamics of plane motion of a rigid body, dynamically equivalent two mass system, correction torque, forced in mechanism and machines. **(Lectures 3)**

Module: 2

Turning moment diagram: Fluctuations of crankshaft speed and energy in a direct acting engine mechanism, flywheels. **(Lectures 5)**

Module: 3

Cams: Classification of cams and followers, types of follower and retardation, cam profile and generation of concentric and offset radial cam profiles by graphical method. Cams with specified contours tangent cam with roller follower, circular arc cam with flat follower. **(Lectures 8)**

Module: 4

Analysis of gyroscopic motion : Principle of gyroscope, gyroscopic couple and gyroscopic reaction couple, Gyroscopic effects on the movement of ships, aeroplanes, two wheeled and four wheeled vehicles, gyrostabilizers. **(Lectures 6)**

Module: 5

Effects of inertia of reciprocating masses on engine frame: Unbalanced primary and secondary forces and couples, balancing of primary and secondary forces, partial balancing of locomotives,

balancing of multicylinder in line and radial engines, direct and reverse cranks methods for balancing of radial engines. **(Lecture 8)**

Module: 6

Mechanical vibrations : Basic concepts degree of freedom, types of damping and viscous damping; natural free, damped free and damped forced vibrations of a single degree of freedom spring mass system, reciprocating and rotating unbalance, vibration isolation and transmissibility, whirling of shaft, elementary treatment of two degree of freedom systems torsional vibrations of single rotor and two rotor systems, transverse vibration of simply supported beam energy method, Rayleigh's and Dankerley method. **(Lecture 12)**

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Analyze stabilization of sea vehicles, aircrafts and automobile vehicles.
2. Compute frictional losses, torque transmission of mechanical systems.
3. Analyze dynamic force analysis of slider crank mechanism and design of flywheel.
4. Understand how to determine the natural frequencies of continuous systems starting from the general equation of displacement.
5. Understand balancing of reciprocating and rotary masses.

Text/References Books:

1. Theory of Machines / S.S Ratan/ Mc. Graw Hill Publ.
2. Mechanism and machine theory by Ashok G. Ambedkar, PHI Publications.
3. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age.
4. Theory of Machines / Shiegly / MGH
5. Theory of Machines / Thomas Bevan / CBS Publishers
6. Theory of machines / Khurmi / S.Chand.

Laboratory:

Minimum of 10 Experiment need to be performed

1. To study various types of Links, Pairs, Chain and Mechanism
2. To study inversion of Four Bar Mechanism
3. To study velocity diagram for Slider Crank Mechanism.
4. To study various kinds of belts drives.
5. To study and find coefficient of friction between belt and pulley.
6. To study various types of Cam and Follower arrangement.
7. To plot follower displacement Vs cam rotation graph for various cam follower arrangement.

8. To study Different types of Gears.
9. To study Different types of Gear Trains.
11. To Perform Experiment on Watt, Porter, Proell and Hartnell Governors and prepare Performance Characteristic Curves also analyze Stability & Sensitivity
12. To study gyroscopic effects through models.
13. To determine gyroscopic couple on Motorized Gyroscope.
14. To perform the experiment of Balancing of rotating parts and find the unbalanced couple and forces.
15. To study Dynamically Equivalent System.
16. Determine the moment of inertial of connecting rod by compound pendulum method and trifler suspension pendulum.
17. To study the various types of dynamometers.
18. To find out critical speed experimentally and to compare the Whirling Speed of a shaft with theoretical values

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PCC-ME 307	Manufacturing Technology	3L:0T:3P	4.5 Credits

Objectives:

(i) To provide knowledge on machines and related tools for manufacturing various components.
(ii) To understand the relationship between process and system in manufacturing domain.
(iii) To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Course Contents:

Module:1

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design. **(Lectures 10)**

Module:2

Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as microscale machining, Inspection and workpiece quality. **(Lectures 10)**

Module:3

Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices. **(Lectures 6)**

Module:4

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, Dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining **(Lectures 14)**

Course Outcomes:

Upon completion of this course, students will be able to the tooling needed for manufacturing, the dimensional accuracy and tolerances of products, assembly of different components and the application of optimization methods in manufacturing.

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-PearsonIndia, 2014.
2. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

Laboratory:

1. Measurement of angle using Sine Center / Sine bar / bevel protractor
2. Measurement of alignment using Autocollimator / Roller set
3. Measurement of cutting tool forces using
    a. Lathe tool Dynamometer
    b. Drill tool Dynamometer.
4. Measurement of Screw Threads Parameters using Two wire or Three-wire method.
5. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
6. Measurement of gear tooth profile using gear tooth Vernier/Gear tooth micrometer
7. Calibration of Micrometer using slip gauges
8. Measurement using Optical Flats

PCC-ME 308	Design of Machine Elements	3L:1T:2P	5 Credits

Objectives:

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through 1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components 2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations 3. An overview of codes, standards and design guidelines for different elements 4. An appreciation of parameter optimization and design iteration 5. An appreciation of the relationships between component level design and overall machine system design and performance

Course Contents:

Module: 1

Introduction to design: Steps in design process, design factors, practical considerations in design, selection of materials, strength of mechanical elements, impact load, shock load, fatigue loading, effects of surface, size, temperature and stress concentration, consideration of creep and thermal stress in design. (**Lectures8**)

Module: 2

Design of shafts: stresses in shafts, design of static loads, combined stresses, reversed bending and steady loads, design of shafts based on deflection and strength, critical speed of shafts. Analysis and design of sliding and rolling contact bearings, (**Lectures10**)

Module: 3

Riveted joint: Stresses in riveted joint, design of riveted joints with central and eccentric loads, boiler and tank joints, structural joints.

Bolt Joints: Stresses in bolt joint, design of bolt joints with central and eccentric loads.

Welded joints: types of welded joints, stresses, design of welded joints subjected to axial, torsional and bending loads, welds subjected to fluctuating loads**.** **(Lectures8**)

Module: 4

Design of Clutches: Friction clutches, uniform wear and uniform pressure assumptions, centrifugal clutches.

Brakes: Design of internal expansion elements, assumptions, design of external contraction elements, band type brakes. (**Lectures6**)

Module: 5

Design of transmission elements: spur, helical, bevel and worm gears;

Springs: stresses in helical springs, deflection of helical compression and tension springs, springs subjected to fatigue loading, concentric and helical torsion spring, critical frequency of springs, leaf springs, and design of automotive leaf springs. (**Lectures 8**)

Course Outcomes:

Upon completion of this course, students will get an overview of the design methodologies employed for the design of various machine components.

Data books allowed for Examination:

1. Mahadevan & Balaveera Reddy : Design Data Hand Book
2. Dr. Linghaigh & Prof. Narayana Iyengar, Vol.1 & 2 : Design Data Hand Book
3. P.S.G. Tech : Design Data Hand Book

Text Books:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

Laboratory:

1. To study the design procedure of Knuckle & Cotter joint.
2. Design of shafts subjected to torsion, bending moment and combined bending and torsion.
3. Design of flat and square key
4. Design and drawing of riveted joints
5. Design and drawing of screw jack
6. Journal Bearing Test Rig

Semester VI (Third year]
Branch/Course Electrical Engineering

PCC-EE23	Power Systems – II	3L:0T:0P	3 credits

Course Outcomes:

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

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the monitoring and control of a power system.
- Understand the basics of power system economics.

Module 1: Power Flow Analysis (7 hours)

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Module 2: Stability Constraints in synchronous grids (8 hours)

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three—phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4^{th} order methods), as well as the Equal Area Criterion. Impact of stability constraintson Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Module 3: Control of Frequency and Voltage (7 hours)

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.

Power flow control using embedded dc links, phase shifters and

Module 4: Monitoring and Control (6 hours)

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

Module 5: Fault Analysis and Protection Systems (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education,1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.,1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education,2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

PCC-EE24: Power Systems-II Laboratory (0:0:2 – 1 credit)

Hands-on and computational experiments related to the course contents of EE20. This should include
programmingofnumericalmethodsforsolutionofthepowerflowproblemandstabilityanalysis.Visit to load dispatch centre is suggested.

PCC-EE25	Electronics Design Laboratory	1L:0T:4P	3 credits

Course Outcomes:

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

- Understand the practical issues related to practical implementation of applications using electronic circuits.
- Choose appropriate components, software and hardware platforms.
- Design a Printed Circuit Board, get it made and populate/solder it with components.
- Work as a team with other students to implement an application.

Basicconceptsonmeasurements;Noiseinelectronicsystems;Sensorsandsignalconditioningcircuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Text/Reference Books

1. A. S. Sedra and K. C. Smith, “Microelectronic circuits”, Oxford University Press, 2007.
2. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1997.
3. H. W. Ott, “Noise Reduction Techniques in Electronic Systems”, Wiley, 1989.
4. W.C. Bosshart, “Printed Circuit Boards: Design and Technology”, Tata McGraw Hill, 1983.
5. G.L. Ginsberg, “Printed Circuit Design”, McGraw Hill, 1991.

Semester VI (Third year]
Branch/Course Electronics & Communication Engineering

EC115 Digital Communication 3L: 1T: 0P 3 Credits

Contents **Hours**

1 Introduction: Block Diagram of Digital Communication System, Advantages of Digital communication system over Analog communication systems, Sampling theorem, Signal reconstruction in time domain, Practical and Flat Top Sampling, Sampling of Band-pass Signal, Aliasing Problem, Uniform and Non-uniform quantization. Signal to Quantization ratio of Quantized Signal. 7 Hrs.

2 Baseband Transmission: Line Coding and its properties, Various types of PCM waveforms. Attributes of PCM waveforms, Mary Pulse Modulation waveforms, Differential Pulse Code Modulation, Multiplexing of PCM signals, Delta modulation, Idling noise and slope overload, Adaptive Delta Modulation, Adaptive DPCM, Comparison of PCM and DM 9 Hrs.

3 Baseband Detection: Error performance degradation in communication systems, Eb/NO parameter, Matched filter and its derivation, Inter-Symbol Interference (ISI), Nyquist criterion for zero ISI and raised cosine spectrum, Correlation detector : Decision threshold and Error probability for Binary, Unipolar (on-off) signalling 7 Hrs.

4 Band-pass Modulation and Demodulation: Types of digital modulation, Waveforms for Amplitude, Frequency and Phase Shift Keying, Method of generation and detection of coherent and non-coherent binary ASK, FSK and PSK, Differential phase shift keying, Quadrature modulation techniques, M- ary FSK, Minimum Shift Keying (MSK), Probability of error and comparison of various digital modulation techniques 9 Hrs.

5 Error: A base band signal receiver, Probability of error, The Optimum filter, Matched Filter, Probability of error in Matched filter, Coherent reception, Coherent reception of ASK, PSK and FSK, Non-Coherent reception of ASK, FSK, PSK and QPSK, Calculation of bit error probability of BPSK and BFSK, Error probability for QPSK 6 Hrs.

6 Multiple Access Techniques: Time division multiplexing, Frequency division multiplexing, Code division multiplexing, Introduction to upcoming techniques of transmission 2 Hrs.

Sl. No. Name of Authors / Books /Publishers

1. "Communication Systems", Simon Haykin, Wiley publication, 4th Edition, 2004
2. "Digital Communication Fundamentals and Applications", Bernard Sklar, Pearson Education India, 2nd Edition, 2009

3. "Modern Electronic Communication", Miller Gary M, Prentice-Hall, 6th Edition, 1999
4. "Digital Communications", John Proakis, Tata Mc Graw Hill, 5th Edition, 2007
5. "Electronic Communication Systems, Fundamentals Through Advanced", Wayne Tomsi, Pearson Education, 4th Edition, 2001

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

EC116Electronics Instruments and Measurements 3L: 1T: 0P 3 Credits

Contents	Hours
1	Introduction to Standards of Measurement, Errors and their evaluation. Calibration, Accuracy, Precision Sensitivity, Resolution, Noise, etc. 3 Hrs.
2	Measurements of voltage, current, power and energy: Moving iron, moving coil, thermal, Induction and Rectifier type. Measurements of power factor and frequency: Dynamometer and moving iron single and three phase power factor meters, Resonance, moving coil and moving iron frequency meters. Range extension of voltmeter, ammeter, Wattmeter and Energy meter: Voltmeter multipliers, Ammeter shunt, Current and Potential Transformers 10 Hrs.
3	Galvanometer: D' Arsonval, Vibration and Ballistic galvanometers 5 Hrs.
4	Bridges: D.C. bridges: Kelvin double bridge, Wheatstone bridge and Carey-Foster bridge; A.C. bridges: Maxwell Bridge, Hay and Owen bridges, Anderson Bridge, Wien Bridge, Schering Bridge and Heaviside-Campbell Bridge 7 Hrs.
5	Potentiometer's Principle, Standardization and application: D.C. Potentiometers: Crompton and Vernier potentiometers, A.C. Potentiometers: Coordinate type and Polar type 5 Hrs.
6	Magnetic measurements: Measurement of magnetic flux by ballistic galvanometer and fluxmeter, Determination of B-H curve and hysteresis loop, Separation of iron loss into hysteresis and eddy current losses, Measurement of iron loss and its separation on Lloyad-Fisher squares 5 Hrs.
7	Digital measurements: Digital voltmeter and multimeter Universal counter and its uses for measurements of frequency, ratio of two frequencies, Time period and Pulse width. 5 Hrs.

Name of Authors / Books /Publishers

1 "Measurement System, Application and Design", E O Doeblin, TMH
2 "Course in Electrical and Electronic Measurement and Instrumentation", A K Sawhney, Dhanpat Rai and Sons
3 "Electronic Measurements and Instrumentation", Rajendra Prasad, Khanna Publishers
4 "Basic Electrical Measurements", M.B. Stout, Prentice Hall

Electronic Instruments and Measurement Lab are according to the theory mentioned above.

0L: 0T: 2P 1 Credit

EC117Computer Organization and Architecture 3L: 0T: 0P 3 Credits

Contents Hours

1 Introduction: Computer Arithmetic, Instruction sets, Introduction to computer organization, CPU Design. Micro programmed Control: Control Memory, Address sequencing, Micro programming, sequencing and execution of microinstructions. 10 Hrs.

2 Memory system: Hierarchical memory structure, Cache memories, Set Associative memory, Virtual Memory, Paging, Segmentation, Input-Output Inter- face, Asynchronous Data Transfer, Programmed I/O, Interrupts, Direct Memory Access 8 Hrs.

3 Input-Output Organization: Basic Input/Output Structure of Computers, serial and parallel communications, Asynchronous Data Communication, Programmed I/O, Interrupt Driven I/O, Interrupt Controller, DMA, Device Drivers, Buses. 10 Hrs.

4 Introduction to Parallel Processing: Evolution of computer systems (RISC vs. CISC), Parallelism in uniprocessor systems, Architectural classification schemes. 5 Hrs.

5 Principles of Pipelining and Vector processing: Pipeline strategy, Pipeline performance, Controls and Data paths, Overlapped parallelism, Principles of designing pipelined processors, Vector processing requirements 7 Hrs.

Name of Authors / Books /Publishers

1 Computer system architecture by M. Morris Mano
2 Computer Architecture and parallel processing by Kai Hwang, Briggs, McGraw
3 Hill
4 Computer Architecture by Carter, Tata McGraw Hill.
5 Computer System Organization and Architecture by John D. Carpinelli, Pearson Education

BSC109	Biology for Engineers	3L:0T:0P	3 credits

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

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

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

Module 2. (3 hours)- Classification
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, uricoteliec, 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. (4 hours)-Genetics
Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"

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

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

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

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

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. 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. (4 hours)- Information Transfer
Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis
Purpose: How to analyses biological processes at the reductionistic level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism

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

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc 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. (3 hours)- Microbiology
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.

Module 10: Plant Physiology covering, Transpiration; Mineral nutrition (3 Lectures)

Module 10B: Ecology covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids; (3 Lectures)

References:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Semester VI (Third year]
Branch/Course Computer Science & Engineering

PCC CS 601	**Complier Design**	**3L:0T: 4P**	**5 Credits**
Pre-requisites	**Formal Language & Automata Theory**		

Objectives of the course

- To understand and list the different stages in the process of compilation.
- Identify different methods of lexical analysis
- Design top-down and bottom-up parsers
- Identify synthesized and inherited attributes
- Develop syntax directed translation schemes
- Develop algorithms to generate code for a target machine
- To study the underlying theories in designing of a compiler
- The study especially consider the imperative languages

Detailed contents

Module 1 **Lecture: 6 hrs.**

Introduction: Phases of compilation and overview.

Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, from regular expressions to finite automata, scanner generator (lex, flex).

Module 2 **Lecture: 9 hrs.**

Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison).

Module 3 **Lecture: 10 hrs.**

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree.

Symbol Table: Its structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope.

Module 4 **Lecture: 10 hrs.**

Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

Code Improvement (optimization) Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc.

Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Module 5 **Lecture: 5 hrs.**

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Suggested Books:

1. Compilers Principles Techniques And Tools by Alfred V. Aho, Ravi Sethi, Jeffery D. Ullman. Pearson Education.

Suggested Reference Book

1. Compiler Design by Santanu Chattopadhyay. PHI
2. Modern Compiler Design by Dick Grune, E. Bal. Ceriel, J. H. Jacobs, and Koen G. Langendoen, Viley Dreamtech.

Course Outcomes

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

1. Develop the lexical analyser for a given grammar specification.
2. Design top-down and bottom-up parsers for a given parser specification
3. Develop syntax directed translation schemes
4. Develop algorithms to generate code for a target machine

PCC CS 601P	**Complier Design Lab**

Hands-on experiments related to the course contents of PCC CS 601.

PCC CS 602	**Computer Networks**	**3L:0T: 4P**	**5 Credits**
Pre-requisites	**PCC CS 402 & PCC CS 403**		

Objectives of the course

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Detailed contents

Module 1 **Lecture 8 hrs.**

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Module 2 **Lecture 8 hrs.**

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Module 3 **Lecture 8 hrs.**

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping - ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Module 4 **Lecture 8 hrs.**

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module 5 **Lecture 8 hrs.**

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Suggested books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Suggested reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Outcomes

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

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) and can able to describe the function of each block.
3. Program for a given problem related TCP/IP protocol.
4. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

PCC CS 602P	**Computer Networks Lab**

Hands-on experiments related to the course contents of PCC CS 602.

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PCC CS 603	Machine Learning	3L: 1T:0 P	4 Credits

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.

Detailed contents

Module 1 **Lecture 8 hrs.**

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

Module 2 **Lecture 8 hrs.**

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

Module 3 **Lecture 8 hrs.**

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.

Module 4 **Lecture 8 hrs.**

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

Module 5 **Lecture 8 hrs.**

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 Ethem Alpaydin

Suggested Reference Books:

1. J. Shavlik and T. Dietterich (Ed), Readings in Machine Learning, Morgan Kaufmann, 1990.
2. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
3. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017. [SS-2017]
4. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009. [TH-2009]

Semester VI (Third year]
Branch/Course Information Technology

PCC-IT602	**Computer Networks**	**3L:0T: 4P**	**5 Credits**
Pre-requisites	**PCC-CS - 402 PCC-CS - 403**		

Objectives of the course

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Module 1: **Lecture 8**

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Module 2: **Lecture 8**

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols -

Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Module 3: **Lecture 8**

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Module 4: **Lecture 8**

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module 5: **Lecture 8**

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Suggested books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Suggested reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Outcomes

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
3. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component
4. For a given problem related TCP/IP protocol developed the network programming.
5. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

PCC- IT601	Software Engineering	3L:0T:4P	5 Credits
Pre-requisites	PCC – CS402		

Module I **Lectures: 8**

Introduction: What is Software Engineering and its history, software crisis, Evolution of a Programming System Product, Characteristics of Software, Brooks' No Silver Bullet, and Software Myths, Software Development Life Cycles: Software Development Process, The Code-and-Fix model, The Waterfall model, The Evolutionary Model, The Incremental Implementation, Prototyping, The Spiral Model, Software Reuse, Critical Comparisons of SDLC models, An Introduction to Non-Traditional Software Development Process: Rational Unified Process, Rapid Application Development, Agile Development Process.

Module II **Lectures: 8**

Requirements: Importance of Requirement Analysis, User Needs, Software Features and Software Requirements, Classes of User Requirements: Enduring and Volatile, Sub phases of Requirement Analysis, Functional and Nonfunctional requirements, Barriers to Eliciting User requirements, The software requirements document and SRS standards, Requirements Engineering, Case Study of SRS for a Real Time System. Tools for Requirements Gathering: Document Flow Chart, Decision Table, Decision Tree, Introduction to nontraditional Requirements.

Module III **Lectures: 8**

Software Design: Goals of good software design, Design strategies and methodologies, Data oriented software design, Structured Design: Structure chart, Coupling, Cohesion, Modular structure, Packaging, Object oriented design, Top-down and bottom-up approach, Design patterns, Structured Analysis: DFD, Data Dictionary, Software Measurement and Metrics: Various Size Oriented Measures: Halstead's software science, Function Point (FP) based measures, Cyclomatic Complexity Measures: Control flow graphs. Development: Selecting a language, Coding guidelines, Writing code, Code documentation.

Module IV **Lectures: 7**

Software Testing: Testing process, Design of test cases, Functional Testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing, Path testing, Data flow and mutation testing, Unit testing, Integration and system testing, Debugging, Alpha & beta testing, testing tools & standards.

Module V **Lectures: 5**

Software Maintenance: Management of maintenance, Maintenance process, Maintenance models, Regression testing, Reverse engineering, Software reengineering, Configuration management, documentation.

Text Book:

1. Software Engineering: A Practitioner's Approach, R. S. Pressman, McGraw Hill
2. Fundamental of Software Engg. By Rajib Mall 4th edition PHI

Reference Book:

1. Zero Defect Software, G. G. Schulmeyer, McGraw-Hill
2. Object Oriented Modeling and Design, J. Rumbaugh, Prentice Hall
3. Software Engineering, K.K. Aggarwal, Yogesh Singh, New Age International Publishers

Semester VI (Third year]
Branch/Course Leather Technology

PCC-LT307	**Chemical Engineering -III**	**3L: 0T:0P**	**3 Credits**

Module I: Mass Transfer and Diffusion (12hours)

Steady-state ordinary molecular diffusion: Fick's law of diffusion; Velocities in mass transfer, Equimolar counter diffusion; unimolecular diffusion, Diffusion coefficients: Diffusivity in gas mixtures, diffusivity in liquid mixtures, Diffusivity in solids, One-dimensional, steady-state, molecular diffusion through stationary media, Models for mass transfer at a fluid-fluid interface: Film theory; Penetration theory; surface-renewal theory; film-penetration theory, Two-film theory and overall mass transfer coefficients

Module 2: Absorption and Stripping (08hours)

Equipment, Gas-liquid equilibrium, Henry's law, Selection of solvent, Absorption in tray column, Graphical and analytical methods, Absorption in packed columns.

Module 3: Adsorption (08hours)

Description of adsorption processes and their application, Types of adsorption, Nature of adsorbents; Adsorption isotherms and adsorption hysteresis; Stagewise and continuous contact adsorption operations, Determination of number of stages, Equipment.

Module 4: Drying (06hours)

Solid-gas equilibrium, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying,

Module 5: Crystallization (08hours)

Crystal geometry-Crystal-size distribution; Thermodynamic considerations Solubility and material balances, Enthalpy balance; Kinetic and transport considerations Supersaturation, Nucleation, Crystal growth; Equipment for solution crystallization-Circulating, batch crystallizers, Continuous, cooling crystallizers, Continuous, vacuum evaporating crystallizers

Texts/References:

1. Treybal, R.E. "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
2. Seader, J.D. and Henley, E.J., "Separation Process Principles", 2nd ed., Wiley India Pvt. Ltd., New Delhi (2013).
3. Sherwood, T. K., Pigford, R. L. and Wilke, C.R. "Mass Transfer" McGraw Hill (1975).
4. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th ed., PHI Learning Private Limited, New Delhi (2012).

PCC-LT308	**Leather finishing materials and Auxiliaries**	**3L: 0T:0P**	**3 Credits**

Module1. Pigments (08hours)

Inorganic and Organic Pigments, Preparation of Pigments, Methods of Preparation of Pigments, Aqueous Pigment Paste, Properties required in Pigments.

Module 2. Principles of Finishing, Finish Formulation and their Application (06hours)

Definition, Aim, Film- Formation mechanism, Properties of films such as transparency, Gloss and resistance to heat, light and solvent, Role is dispersion and stability – Requirement in multiple coat technique- Single coat, Composition and methods of application like spraying, Curtain coating, Roller coating etc., Cationic finishes and their relative merits.

Module 3. **(06hours)**

Chemistry and Preparation of Nitrocellulose, lacquers, lacuuer emulsion, Coloured lacquers, Wax emulsions, Silicone emlsion.

Module4. **(06hours)**

Chemistry and Properties required of Synthetic Polymers, Impregnatin agents, Binders, Chemistry of Polyurethane lacquers.

Module 5. **(06hours)**

Chemistry and Mechanism of Plasticization, Internal and External Plasticizers.

Module 6. **(06hours)**

Definition of Water proofing, Theory of water Proofing, Chemistry &Mechanism involved in water proofing**.**

Module 7. **(06hours)**

Upgradation technologies in finishing. General introduction to addition, condensation, Natural polymer, Caesin, Cellulose

Text/References

1. Acrylics and their uses in leather manufacture. By Rajadesa, S. and Kula Sekhran, S. CLRI 3 Chennai –1956.
2. Chemistry of Tanning Process. By Gustavson, K.H. Academic Press, New York- 1956.
3. The Chemistry and Technology of Leather. By Fred O, Flaherty, Toddy T.W. and Hollar, R. M. Vol – II, Types of tannages, Rober E. Krieger, Publishing Co. New York – 1977.

HSMC 04	FINANCE AND ACCOUNTING	3L:0T:0P	3 Credits

Module 1

Various definitions of Economics: Nature of Economic Problem, Relation between science Engineering. Technology & Economics **(3 lectures)**

Module 2

Meaning of demand, Law of Demand, Elasticity of demand, Practical importance & application of the concept of elasticity of Demand **(5 lectures)**

Module 3

Meaning of Production and factor of Production: Land, labor, Capital, Entrepreneur& Organization –their Characteristics law of variable Proportion. Return to Scale **(5 lectures)**

Module 4

Cost Analysis: Various concepts of cost, Cost function, Short & Long run cost. Concept of Revenue, Break-Even Analysis **(5 lectures)**

Module 5

Meaning of Market: Type of market –Perfect completion, Monopoly, Oligopoly, Monopolistic competition, Main feature of these market), Meaning of Supply and Law of Supply, R ole of Demand & Supply in price in prime determination imperfect t competition **(7 lectures)**

Module 6

Engineering Economy:

(a) Simple and compound interest, Annuities, (b)Basic methods For making economy Studies -(i) Present worth method, (ii) Future worth method (iii)I.R.R method (c) Comparison of alternative –(i) Present worth method, (ii\) Future Worth method (iii) I.R.R method. **(7 Lecture)**

Module 7

Accounting: Meaning Scope and Role of accounting, Accounting concept & Convention. Accounting as information System. Recording of transaction in journal and Ledgers. Trial –Balance, Preparation of final Account. (**9 Lecture)**

Text Book:

1. Modern Micro Economics by Theory -H.L.Ahuja-S.Chand
2. Advance Economic Theory by M .L.Jhingan-Konark Publication
3. Engineering Economics by Degarmo , Sullican & Canada –McMillan
4. Double Entry Book Keeping by T.S.Grewal –S .Chand

Reference Books:

1. Stonier & Hague by A test book of Economic Theory-Pearson
2. Industrial Organisation and Engg. Economics by Banga & Sharma

BSC109	Biology for Engineers	3L:0T:0P	3 credits

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

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

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

Module 2. (3 hours)- Classification
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, uricoteliec, 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. (4 hours)-Genetics
Purpose: To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”

Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to

genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

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

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

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

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. 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. (4 hours)- Information Transfer
Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis
Purpose: How to analyses biological processes at the reductionistic level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism

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

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc 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. (3 hours)- Microbiology

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.

Module 10: Plant Physiology covering, Transpiration; Mineral nutrition (3 Lectures)

Module 10B: Ecology covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids; (3 Lectures)

References:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Semester VI (Third year]
Branch/Course Electrical Electronics Engineering

PEC-EEE23	Digital Signal Processing	3L:0T:0P	3 credits

Course Outcomes:

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

- Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
- Analyse discrete-time systems using z-transform.
- Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
- Design digital filters for various applications.
- Apply digital signal processing for the analysis of real-life signals.

Module 1: Discrete-time signals and systems (6 hours)

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Module 2: Z-transform (6 hours)

z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

Module 2: Discrete Fourier Transform (10 hours)

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Connvolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Module 3: Designof Digital filters (12 hours)

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and Highpass filters.

Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Module 4: Applications of Digital Signal Processing (6 hours)

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Text/Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall,

1992.
5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, “Digital Signal Processing”, John Wiley & Sons, 1988.

PCC-EEE24: Digital Signal Processing Laboratory (0:0:2 – 1 credit)

Hands-on/Computer experiments related to the course contents of PCC-EEE23.

PCC-EEE25	Measurements and Instrumentation	3L:0T:0P	3 credits

Course Outcomes:

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

- Design and validate DC and AC bridges.
- Analyze the dynamic response and the calibration of few instruments.
- Learn about various measurement devices, their characteristics, their operation and their limitations.
- Understand statistical data analysis.
- 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.
8. Basic components of bio-medical instruments, bio-electric signals & recording electrodes, transducers, recording and display devices. Patient care and monitoring systems, cardiovascular measurements-blood pressure, blood flow, cardiac output, heart sounds etc.; instrumentation for respiratory and nervous systems, analysis of EEG, ECG, EMG, EOG and action potentials, non- invasive diagnostic measurements - temperature, ultrasonic diagnosis, CAT scan techniques, sensory measurements-motor response.

PCC-EEE26: Measurements and Instrumentation Laboratory (0:0:2 – 1 credit)

List of 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 DSO for steady state periodic waveforms produced by a function generator.
    a. Selection of trigger source and trigger level, selection of time-scale and voltage scale.
    b. 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-EEE27	Electronics Design Laboratory	1L:0T:4P	3 credits

Course Outcomes:

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

- Understand the practical issues related to practical implementation of applications using electronic circuits.
- Choose appropriate components, software and hardware platforms.
- Design a Printed Circuit Board, get it made and populate/solder it with components.
- Work as a team with other students to implement an application.

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Text/Reference Books

1. A. S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press, 2007.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1997.
3. H.W.Ott, "Noise Reduction Techniques in Electronic Systems", Wiley, 1989.
4. W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, 1983.
5. G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.

Program Elective - 1

Sl. No.	Course Code	Course Title	L	T	P	Credit
1	100903	Information Theory and Coding	3	0	0	3
2	100904	Speech and Audio Processing	3	0	0	3
3	100905	Introduction to MEMS	3	0	0	3
4	100908	Bio-Medical Electronics	3	0	0	3
5	100913	CMOS Design	3	0	0	3
6	100914	Power Electronics	3	0	0	3
7	100919	Nano electronics	3	0	0	3
8	100921	Scientific computing	3	0	0	3

100903 Information Theory and Coding 3L: 0T:0P 3 credits

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.

Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

Text/Reference Books:

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Course Outcomes:

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

1. Understand the concept of information and entropy
2. Understand Shannon’s theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

100904 Speech and Audio Processing 3L: 0T: 0P 3 credits

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, Wiley Inter science, 2003.

Course Outcomes:

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

1. Mathematically model the speech signal
2. Analyze the quality and properties of speech signal.
3. Modify and enhance the speech and audio signals.

100905 Introduction to MEMS 3L: 0T: 0P 3 credits

Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview: Case studies. Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding. Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E. Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Micro engineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Micro fabrication, CRC Press, 1997.
5. G. Kovacs, Micro machined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

100908 Bio-Medical Electronics 3L:0T:0P 3 credits

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc.

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X-ray and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Text/Reference Books:

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Course Outcomes:

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

1. Understand the application of the electronic systems in biological and medical applications.
2. Understand the practical limitations on the electronic components while handling bio-substances.
3. Understand and analyze the biological processes like other electronic processes.

100913 CMOS Design 3L: 0T: 0P 3 credits

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor. Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout. Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

Text/Reference Books:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4thEdition, Pearson Education India, 2011.
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.

100914 Power Electronics 3L: 0T:0P 3 credits

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and

level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter – series loaded half bridge DC-DC converter.
Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Text /Reference Books:

1. Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
3. P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.
4. V.R.Moorthi, "Power Electronics", Oxford University Press.
5. Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

Course Outcomes:

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

1. Build and test circuits using power devices such as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

100919 Nano electronics 3L: 0T: 0P 3 credits

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand
1. Novel Devices), Wiley-VCH, 2003.
2. K.E. Drexler, Nanosystems, Wiley, 1992.
3. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
4. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Course Outcomes:

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

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and theprocesses involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

100921 Scientific computing 3L: 0T:0P 3 credits

Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy

Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

Eigenvalues and singular values: Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD

Nonlinear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation Method

Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation Numerical Integration And

Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

Text/ Reference Books:

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Ed., 2006
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

Course Outcomes:

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

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.
