Curriculum for Undergraduate Degree (B.Tech.) in Electrical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Sixth Semester (Third Year)

Course Name:	**Power Electronics**		
Course Code:	**PC-EE 601**	**Category:**	Professional Core Courses
Semester:	6th	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	1. Electric Circuit Theory 2. Analog Electronics 3. Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the functioning and characteristics of power switching devices.
2	To understand different triggering circuits and techniques of commutation of SCR
3	To understand the principle of operation of converters.
4	To find external performance parameter of converters.
5	To analyze methods of voltage control, improvement of power factor and reduction of harmonics of the converter
6	To solve numerical problems of converters

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Concept of power electronics, advantages and disadvantages of power electronics converters, characteristics and switching behavior of different solid-state devices namely Power Diode, Power BJT, Power MOSFET, IGBT, GTO and MCT, basic idea about modern power electronics devices used in industry	4L
2	**PNPN devices:** Thyristors, brief description of members of Thyristor family with symbol, V-I characteristics of SCR, Two transistor model of SCR, SCR turn on methods, switching characteristics, gate triggering method, commutation techniques, SCR protection, series and parallel operation-I characteristics of DIAC and TRIAC, gate triggering circuit of TRIAC.	5L

3	**Phase controlled converters:** Principle of operation of single phase and three phase half wave, full wave and half controlled converters with R and R-L loads, effects of freewheeling diodes and source inductance on the performance of converters, Principle of dual converters	6L
4	**DC-DC converters:** Principle of operation, control strategies, concept of Buck, Boost, Buck- Boost and Cuk Converter, types of choppers circuits based on quadrant of operation, multiphase choppers, flyback converters.	5L
5	**Inverters:** Definition, classification of inverters based on nature of input source, wave shape of output voltage, method of commutation & connections, principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance analysis, methods of voltage control and harmonic reduction of inverters, Unipolar and bipolar PWM inverter. Resonant converter, Zero-Current Switching and Zero-Voltage Switching Resonant converter.	10L
6	**AC voltage regulator and Cycloconverter:** Single phase half wave and full wave AC regulator, on off control and phase control technique, principle of Cycloconverter, step up and step down operation, Three phase to single phase Cycloconverter	5L
7	**Applications:** Speed control of AC and DC motors, Electronic Ballast, HVDC transmission, Static circuit breaker, UPS.	5L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Differentiate different power electronic devices on the basis of construction and fundamental operations.
2	Describe about different triggering, commutation and protection circuits suitable for different power electronic devices.
3	Explain about the operation and application of different single phase, three phase power converters and DC to DC converters.
4	Select an appropriate power semiconductor device for required converter application.
5	Apply the above knowledge to predict the performance of a simple power electronic circuit.
6	Use different power electronic converters in commercial and industrial applications.

Learning Resources:	
Recommended Text Books	
1	Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Graw Hill.
2	Power Electronics, P.S. Bhimra, , 3rd Edition, Khanna Publishers.
Alternative Text Books	
3	Power Electronics, M.H. Rashid,4th Edition, Pearson .
4	Power Electronics, V.R. Moorthi, Oxford.

Reference Books	
5	Modern Power Electronics & AC drives, B.K. Bose, Prentice Hal.
6	Power Electronics, Mohan, Undeland & Riobbins, Wiley India.
7	Element of power Electronics, Phillip T Krein, Oxford.
8	Power Electronics systems, J.P. Agarwal, Pearson Education.

Course Name:	**Power System-II**		
Course Code:	PC-EE-602	**Category:**	Professional Core Courses
Semester:	6th	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Electric Circuit Theory(PC-EE-301) Electromagnetic Field Theory(PC-EE-303)) Power System I (PC-EE-502)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1.	To understand the method of representation of power system components
2.	To know about location and components of a distribution substation
3.	To understand different methods of load flow studies
4.	To determine faults in Electrical systems
5.	To understand the principle of power system stability
6.	To understand the principle of relays and methods of protection of power system
7.	To solve numerical problems on the topics studied

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Representation of Power system components: Single phase representation of balanced three phase networks, the on-line diagram and the impedance or reactance diagram, PU system	2L
2	Distribution substation: Types of substations, location of substations, substation equipment and accessories, earthing system and equipment, feeders and distributors, radial and ring main systems	5L
3	Load flow studies: Network model formulation, formation of Y-bus, load flow problem, Gauss-Seidal method, Newton-Raphson method, Decoupled load flow studies, comparison of load flow methods	5L

4	Faults in Electrical systems: Transient o a transmission line, short circuit f a synchronous machine under no load and loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Symmetrical component analysis of unsymmetrical faults, LG, LL, LLG faults	8L
5	Power system stability: Steady state stability, transient stability, equal area criteria, swing equation, multi-machine stability concept	4L
6	Power system protection: Protective zones, relaying elements and quantities. Protective relays, basic requirements and type of protection, phase and amplitude comparator, grading (time and current), classification of electromagnetic relays, directional relay, distant relay, differential relay, basic aspects of static and digital relays, relay protection scheme for transformer, feeder, generators and motors Circuit breakers, circuit breaker transients, transient recovery voltage, current chopping and resistance switching, circuit breaker rating, arc and arc extinction, circuit breaker types, oil circuit breaker, vacuum circuit breaker, air blast circuit breaker, SF6 circuit breaker and operating mechanism, advantages and disadvantages of different types	12L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Represent power system components in line diagrams.
2	Determine location of distribution substation
3	Determine the performance of power system with the help of load flow studies.
4	Analyze faults in Electrical systems.
5	Determine the stability of Power system.
6	Explain principle of operation of different power system protection equipment.
7	Solve numerical problems related to representation, load flow, faults, stability and protection of power system.

Learning Resources:	
Recommended Text Books	
1	Modern Power System Analysis, D.P. Kothari &I.J. Nagrath, 4th Edition, Tata McGraw Hill.
2	Electrical Power Systems, Subir Ray, PHI
3	A text book on Power System Engineering, M.L. Soni, P.V. Gupta, U.S. Bhatnagar & A. Chakrabari, Dhanpat Rai & Co.
Reference Books	
4	Power Engineering, D.P. Kothari & I.L. Nagrath, Tata McGraw Hill
5	Power System Stability, VOl. I, II, III, E.W. Kimbark, Wiley
6	A course in Power Systems, J.B. Gupa, S.K. Kataria & Sons

Course Name:	**Advanced Control system**		
Course Code:	PE-EE601A	**Category:**	Professional Elective Courses
Semester:	6th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	1. Control system 2. Electric Circuit theory
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To describe the state space analysis of linear, non-linear and discrete time system.
2	To design state feedback controller using various methods.
3	To illustrate and compare the stability analysis of discrete and non-linear control system
4	To study the conventional technique of non-linear system analysis.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**State Variable Analysis :** Concept of state, state variable and state model, State space representation using physical variables, Converting higher order linear differential equations into State Variable (SV) form. Obtaining SV model from Transfer Function. Obtaining characteristic equation and transfer functions from SV model, Solution of State Equations, State transition matrix and its properties, Concepts of Controllability and Observability.	13L
2	**Design of state feedback controller:** Linear state variable feedback controller. Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman‘s formula.	5L
3	**Discrete-time Control System :** Introduction to Z transform, Difference equation. Inverse Z transforms. State variable analysis of discrete system, Stability analysis of closed-loop systems in the z-plane, Jury‘s Stability analysis**.**	12L
3	**Nonlinear Control Systems:** Introduction to Nonlinear systems and their properties, Common Non-linearities, state variable representation of nonlinear systems, Describing functions Analysis, Limit cycles in nonlinear systems. Prediction of limit cycles using describing function technique, Phase plane method Analysis, Methods of obtaining phase plane trajectories by graphical method, isoclines method, Lyapounov‘s method for stability study.	10L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Acquire knowledge of state space model and state feedback in modern control systems,
2	Derive discrete-time mathematical models and perform stability analysis z domain
3	Demonstrate non-linear system behavior by phase plane and describing function methods
4	Perform the stability analysis nonlinear systems by Lyapunov method
5	Design of state observers and output feedback controllers

Learning Resources:	
Recommended Text Books	
1	I. J. Nagrath & M. Gopal. ,Control System Engineering, New Age International Publication
2	K. Ogata, Discrete-time Control Systems, Pearson Education
Alternative Text Books	
3	M. Gopal , Digital Control and State Variable Methods, Conventional and Intelligent Control Systems, McGraw Hill. Third Edition,
4	K. Ogata. Modern Control Engineering. Fifth edition, Prentice Hall of India,
Reference Books	
5	M.N. Bandyopadhyay, Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited

Course Name:	**Computational Electromagnetics**		
Course Code:	PE-EE601B	**Category:**	Professional Elective Courses
Semester:	6th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics Engineering (ES-EE 201), Mathematics (BS-M101, BS-M201), Physics (BS-PH201) and Electromagnetic field theory (PC-EE303)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To broaden understanding of Maxwell‘s equations and how to solve them
2	To provide knowledge of the basics of numerical computation.
3	To be aware of the problems and limits of finite-precision arithmetic.
4	To understand how to use computational EM techniques to solve real-world problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1	**Introduction:** Computational Electromagnetics. Maxwell's Equations: Boundary Conditions, Energy Relations, Time Evolution. Dispersion Relation and Wave Velocities. Low-Frequency Approximation. Integral Formulation.	4L
2	**Convergence:** Extrapolation to Zero Cell Size. A Singular Problem. Practical Procedures.	2L
3	**Finite Differences:** A2D Capacitance Problem: Iterative Solution of Laplace's Equation. Computing the Capacitance. MATLAB: Capacitance of Coaxial Cable. Finite Difference Derivatives of Complex Exponentials: First-Order Derivative. Spurious Solutions and Staggered Grids. Second-Order Derivative.	4L
4	**Eigenvalues:** Maxwell's Equations. Model Problems. Frequency-Domain Eigenvalue Calculation: MATLAB: The 1D Helmholtz Equation. Time-Domain Eigenvalue Calculation: Stability Analysis. MATLAB: The 1D Wave Equation. Extracting the Eigen frequencies. MATLAB: Pad´e Approximation	4L
5	**The Finite-Difference Time-Domain Method:** The 1D Wave Equation. Dispersion and Stability. The FDTD Method: Staggered Grids: One Space Dimension. Three Space Dimensions. MATLAB: Cubical Cavity. Integral Interpretation of the FDTD Method. Dispersion Analysis in Three Dimensions. Boundary Conditions for Open Regions: The Perfectly Matched Layer. Near-to-Far-Field Transformation.	4L
6	**The Finite Element Method:** General Recipe. 1D Finite Element Analysis. 2D Finite Element Analysis: The Assembling Procedure. Unstructured Meshes in Practice. MATLAB: 2D FEM Using Nodal Basis Functions. Adaptivity. Vector Equations: Mixed-Order FEM for Systems of First-Order Equations. The Curl-Curl Equation and Edge Elements. Edge Elements on Cartesian Grids. Eigenfrequencies of a Rectangular Cavity. Edge Elements on Triangles. Edge Elements in Practice. MATLAB: FEM with Triangular Edge Elements. Time-Dependent Problems. Magnetostatics and Eddy Current Problems: 2D Formulation. A 2D Application Problem. 3D Eddy Current Calculations. Variational Methods: Relation Between Linear Differential Equations and Quadratic Forms. Rayleigh–Ritz Method. Galerkin's Method. A Variational Method for Maxwell's Equations.	6L

7	**Boundary Element Method:** Modelling of Problems via the BEM: Direct and Indirect Approach. The Boundary Element Method. Integral Equation formulation. Boundary element Discretization. Computational example for 2D Static Problem. Boundary Element Solution of the Eddy Current Problem. Two-Dimensional Scattering from a Perfectly conducting Cylinder of Arbitrary Cross-section. Solution by the Indirect Boundary Element Method.	5L
8	**The Method of Moments:** Integral Formulation of Electrostatics: Green's Function. General Formulation. FEM Solution. Capacitance Problem in an Unbounded 2D Region: Integration. MATLAB: MoM for General, 2D Geometry. Charge Distribution. Adaptivity. Numerical Integration. Electromagnetic Scattering: Representation by Potentials and a Lorentz Gauge. Green's Function for the Vector Potential. The Electric Field Integral Equation. The Magnetic Field Integral Equation. The Combined Field Integral Equation Scattering on Thin Wires: Hall´en's Equation. Valid Approximation for the 1D Kernel. Numerical Solution. MATLAB: Hall´en's Equation. Numerical Results.	6L
9	**Summary and Overview:** Differential Equation Solvers: Finite-Difference Time-Domain. Finite-Volume Time-Domain. Finite Element Method. Transmission Line Method. Finite Integration Technique Integral Equation Solvers: Frequency-Domain Integral Equations. Time-Domain Integral Equations. Hybrid Methods.	3L
Total		**38L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Formulate and implement a basic computational algorithm in electromagnetics based on- (i) the finite-difference scheme, (ii) the finite-element method and (ii) the boundary-element method.
2	Perform basic assessment of the numerical error.
3	Distinguish between different sources that contribute to the numerical error.
4	Use basic extrapolation techniques.
5	Choose between time, frequency or eigenvalue analysis for a given electromagnetic problem.
6	Choose appropriate numerical techniques for a given application.
7	Choose appropriate post-processing tools for a given application.
8	Operate commercial software in a well-informed manner.
9	Evaluate the computational resources required to analyze a given industrial problem.

Learning Resources:
Recommended Text Books

1	Coputational Electromagnetics by Anders Bondeson, Par Ingelstrom, and Thomas Rylander. Springer.
2	Computational Electromagnetics with MATLAB, Fourth Edition Book by Matthew N.O. Sadiku. CRC press.
Alternative Text Books	
4	Computational Electromagnetism. Houssem Haddar, Ralf Hiptmair, Peter Monk, Rodolfo Rodríguez. Springer.
Reference Books	
5	Computational Electromagnetics: Recent Advances and Engineering Applications by RajMittra. Springer.

Course Name:	**Renewable and Non-conventional Energy**		
Course Code:	PE-EE601C	**Category:**	Professional Elective Courses
Semester:	6th	**Credit: 3**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Electric Circuit Theory (PC-EE-301), Electromagnetic field theory (PC-EE-303), Electric Machine-I (PC-EE-401), Electrical and Electronics measurement (PC-EE-403)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the difference between Renewable and non-renewable energy sources
2	To understand methods of conversion of solar energy and wind energy to other form of energy
3	To understand methods harnessing energy from Biomass, Geothermal and ocean
4	To understand the principle of operation of Magneto Hydrodynamic power generation
5	To understand the principle and operation of fuel cell.
6	To solve numerical problems of Renewable and non-renewable energy sources

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Energy sources:** Renewable and non-renewable energy sources, energy consumption as a measure of Nation‘s development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol.	4L

2	**Solar Energy:** Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaic – solar cells, different types of PV Cells, Mono-poly Crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems	10L
3	**Wind Energy:** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations	5L
4	**Energy from Biomass:** Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	5L
5	**Geothermal Energy:** Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.	5L
6	**Energy from Ocean:** Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.	5L
7	**Magneto Hydrodynamic power generation:** Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects	3L
8	**Hydrogen Energy:** Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles	3L
9	**Fuel cell:** Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells	2L

Total	**42L**

Course Outcomes:	
1	Explain the principle of conversion of solar energy, wind energy , biomass, Geothermal energy, Ocean energy and Hydrogen energy to other form of energy.
2	Suggest location to set up wind mill and biogas generation plant
3	Use Solar energy, Wind energy , Biomass, Geothermal energy, Ocean energy, Hydrogen energy and fuel cell for different applications.
4	Explain the principle of operation of magneto hydrodynamic power generation
5	Estimate conversion efficiency of fuel cell.

Learning Resources:	
Recommended Text Books	
1	Renewable energy sources and conversion technology, Bansal Keemann, Meliss, Tata Mc Graw Hill
2	Non-conventional Energy sources, G.D. Rai, Khanna Publishers.
3	Non-conventional Energy Resources, B. H. Khan, , Tata Mc Graw Hill
Alternative Text Books	
4	Renewable energy resources and emerging technologies, D.P. Kothari, PHI
Reference Books	
5	Non-conventional Energy, Ashok V. Desai, New Age International Publishers Ltd.

Course Name:	**Network Analysis and Synthesis**		
Course Code:	PE-EE601D	**Category:**	Professional Elective Courses
Semester:	6th	**Credit: 3**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Electric Circuit Theory (PC-EE-301),
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To expanding the student‘s knowledge in network analysis beyond the basic topics
2	To understand advanced topics in network analysis, basics of filter design and network synthesis concepts.
3	To explore more advanced concepts in the analysis of complex networks

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Network Topology**: Linear Oriented Graphs -incidence matrix of a linear oriented graph –Kirchoff's Laws in incidence matrix formulation –nodal analysis of networks (independent and dependent sources) – Circuit matrix of linear oriented graph –Kirchoff's laws in fundamental circuit matrix formulation. Planar graphs –Mesh analysis- Duality –Relation between circuit, cut set and incidence matrices –Kirchoff's laws in fundamental cut-set formulation Equilibrium equations on loop basis, equilibrium equations on node basis, Solving network problem using equilibrium equations.	10L
2	Modeling Two-port networks-application examples-amplifiers, transmission lines, passive filters. Image parameter description of a reciprocal two-port network -- Image impedance - Characteristic impedance - propagation constant—derivation of characteristic impedance and propagation constant for T and Pi networks under sinusoidal steady state -- Attenuation constant and phase constant. Constant k and m-derived filters -- low pass, high pass, band-pass and band-stop filters --design--effect of cascading multiple sections. Resistive T, Pi and lattice attenuators.	8L
3	**Network Functions:** Review of Network functions for one port and two port networks: – pole zero location for driving point and transfer functions- Impulse response of Network functions from pole-zero plots- Sinusoidal steady-state frequency response from pole-zero plots. Hurwitz polynomials –properties - Positive real functions –Properties of positive real functions – passivity-necessary and sufficient conditions for positive real functions-physical realizability.	10L
4	Synthesis of one port network, Synthesis of reactive one-ports by foster's and Cauer methods (forms I and II) –Synthesis of LC, RC and RL driving-point functions.	8L
Total		**36L**

Course Outcomes:	
1	Apply network topology concepts in the formulation and solution of electric network problems.
2	Apply two-port network analysis in the design and analysis of filter and attenuator networks.
3	Identify the properties and characteristics of network functions, and verify the mathematical constraints for their physical realization.
4	Synthesize passive one-port networks using standard Foster and Cauer forms.

Learning Resources:	
Recommended Text Books	
1	Chakrabarti, A., "Circuit Theory Analysis and Synthesis", DhanpatRai& Co., Seventh - Revised edition, 2018.
2	S. K. Bhattacharya, ―Network Analysis and Synthesis,‖ Pearson Education India.
Alternative Text Books	
3.	Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013.
4	K. S. Suresh Kumar, ―Electric Circuit Analysis‖, Pearson Publications, 2013.
Reference Books	
5	Van Valkenburg M.E, ―Network Analysis,‖ Prentice Hall India, 2014
6	Charles A. Desoer and Ernest S. Kuh, ―Basic Circuit Theory,‖ Tata McGraw Hill Edition.
7	Franklin Kuo, ―Network Analysis and Synthesis‖, 2nd Ed.,Wiley India.
8	Van Valkenburg M.E., ―Introduction to Modern Network Synthesis,‖ Wiley Eastern, 1960 (reprint 1986).

Course Name:	**Data Structure and Algorithm**		
Course Code:	OE-CS601F	**Category:**	Open Elective II
Semester:	6th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Programming Concept, basic Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To familiarize the students with the basic concepts of linear data structures and operations on it.
2	To acquaint the students with nonlinear data structures and its application areas.
3	To develop the ability to compare complexity of different algorithms and find the best one for a given problem

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: Definition of Data Structure, Array operations: insertion, deletion, traversal, Analysis of an Algorithm: Asymptotic Notations, Time complexity analysis. Recursion: Definition and different types with examples, solution of Tower of Hanoi problem. Linear Data structures: Stacks and Queues Stack as an ADT and its operations, Applications of Stacks: Expression	8L

	Conversion and Evaluation – corresponding algorithms. Types of Queue: Linear Queue, Circular Queue, Priority Queue; Operations on each types and their algorithms. Dequeue: Basic concept and associated algorithms.	
2	Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Application of Linked list: representation of Polynomial and addition of two polynomials. Doubly linked list and Circular Linked List: Basic Concept and Operations.	6L
3	Non Linear Data structures: Tree: Basic Tree Terminologies, Different types of Trees: Binary Tree, its properties, Complete and Strictly Binary Tree, Threaded Binary Tree, Binary Search Tree: insertion, deletion & traversal algorithms, AVL tree, Applications of Binary Trees. B Tree, B+ Tree: definitions and construction algorithms. Graph: Basic terminologies and Representations, Graph traversal algorithms (BFS and DFS), Minimal Spanning Tree algorithms (Prim‘s and Kruskal‘s).	10L
4	Searching & Sorting: Linear Search and Binary Search algorithms and their complexity analysis, Interpolation Search algorithm. Sorting: Different sorting algorithms: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance analysis and comparison among all the methods;	8L
5	Hashing: Definition, different Hash functions and Collision resolution techniques. Advance Algorithm used solve real life problems like Job sequencing, Matrix chain multiplication or Fractional Knapsack	4L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basic concepts of Data structures and complexity of algorithms.
2	Comprehend the concepts of linear and nonlinear data structures and operations on them.
3	Apply the knowledge of linear and nonlinear data structures in solving problems.
4	Analyze complexity of different Sorting and Searching algorithms.

Learning Resources:	
1	–Data Structures with C‖ by Seymour Lipschutz, McGrawHill
2	–Data Structures Using C‖ by Reema Thareja, Oxford
3	–Fundamentals of Data Structures of C‖ by Ellis Horowitz, Sartaj Sahni
4	–Data Structures using C‖ by A N Tenenbaum, Y Langsam, M J Augenstein, Pearson

Course Name:	**Computer Organization**		
Course Code:	OE-EC601B	**Category:**	Open Elective Courses
Semester:	6th	**Credit:**	**3**
L-T-P:	3-0-0	**Pre-Requisites:**	Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce students how Computer Systems work & basics involved in data representation
2	This course will also expose students to the basic organization of Processor and Memory System.
3	The students will be able to know how I/O devices are being accessed.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Basic Computer Organization and Data Representation** Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage. Commonly used number systems. Fixed- and floating-point representation of numbers Floating point - IEEE 754 standard, Overflow, Underflow	5L
2	**Micro-operation and Computer Arithmetic:** Arithmetic Microoperations, Logic Microoperations, Shift Microoperation Design of adders - Ripple carry adder, Serial Adder and Carry Look Ahead Adder, BCD Adder Binary Incrementer Circuit, Binary Decrementer Circuit, Arithmetic Circuit, Arithmetic Logic Shift Unit Fixed point multiplication -Booth's algorithm. Fixed point division - Restoring and non-restoring algorithms.	9L
3	**Central Processing Unit** General Register Organization, Stack Organization Instruction Formats, Addressing Modes, Instruction Set, CISC Characteristics, RISC Characteristics Design of control unit - hardwired and microprogrammed control.	6L
4	**Memory Organization** Static and dynamic memory, Memory hierarchy, Associative memory. Cache memory, Associative Mapping, Direct Mapping, Set Associative Mapping, Virtual memory, Paging, Segmentation and Page replacement Algorithm, Memory unit design with special emphasis on implementation	10L

	of CPU-memory interfacing. Data path design for read/write access.	
5	**Input-Output Organization** Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Mode of Transfer, Priority Interrupt, Direct Memory Access	6L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe Computer hardware System, Instruction sets and Addressing Mode.
2	Apply the knowledge of number system to perform different arithmetical operations.
3	Design memory organization that uses banks for different word size operations.
4	Compare different type of control units and I/O transfer techniques.

Learning Resources:	
Recommended Text Books	
1	Mano, M.M., ―Computer System Architecture‖, PHI.
Alternative Text Books	
2	Hayes J. P., ―Computer Architecture & Organisation‖, McGraw Hill,
3	Hamacher, ―Computer Organisation‖, McGraw Hill,
Reference Books	
4	William Stallings ―Computer Organization and Architecture Designing for Performance‖, Pearson
5	B.Ram – ―Computer Organization & Architecture‖, Newage Publications

Course Name:	**Analog and Digital Communication**		
Course Code:	OE-EC601A	**Category**:	Open Elective
Semester:	6th	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic knowledge of Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the need for modulation in communication applications
2	To analyze various analog modulation schemes.
3	To analyze various digital modulation techniques.
4	To identify the utilities of various line coding techniques.
5	To apply the knowledge of digital carrier modulation techniques for choosing application specific modulation schemes.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Review of Fourier Series, Fourier Transform and probability theory in view of applications in Electronic Communication.	4L
2	**Introduction to Communication** Introduction to Communication, Elements of communication system Transmitters, Transmission channels & receivers, Concept of Baseband signal, Concept of modulation, it's need.	2L
3	**Continuous Wave Modulation** (a)Basic principle of Amplitude Modulation (AM), Time and frequency domain representation of AM signal, Generation of AM waves, Demodulation of AM wave. Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. Single side band modulation (SSB). basic concept of VSB, Spectra and band-width. Calculation of modulation index, power and bandwidth. Basic concept of Frequency and Phase Modulation, Generation of FM waves. Time and Frequency domain representations, Demodulation of FM waves, Calculation of modulation index, power and bandwidth.	10L
4	**Source Encoding** Introduction to Digital Communication, Concept of sampling, Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM), uniform and non-uniform quantization, quantization noise, binary encoding, A-Law and μ -law companding, differential PCM, delta modulation and adaptive delta modulation. Different line coding schemes i.e RZ, NRZ, Manchester coding	10L
5	**Base band pulse transmission** Nyquest criteria, ISI, Eye pattern, Matched Filter.	4L
6	***Digital carrier modulation and demodulation technique***: Different digital modulation techniques i.e ASK, BPSK, BFSK, QPSK- Basic theory, Transmitter and Receiver, Bit error rate . Bandwidth Efficiency. Introduction to QAM and Minimum Shift Keying	10L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the need for modulation, representation of the modulated carrier wave in both analog and digital communication.
2	Analyze the different types of analog and digital modulation techniques.

3	Understand the basic concept of Sampling and analog to digital signal conversion techniques, concept of line coding and ISI.
4	Analyze different career modulation techniques considering noise aspects.

Learning Resources:	
1	Principles of Communication Systems , H. Taub and D.L.Schilling, Goutam Saha, TMH Publishing Co., 4th edition, 2017.
2	Communication Systems , Simon Haykin, Wiley, 4th edition, 2006
3	Modern Digital and Analog Communication Systems, B. P Lathi. Oxford University Press, 4th edition, 2011.
4	Analog and Digital Communications, Sanjay Sharma, Kataria Publishers, 7th edition, 2017

Course Name:	**Electronic Devices**		
Course Code:	OE-EC601C	**Category:**	Open elective III
Semester:	6th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concepts of semiconductor physics.
2	To understand the physics of p n junction and different diodes.
3	To understand the basic concepts of BJT and MOSFET.
4	To characterize diodes and transistors
5	To develop an insight into the construction and working of opto electronic devices.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Energy bands & Current Carriers in Semiconductors:** Energy Bands theory in crystals (Qualitative Analysis), Metals, Semiconductors, & Insulators, Elemental and Compound Semiconductors, Direct and Indirect bandgap semiconductors, Fermi-Level, Intrinsic and Extrinsic Semiconductors, Effective mass, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of charge carriers, Generation and recombination of carriers; continuity equation. Quasi Fermi Energy level, Degenerate and Non-Degenerate semiconductors, Hall effect.	10L
2	**P-N junction:** P-N junction physics, I-V characteristics, junction	

	capacitance, Avalanche breakdown, Zener diode, Zener breakdown, ohmic contacts, Schottky diode, Tunnel Diode, Gunn diode, IMPATT Diode. Basic device technologies for fabrication of a p-n junction, **Bipolar Junction Transistor**: Basic Construction, I-V characteristics, Ebers-Moll Model.	10L
3	FET: JFET-Basic construction, principle of operation, Drain and Transfer characteristics. MOSFET- Basic construction, Depletion and Enhancement type, I-V characteristics, FET parameters, MOS capacitor, C-V characteristics, flat band voltage and threshold voltage and small signal models of MOS transistor.	8L
4	**Opto–Electronics**: Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction) Integrated circuit: fabrication process.	6L
Total		**34L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe semiconductor physics ,semiconductor types and carrier transport phenomena
2	Describe working principle of various diodes, BJT, MOSFET, solar cell and opto electronic devices.
3	Characterize diodes, BJT and MOSFETs.
4	Apply the acquired knowledge for implementing these devices for further application.
5	Calculate various device related parameters.

Learning Resources:	
Recommended Text Books	
1	Neamen- Semiconductor Physics and Devices TMH
2	Streetman Banerjee-Solid State Devices-PHI
3	Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson
Alternative Text Books	
4	Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
Reference Books	
5	Milman & Halkias - Electronics Devices and Circuits- TMH
6	Maini & Agrawal- Electronics Devices and Circuits- Wiley

Course Name:	**VLSI System**		
Course Code:	OE-EC601E	**Category:**	Open Elective Courses
Semester:	6th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Semiconductor Physics, Analog Electronics and Digital Electronics.
Full Marks:	100		

Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance 05

Course Objectives:	
1	Understand the issues involved in ASIC design, including technology choices.
2	To develop the ability to design and analyze MOS based Analog VLSI circuits to draw the equivalent circuits of MOS based Analog VLSI and analyze their performance.
3	To provide fundamental concept in MOS and CMOS digital circuits.
4	To develop the skills to design Digital VLSI circuits for a given specification.
5	To make the students exposed to Front end and Back end VLSI CAD tools.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to VLSI Design:** VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI,GLSI Types of VLSI ICs (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), VLSI Design flow ,VLSI Design style: Semi Custom Design & Full custom Design, Gate array, standard-cell, and Macro cell based design, Types of ASICs, , Design and Layout Rules, ASIC physical design issues, System Partitioning, Floor planning and Placement.	6L
2	**Analog VLSI Circuit Design:** Introduction to CMOS circuits: MOS transistors, Basic building blocks of Analog VLSI, MOS switch. BiCMOS and CMOS technologies, CMOS Inverter, CMOS Current source, sink and Current Mirror. CMOS Differential amplifier and its DC and AC analysis for the determination of CMRR. Temperature Dependence of Threshold Voltage, MOSFET Channel Mobility, Short-Channel MOSFETs, Short-Channel Effect, Channel Length Modulation. Evolution of CMOS technology, BiCMOS and CMOS technologies, MOSFET Scaling, Constant-Field Scaling, Generalized Scaling, Scaling Effects.	12L
3	**Digital VLSI Circuit Design:** Introduction of sequential CMOS logic circuits, Stick diagram. CMOS Power: static and dynamic power dissipation Static CMOS logic circuit design, Dynamic CMOS logic circuits, charge leakage and charge sharing problem, dynamic gate cascading problem, Domino and NORA logic, CMOS Transmission Gate (TG) logic design, Complementary Pass Transistor Logic (CPL)	10L
4	**VLSI Fabrication Process:** Wafer preparation, Oxidation, Diffusion, Ion implantation, Deposition, Metallization, Etching and Lithography. Nmos fabrication, n-well and p-well process, Layout and Layout design rules**.** Synthesis and simulation using HDLs-Logic synthesis using VHDL/Verilog, Switch level and transistor level simulation.	8L
Total		**36L**

Course Outcomes:	
1	Designs of MOS based Analog VLSI circuits and analyze their performance.
2	Analysis of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design
3	Understand various techniques involved in the VLSI fabrication process.

Learning Resources:	
Recommended Text Books	
1	B.Razavi, ―Design of Analog CMOS Integrated Circuits‖, 2nd Edition, McGraw Hill Edition 2016.
2	CMOS Digital Integrated Circuit, S.M.Kang & Y.Leblebici, TMH.
3	VLSI Design and EDA Tools – Angsuman Sarkar, Swapnadip De & Chandan Kumar Sarkar, Scitech Publication(India) PVT, LTD
Alternative Text Books	
4	N.H.E.Weste, D. Harris, –CMOS VLSI Design (4th edition)‖, Pearson, 2010.
5	Advance Digital Design Using Verilog , Michel D. Celliti, PHI
6	S.M.Sze, –VLSI Technology (2nd edition)‖ , McGraw Hill, 1988
Reference Books	
7	P.E.Allen&D.R. Holberg, –CMOS Analog Circuit Design‖, 3rd Edition, Oxford University Press, 2011.
8	R. Jacob Baker, –CMOS Circuit Design, Layout, and Simulation‖, 3rd Edition, Wiley, 2010.
9	Jan.M.Rabaey et al, –Digital Integrated Circuit Design Perspective‖, 2nd Edition, PHI 2003.

Course Name:	**Power Electronics Lab**		
Course Code:	PC-EE 691	**Category:**	Professional Core Courses
Semester:	6th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	1. Electric Circuit Theory 2. Analog Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 20	Attend ance: 20

Course Objectives:	
1	Study V-I characteristics of SCR and TRIAC.
2	Study the operation of different power electronics converter.
3	Observe output characteristics of different power electronics converter.
4	Simulate AC- DC, DC-DC and DC -AC controlled converter.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Study of the characteristics of an SCR.	3P
2	Study of R and RC triggering circuits of an SCR	3P
3	Study of UJT triggering circuits of an SCR	3P
4	Study firing circuit of SCR using ramp-comparator scheme.	3P
5	Study of the characteristics of an TRIAC.	3P
6	Study of the operation of a single phase full controlled bridge converter with R and R-L load.	3P
7	Study of performance of single phase half controlled symmetrical and asymmetrical bridge converters.	3P
8	Study of performance of single phase controlled converter with and without source inductance (simulation).	3P
9	Study of performance of single phase half controlled symmetrical and asymmetrical bridge converter (simulation).	3P
10	Study of performance of three phase controlled converter with R & R-L load. (Simulation).	3P
11	Study of performance of Multiquadrant operation of Chopper (simulation).	3P
12	Study of performance of Unipolar and Bipolar PWM bridge inverter using MOSFET as switch with R-L load (simulation).	3P
Total		**36P**

Course Outcomes:	
The learners will be able to	
1	Demonstrate V-I characteristics of SCR and TRIAC.
2	Differentiate between different gate triggering circuits for Thyristors.
3	Demonstrate the operation of different power electronic converter circuits.
4	Design different power electronic converters by software simulation.
5	Apply pulse width modulation techniques in power electronic converter.

Course Name:	**Power System-II Lab**		
Course Code:	PC-EE-692	**Category:**	Professional Core Courses
Semester:	6th	**Credit:**	1

L-T-P:	0-0-2	**Pre-Requisites:**	Electric Circuit Theory(PC-EE-301) Electromagnetic Field Theory(PC-EE-303)) Power System I (PC-EE-502)
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 20	Attendance: 20

Course Objectives:	
1.	To understand the method of representation of power system components
2.	To know about location and components of a distribution substation
3.	To understand different methods of load flow studies
4.	To determine faults in Electrical systems
5.	To understand the principle of power system stability
6.	To understand the principle of relays and methods of protection of power system
7.	To solve numerical problems on the topics studied

Course Contents:
After completion of the course, students will be able to:

Module No.	Experiments	Contact Hrs.
1	Study on the characteristics of on load time delay relay and off load time delay relay	3P
2	Test to find out polarity, ration an magnetization characteristics of CT and PT	3P
3	Test to find out characteristics of (a) under voltage relay (b) earth fault relay	3P
4	Study on DC load flow	3P
5	Study on AC load flow using Gauss-seidal method	3P
6	Study on AC load flow using Newton-Rapson method	3P
7	Study on Economic load dispatch	3P
8	Study of different transformer protection schemes by simulation	3P
9	Study of different generator protection schemes by simulation	3P
10	Study of different motor protection schemes by simulation	3P
11	Study of different characteristics of over current relay	3P
12	Study of different protection scheme for feeder	3P
Total		**36P**

Course Outcomes:	
1	Identify appropriate equipment and instruments for the experiment
2	Test the instrument for application to the equipment
3	Construct circuits with appropriate instruments and safety precautions
4	Validate the characteristics of under voltage relay, over current relay, earth fault relay, on load time delay relay, off load time delay relay, CT & PT
5	Validate protection schemes of transformer, generator, motor & feeder
6	Apply software tools to find bus voltage, currents and power flows throughout the electrical system
7	Work effectively in a team

Course Name:	**Data Structure and Algorithm Lab**		
Course Code:	OE-CS691F	**Category:**	Open Elective II
Semester:	6th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Programming knowledge in C
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To familiarize the students with programming concepts required for implementing linear data structures and operations on it.
2	To acquaint the students with dynamic memory allocation concepts required for implementing linear & nonlinear data structures.
3	To develop the ability to write menu driven programs that compares different sorting and searching techniques.

Course Contents: The course should cover (but may not limited to) C program implementation of the following topics

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Linear Data Structure:** a) Recap of C programming and implementation of basic data structure operations using Array b) Implementation of Stack operations using array c) Implementation of Linear Queue operations using array d)Implementation of Circular Queue operations using array	16L
2	**Application of Stack:** a) Program to convert an infix expression to Postfix Expression b) Program for Evaluating a Postfix Expression. (optional)	4L

3	**Programs using Dynamic Memory Allocation:** Implementation of Single Linked List and associated operations (menu driven) Application of Single Linked List : a) Implementation of Stack and Queue using Single Linked List. b) Program to add two Polynomials using Single Linked List (SLL).	12L
4	Implementation of various Sorting algorithms (Menu driven) Implementation of various Searching algorithms (Menu driven)	12L
5	**Implementation of Non Linear Data Structure** a) Binary Search Tree: Construction and Traversal b) AVL tree: Construction and Traversal (optional)	4L
Total		**48L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Write the basic codes on linear Data structures and operations performed on it .
2	Apply dynamic memory allocation concept to implement linear and nonlinear data structures.
3	Apply the knowledge of linear data structures to solve expression conversion programs.
4	Compare different Sorting and Searching techniques by writing menu driven programs.

Learning Resources:	
1	-Data Structures with C‖ by Seymour Lipschutz, McGrawHill
2	—Data Structures Using C‖ by Reema Thareja, Oxford
3	-Fundamentals of Data Structures of C‖ by Ellis Horowitz, Sartaj Sahni
4	-Data Structures using C‖ by A N Tenenbaum, Y Langsam, M J Augenstein, Pearson

Course Name:	**Computer Organization Lab**		
Course Code:	OE-EC691B	**Category:**	Open Elective Courses
Semester:	6th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Digital Electronics Laboratory
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To Familiar with different type of IC-chips

2	To Design different arithmetic and Logic Circuits
3	To know the working principle of RAM IC.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Familiarity with IC-chips: a) Multiplexer, b) Decoder, c) Encoder d) Comparator Truth Table verification and clarification from Data-book.	6P
2	Design an Adder/Subtractor composite unit.	3P
3	Design a BCD adder.	3P
4	Design of a _Carry-Look-Ahead' Adder circuit.	3P
5	Design of Code Converter Circuit	3P
6	Construct a Binary Multiplier using basic logic gates	3P
7	Use a multiplexer unit to design a composite ALU	3P
8	Use ALU chip for multibit arithmetic operation	3P
9	Implement read write operation using RAM IC	3P
10	(a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.	6P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Verify truth-table of different types of IC.
2	Design different type of adder circuits.
3	Design ALU by applying the knowledge of Combinational circuit.
4	Design different circuits with RAM ICs and perform read-write operation.

Learning Resources:	
1	Morris Mano- Digital Logic and Computer Design- PHI
2	Leach & Malvino—Digital Principles & Application, 5/e, McGraw H
3	S. Salivahanan, S. Arivazhagan – Digital Circuits and Design
4	Mano, M.M., "Computer System Architecture", PHI.

Course Name:	**Soft Skill Development Lab**		
Course Code:	HM-HU691	**Category:**	HU
Semester:	6th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Students must have basic knowledge of English Language.
Full Marks:	100		

Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To equip the students with good communication skills.
2	To enable the students to think and speak effectively on everyday topics, including topics related to technical concepts
3	To prepare them for interviews and future job environments.
4	Developing industry-ready attitude towards professional communication

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Conversation Practice Sessions - General Conversation - Warm-up sessions - Basics of Communication, verbal and non-verbal communication	4P
2	Group Discussion - Group Discussion & Debates, Do‘s & Don‘ts, etc., Intensive Practice Sessions	8P
3	Interview sessions: Principles and practices of Personal Interview • Do‘s and Don‘ts of facing an interview. • SWOC Analysis • Rigorous practices of mock-interviews.	6P
4	Presentations: Fundamentals of presentation skills, Secrets of an effective presentation, Presentation Practice Sessions with the help of power point presentation and other audio-visual aids, Face question answer sessions at the end of their presentation.	6P
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to	
1	Honing over all Communicative Competence
2	Develop Team Building and Leadership Quality
3	Deliver an enthusiastic and well-practiced presentation
4	Communicate with clarity and confidence thereby enhancing employability skills of the students.

Learning Resources:	
Recommended Text Books	
1	Soft Skills: Key to success in Workplace and Life, Meenakshi Raman and Shalini Upadhyay
2	Communication Skills. Sanjay Kumar and PushpLata, Oxford University Press, 2011.
3	Monipally: Business Communication, Tata McGraw Hill
Alternative Text Books	

4	Madhukar: Business Communications; Vikas Publishing House
5	Senguin J: Business Communication; Allied Publishers
6	Business Communication: Rajendra Pal & Korlahalli

Course Name:	**Aptitude Skill Development-II**		
Course Code:	MC671	**Category:**	**Mandatory Courses**
Semester:	6th	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Quantitative Ability, Logical and Verbal Reasoning
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To be prepared in the area of Quantitative Ability as well as Logical and Verbal Reasoning for Campus Placements and different Competitive Exams

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Verbal: Reading Comprehension, Para Jumbles, Email Writing, Resume Writing	3L
2	Game based Cognitive Skills, Tournaments	3L
3	Solve company oriented campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability.	12L
4	MCQ Based Strategies/Sort cuts and Mock test	6L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Prepared for Campus Placements and different Competitive Exams

Learning Resources:	
1	Arun Sharma,‖Quantitative abilities‖, McGraw-Hill
2	R.S.Agrawal, ―Quantitative Aptitude for Competitive Examinations‖, S. Chand
3	R.S.Agarwal,‖A Modern Approach to Verbal & Non-Verbal Reasoning ‖,S.Chand