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

Part III: Detailed Curriculum

Sixth Semester

Course Name:	**Control System**		
Course Code:	PC-EC601	**Category:**	Professional Core
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic knowledge of mathematics: Laplace Transform, Matrix, Circuit Theory.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To make the students knowledgeable with control system and make them able to illustrate the mathematical representation of the real SISO & MIMO systems.
2	To make the students able to determine the system response to analyze the transient & steady state performance of different systems.
3	To make the students efficient to analyze the stability of the systems using different techniques and be able to design some classical control system.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**a) INTRODUCTION** Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer functions – transfer functions of electrical network. Translational and Rotational mechanical systems , Mechanical and electrical analogous systems. **b) TRANSFER FUNCTION REPRESENTATION** Transfer Function of linear systems, Block diagram representation of systems considering electrical systems as examples -Block diagram algebra –Representation by Signal flow graph - Reduction using Mason's gain formula.	5 5

2	**a) TIME RESPONSE ANALYSIS** Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants. **b) STABILITY ANALYSIS IN S-DOMAIN** The concept of stability – Routh's stability criterion – limitations of Routh's stability.Root Locus Technique: The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root locii.	5 5
3	**a) FREQUENCY RESPONSE ANALYSIS** Introduction, Frequency domain Specifications- Bode Diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots. **b) STABILITY ANALYSIS IN FREQUENCY DOMAIN** Polar Plots, Nyquist Plots , Nyquist stability criteria, Stability Analysis.	6 4
4	**a) CLASSICAL CONTROL DESIGN TECHNIQUES** Compensation techniques – Lag, Lead, Lead-Lag.Controllers design in frequency Domain, P,I, D and PID Controllers- basic concepts. **b) STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS** Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability of a system, Kalmans Test.	4 6
Total		40

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand basic knowledge of control system and illustrate mathematical representation of the real SISO & MIMO systems.
2	Determine the system response to analyze the transient & steady state performance of the systems.
3	Analyze the stability of system using different techniques .
4	Design some classical control system and perform stability analysis.

Learning Resources:	
1	Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.
2	Control System Engineering – by P. Ramesh Babu, SCITECH
3	Automatic Control Systems 8th edition– by B. C. Kuo 2003– John Wiley and son's.,
4	Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
5	Linear Control Systems – by B.S. Manke – Khanna Publishers

Course Name:	**Computer Network**		
Course Code:	PC-EC602	**Category**:	Professional Core
Semester:	Sixth	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Digital and Analog Communication
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To have a basic idea of communication network and layered protocol architecture.
2	To understand different flow control and error control mechanisms and to analyze the performance of different multiple access protocols.
3	To understand internet addressing, routing techniques, process to process delivery, congestion control and their associated protocols.
4	To understand different application layer protocols and modern communication technologies.
5	To have the basic idea of cryptography and network security.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Overview of Data Communication and Networking:** Introduction; Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.	4
	Physical Level: Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided &	2

	unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network.	
2	**Data link Layer:** Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, HDLC.	4
	Medium Access sub layer: Point-to-Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief).	6
3	**Network layer:** Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing: techniques, static vs. dynamic routing, Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPV6.	6
	Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.	6
4	**Application Layer:** Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls.	4
	Modern topics: ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief, Wireless LAN: IEEE 802.11, Introduction to blue-tooth.	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand basic idea of communication network and layered protocol architecture.
2	Understand different flow control and error control mechanisms and analyze the performance of different multiple access protocols.
3	Understand internet addressing, routing techniques, process to process delivery, congestion control and design a subnet as per the requirement.
4	Apply different application layer protocols and modern communication technologies.
5	Understand the basic idea of cryptography and network security.

Learning Resources:	
1	B. A. Forouzan - "Data Communications and Networking (4th Ed.)" - TMH
2	A. S. Tanenbaum - "Computer Networks (4th Ed.)" - Pearson Education/PHI
3	W.Stallings - "Data and Computer Communications (5th Ed.)" -PHI/ Pearson Education

4	Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5	Black, Data & Computer Communication, PHI
6	Kurose and Rose - " Computer Networking -A top down approach featuring the internet" - Pearson Education
7	Leon, Garica, Widjaja - "Communication Networks" - TMH

Course Name:	**Introduction to MEMS**		
Course Code:	PE-EC601A	**Category:**	Professional Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic knowledge of Physics and Mechanics (BS-PH101, ES-EE101)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the operation of major classes of MEMS devices/systems
2	To learn fundamentals of standard micro fabrication techniques and processes
3	To understand the unique demands, environments and applications of MEMS devices

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Introduction and Historical Background	2
2.	Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview, Applications of Micro and Nano electromechanical systems	4
3	Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods, Beams, Cantilevers, Plates, Diaphragms – Typical applications	5
4	Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals. Case studies: Capacitive Pressure sensors, Piezoelectric energy harvester, Accelerometers etc	5
5.	Review of Basic MEMS fabrication modules: Photolithography, Ion Implantation, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.	8
6.	Micromachining: Surface Micromachining, sacrificial layer processes, Stiction;	4

7.	Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.	4
8.	Overview of Finite Element Method, Modelling of Coupled Electromechanical system	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Appreciate the underlying working principles of MEMS and NEMS devices.
2	Understand the typical materials used for fabrication of micro systems
3	Understand the principles of standard micro fabrication techniques
4	Design and model MEMS devices.

Learning Resources:	
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
3	S.D. Senturia, Microsystem Design, Kluwer, Academic Publishers, 2001.
4	M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5.	Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture
6	Chang C Y and Sze S. M., VLSI Technology, McGraw-Hill, New York, 2000

Course Name:	**Bio-Medical Electronics**		
Course Code:	PE-EC601B	**Category:**	Professional Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics [ES-EE 101], Analog Electronic Circuits[PC-EC302]
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concept of human physiology.
2	To impart knowledge about different required Biomedical transducers.
3	To understand required different Bio-Medical measurement techniques.
4	To understand the basic principle of operation of various required Prostheses and aids.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Brief introduction to human physiology.	4
2	Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc.	12
3	Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X-ray and nuclear imaging.	10
4	Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.	10
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the concept of human physiology.
2	Use properly different required Biomedical transducers.
3	Execute required different Bio-Medical measurement techniques.
4	Understand and analyze the basic principle of operation of various required Bio-Medical prostheses and aids.

Learning Resources:	
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 Name:	**CMOS VLSI Design**		
Course Code:	PE-EC601C	**Category**:	Professional Elective
Semester:	Sixth	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of Analog and Digital Electronics.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To nurture students with CMOS analog circuit designs.
2	To learn digital CMOS logic design and layout design rules.
3	To realize importance of testability in logic circuit design.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	VLSI Methodologies: Introduction to VLSI design, Moore's Law, VLSI Design flow, Design hierarchy, VLSI Design style: Full custom, Gate array, standard-cell, and Macro cell based design, Field programmable devices and design quality.	6
2	**MOSFET:** Electrical characteristics of MOSFET, Threshold voltage, Body effect, current expression (gradual channel approximation method), Channel length modulation, MOSFET scaling: constant field and constant voltage scaling, Short-channel effects.	8
3	Unit process in VLSI and IC fabrication: Unit process in VLSI: Wafer preparation, Oxidation, Diffusion, Ion implantation, Deposition, Metallization, Etching and Lithography. NMOS fabrication, n-well and p-well process.	10
4	CMOS for Digital VLSI Circuits: General CMOS logic structure, VTC of inverter, noise margin, Different types of inverter (resistive load, enhancement and depletion nMOS load and CMOS), Switching characteristic (propagation delay and parasitic capacitance estimation), NAND, NOR and other complex CMOS logic circuits, Sizing of CMOS logic circuits, CMOS Power: static and dynamic power dissipation, latch-up, sizing for large capacitive load,. Dynamic CMOS logic circuits, charge leakage and charge sharing problem, dynamic gate cascading problem, Domino and NORA logic, Introduction of sequential CMOS logic circuits, Stick diagram. Layout and Layout design rules.	10
5	Physical Design Automation: Objectives and goals of partitioning, floor planning and placement, Global routing	2
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply MOS and CMOS circuit design techniques to different digital & analog circuits.
2	Design analog & digital CMOS circuits for specified applications.
3	Explain VLSI design flow and study different fabrication process.

Learning Resources:	
1	CMOS Digital Integrated Circuits – S. Mo. Kang and Yusuf Leblebici, 3rd Ed, TMH 314.
2	Digital Integrated Circuits A Design Perspective -Jan M. Rabaey, Prentice-Hall Publication, 2nd Edition.
3	VLSI Design and EDA Tools – Angsuman Sarkar, Swapnadip De & Chandan Kumar Sarkar, Scitech Publication(India) PVT, LTD
4	CMOS Analog Circuit Design by P.E. Allen & D.R. Holberg; OUP
5	Principle of CMOS VLSI Design – Neil H. E. Weste – Pearson Edition, 2nd Edition.
6	CMOS Circuit Design – R. Jacob Baker, Harry W. Li, David E. Boyce – PHI, 2003.
7	Fundamental of Semiconductor Fabrication- Garry S. May, Simon M SZE (WILEY INDIA PVT LTD)

Course Name:	**Information Theory and Coding**		
Course Code:	PE-EC601D	**Category:**	Professional Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Digital communication and Random signal theory
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Students will be capable to explain Information, Entropy of various types of channel
2	Students can discuss various Source coding mechanism in order to enhance average bit rate
3	Students will acquire knowledge about numerous channel coding techniques to accomplish error free transmission

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Information and Entropy:** Basic concept of Information, Uncertainty, average information, Mutual information, Entropy, Concept of Discrete memory less Source and Discrete memory less channel, Loss less channel, Deterministic channel, Binary symmetrical channel, Maximum Entropy, Channel matrix, Information	7

	measure	
2	**Discrete Channel Capacity:** Shanon – Hertley channel capacity theorem, Information rate, Error probability, Gaussian channel noise, Bandwidth SNR trade off, Information Capacity Theorem, Shanon Limit	4
3	**Source Coding:** Basic source coding mechanism, Shanon Fano coding, Hauffman Coding hypothesis, Source Coding theorem,	4
4	**Channel Coding:** Hamming code and hamming distance, Linear block code, Generator matrix, Parity check matrix, Syndrom calculation, error matrix, cyclic properties of coding, Division algorithm for polynomial, Systematic cyclic coding, Generator and parity check polynomial, Cyclic redundancy check	6
5	**Galois algorithm and BCH Codes:** Galois field and minimal polynomial, GF(8) and GF(16) field elements primitive polynomial, Irreducible polynomial, BCH generator polynomial construction for single dual and triple error detection and correction, BCH decoding, Reed soloman codes. RS encoders and Decoders	8
6	**Convolution Code Viterbi algorithm**: Introduction of convolution codes, Sequential coding and Decoding using shift Registers, Code Tree, Code Trellis, State diagram for encoder, Rate ½ Convolution Encoder, Generating Function and Modified state diagram, Viterbi Decoding algorithm of convolution code, Turbo codes	7
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand Information, Uncertainty, Entropy and channel capacity of AWGN channel
2	Analyze various source coding mechanism.
3	Apply the knowledge of error control coding techniques to detect and correct the channel error.

Learning Resources:	
1	Ranjan Bose, Information Theory coding and cryptography, 2/e, TMH
2	Salvatore Gravano, Error control Codes, Oxford University press
3	Shu Lin & Danial J castalo, Error control Coding, 2/e, Pearson

Course Name:	**Electronic Instrumentation and Measurement**		
Course Code:	OE-EE601A	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics [ES-EE 101], Analog Electronic Circuits[PC-EC302]
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concept of instrument characteristics.
2	To impart knowledge about different required Measuring Instruments.
3	To understand the operational technique of different Signal Analyzers.
4	To understand the basic principle of operation of various Oscilloscopes.
5	To develop an insight into the construction and working of different Transducers.
6.	To understand and analyze the concept of Bridges and DAS.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Block Schematics of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag, Standards.	4
2	Measuring Instruments: DC Voltmeters, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.	6
3	Signal Analyzers: Wave Analyzers, Harmonic Distortion, Spectrum Analyzers, Signal Generators, Frequency Synthesizer.	6
4	Oscilloscopes: CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes,Delay lines, Applications: Measurement of Time, Period and Frequency. Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Digital Storage CROs.	6
5	Transducers: Classification, Strain Gauges, Force and Displacement Transducers, Resistance Thermometers, LVDT, Thermocouples, Piezoelectric Transducers.	6
6	Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.	4
7	Display Device: Classification of Display device, LED Display, LCD Display, Segmental Display, Dot Matrix Display.	4

8	Data Acquisition System: Single channel DAS, Multi-channel Das, Data logging, IEEE-488.	4
Total		**40**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basic concept of instrument characteristics.
2	Explain the process of different required Measuring Instruments.
3	Understand the operational technique of different Signal Analyzers.
4	Understand the insight of the construction and working of different Transducers
5	Understand and analyze the concept of Bridges and DAS.

Learning Resources:	
1	Electronic instrumentation: H.S.Kalsi, TMH, 2nd Edition 2004.
2	Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI, 5th Edition, 2003
3	Electronic Measurements and Instrumentations by K. Lal Kishore, Pearson Education, 2010.
4	Electronic Instrumentation and Measurements, David A. Bell, Oxford Uiv. Press, 1997.
5	Electronic Measurements and Instrumentation: B. M. Oliver, J. M. Cage TMH Reprint.
6	A Course in Electronics and Electrical Measurements and Instrumentation: S K Kataria and Sons,2013.

Course Name:	**Design and Analysis of Algorithm**		
Course Code:	OE-CS601A	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Data Structure, Discrete Mathematics, Basic Programming Ability
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The aim of this course is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them
2	Through the complexity measures, different range of behaviors of algorithmsand the notion of tractable and intractable problems will be understood.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**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, Method of Iteration, Recursion Tree method and Masters' theorem (Examples: Analysis of Binary Search, Merge Sort and Quick Sort using Recurrence)	6
2	**Fundamental Algorithmic Strategies:** **Divide and Conquer Method:** Basic method, use, Example – Max-Min Problems and its complexity analysis. **Greedy Method:** Basic method, use, Examples – Fractional Knapsack Problem, Job sequencing with deadlines, Activity Scheduling Problem, Travelling Salesperson Problem and their complexity analysis **Dynamic Programming:** Basic method, use, Examples – Matrix Chain Manipulation, 0/1 Knapsack Problem and their complexity analysis **Backtracking:** Basic method, use, Examples –Nqueen's problem, Graph Coloring problem.	12
3	**Graph and Tree Algorithms:** Traversal algorithms: Recapitulation of Depth First Search (DFS) and Breadth First Search (BFS); Shortest path Algorithms (Single Source and All Pairs with their Complexity Analysis), Transitive Closure, Minimum Spanning Tree (Prim's and Kruskal's Algorithms with their Complexity Analysis), Topological Sorting, Ford Fulkerson algorithm, Max-Flow Min-Cut theorem (Statement and Illustration).	10
4	**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP- complete and NP-hard. Satisfiability Problem.	4
5	**Advanced Topics:** Approximation Algorithms: Introduction and Example - Vertex Cover Problem.	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Recall the fundamental concepts of Asymptotic Notations and identify their mathematical significance and analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms. Derive and solve recurrence relation.
2	Describe different algorithm design techniques like D&C, Greedy Method, DP, Backtracking, Graph Algorithms, NP etc. and their implementations.
3	Apply appropriate algorithms and required Data Structure to construct the solution of a given problem.
4	Explain Approximation algorithm to compute approximation factors.
5	Analyze algorithms and determine the correctness.

Learning Resources:	
1	Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2	Fundamentals of Algorithms – E. Horowitz et al.
3	Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4	Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5	Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
6	Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
7	Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

Course Name:	**Object Oriented Programming**		
Course Code:	OE-IT601B	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand Object Oriented Design principle and Programming concepts using characteristics of Java
2	To know the principles of Inheritance, Packages and Interfaces
3	To define Exceptions and use I/O streams
4	To develop synchronization applications with Java threads and to develop generics

	classes
5	To design Graphical User Interfaces through Java
6	To handle Database related problems through JDBC tools

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Object Oriented Design:** Concepts of object oriented programming language, Major and minor elements, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation, using, instantiation, meta-class, grouping constructs State Modeling	6
2	**Features of object-oriented programming:** Objects and Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, Modularity	4
3	**Basic concepts of Object Oriented Programming using Java:** **Class & Object properties:** Basic concepts of java programming – advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling concepts-concept of mutable and immutable string, command line arguments, basics of I/O operations – keyboard input using Buffered Reader & Scanner classes.	7
4	**Reusability properties**: Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages	5
5	**Exception Handling and Multithreading :** Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads	4
6	**I/O programming :** Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files	3

7	**Generic Programming**: Generic classes – generic methods – Bounded Types – Restrictions and Limitations.	3
8	**Graphical programming with AWT and Swing:** Frame, Components, working with 2D shapes, Using color, fonts, and images, Basics of event handling, event handlers, adapter classes, actions, mouse events, AWT event hierarchy Introduction to Swing, layout management, Swing Components, Text Fields , Text Areas , Button-Check Boxes-Radio Buttons, Lists, choices, Scrollbars, Windows –Menus – Dialog Boxes	4
9	**Database Connectivity through JDBC tools**	2
10	**Networking with java.net** InetAddress class,Socket class, DatagramSocket class, DatagramPacket class	2
Total		**40**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity
2	Express basic techniques of writing programs using loops , methods and arrays in object oriented paradigm
3	Apply the concepts of Encapsulation, Inheritance, Polymorphism in developing object oriented featured software.
4	Design applications with an event-driven graphical user interface and using databases
5	Practice efficient mapping of the real world interdisciplinary problems into object oriented programming methodologies.

Learning Resources:	
1	Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2	Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3	Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
5	Ivor Horton's Beginning Java 2 SDK – Wrox
6	E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Name:	**Economics for Engineers**		
Course Code:	HM-HU601	**Category:**	Management Science and Humanities
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Prepare engineering students to analyze cost/revenue data and conduct economic analyses
2	Compute Present worth, Future worth, Annual worth, etc.to obtain the best economic alternative.
3	Understand and compute depreciation by various methods.
4	Prepare Profit and Loss account, Balance sheet, Cost sheet, Overheads allocations etc.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Economic Decisions Making– Overview, Problems, Role, Decision making process.	3
2	Engineering Costs & Estimation– Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models- Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	5
3	Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.	5
4	Cash Flow & Rate Of Return Analysis– Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector- Quantifying And Valuing Benefits & drawbacks.	6
5	Depreciation- Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation	6

	Calculation Fundamentals, Depreciation and Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.	
6	Inflation And Price Change– Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.	3
7	Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	8
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe the role of economics in the decision making process and perform calculations in regard to interest formulas.
2	Estimate the Present, annual and future worth comparisons for cash flows.
3	Calculate the rate of return, depreciation charges.
4	Explain the importance of finance functions, financial ratios and solve related problems.

Learning Resources:	
1	Riggs J.L., Bedworth D.D. and Randhawa S.U., Economics for Engineers, 4th Edition, Tata McGraw-Hill.
2	Newnan D., Eschembach T. and Lavelle J., Engineering Economics Analysis, OUP. 3.
3	White J.A., Case K.E. and Pratt D.B., Principle of Engineering Economic Analysis, John Wiley.
4	Sullivan and Wicks, Engineering Economy, Pearson.
5	Bhatia and Maheswari., Economics for Engineers, 3rd Edition, Vikas Publishing.
6	Paneerselvan R, Engineering Economics, PHI

Course Name:	**Value and Ethics in Profession**		
Course Code:	HM-HU602	**Category**:	Management Science and Humanities
Semester:	Sixth	**Credit**:	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic Managerial acumen
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Concept of Human Values, Ethics and Profession; Engineering as a profession	2
2.	Societal values: justice, democracy, secularism, rule of law; Maslow's Hierarchy and Integrated personality; Value Crisis in contemporary society	5
3.	Codes of professional ethics. Whistle blowing and beyond. Case studies	3
4	Human Operator in Engineering projects and industries. Problems of man machine interaction	2
5	Rapid Technological growth and depletion of resources. Reports of the Club of Rome. Limits of growth; sustainable development	4
6	Environmental degradation and pollution. Eco-friendly Technologies; Appropriate Technology Movement of Schumacher: later developments	3
7	Emotional Intelligence – Salovey – Mayer Model ;Uses of Ethical Theories – Deontology- Types of Inquiry –Kohlberg's Theory – Gilligan's Argument – Heinz's Dilemma -Intellectual Property Rights	5
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument.
2	Apply the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.
3	Inculcate right understanding leading to lack of relationship as the major cause of problems in their family and not the lack of physical facilities.

Learning Resources:	
1	Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2	Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991
3	A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta ,1996
4	Samita Manna and Suparna Chakraborti:Values and Ethics in Profession
5.	S.K.Sarangi,Values and Ethics in Profession

Course Name:	**Control System Lab**		
Course Code:	PC-EC691	**Category:**	Professional Core
Semester:	Sixth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Knowledge of MATLAB and pSPICE.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make students aware of importance of MATLAB and pSPICE.
2	Apply the concepts of MATLAB to determine the step, impulse response for 1st and 2nd order system with increased system Type.
3	Determination of time and frequency domain analysis for different Type and order of system using MATLAB toolbox.
4	Study of Compensator and Controller using MATLAB/pSPICE.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Familiarization with MATLAB Control System tool Box, MATLAB-SIMULINK tool box.	2
2	Introduction to pSPICE and determination of transient response for 1st order & 2nd order system.	2
3	Determination of step response for 1st order & 2nd order system with unity feedback and calculation of control system specifications for variations of system design.	4
4	Simulation of step response & impulse response for Type-I & Type-II system with unity feedback using MATLAB.	2
5	Determination of root locus using MATLAB control system toolbox for a given 2nd order transfer function & determination of different control system specifications.	2
6	Determination of Bode-plot, Nyquist Plot, using MATLAB control system toolbox for a given 2nd order transfer function & determination of different control system specifications.	4
7	Evaluation of steady-state error, setting time, percentage peak overshoots, gain margin, phase margin with addition of lead compensator in forward path transfer functions using MATLAB.	2
8	Determination of PI, PD, and PID controller action on 1st order simulated process using pSPICE.	4
9	Determination of approximate transfer function experimentally using Bode Plot.	2
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use MATLAB Control System tool Box, MATLAB- SIMULINK tool box and pSpice.
2	Use the concepts of MATLAB to determine the step, impulse response for 1st and 2nd order system with increased system Type.
3	Determine the time and frequency domain analysis with Root Locus, Bode Plot, Nyquist plot for different Type and order of system using MATLAB toolbox.
4	Determine the compensator and controller actions using MATLAB/pSPICE.

Learning Resources:	
1	Laboratory Manual

Course Name:	**Computer Network Lab**		
Course Code:	PC-EC692	**Category:**	Professional Core
Semester:	Sixth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic programming concept in C under Linux environment
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To design the structure of a LAN and select the components required to install it.
2	To configure NIC for multiple operating systems.
3	To write programs in C for inter process communication using Pipe in Linux environment.
4	To write network programs in C using Socket in Linux environment.

Course Contents:

Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
01	Familiarization of different Networking devices, such as hub, switch etc. and writing a report on structures and layouts of a LAN.	2
02	Preparation of Straight-Trough and Cross-Over cable and testing the performance of them.	2
03	Configuration of IP address on Windows and Linux platforms.	2
04	Write a program for ECHO Server using TCP that will receive a string from a client and will send it back to the client. The client will display the receive text.	2
05	Write a program for ECHO Server using UDP that will receive a string from a client and will send it back to the client. The client will display the receive text.	2
06	Write a program for Day-Time Server using TCP.	2
07	Write a program for Day-Time Server using UDP.	2
08	Write a Concurrent ECHO Server program using TCP.	2
09	Write a program to implement flow control mechanism.	2
10	Write a program to implement error detection mechanism using Cyclic Redundancy Check (CRC).	2
11	Write a program to implement error control mechanism.	2
12	Write a program to implement multicast/broadcast sockets.	2
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Design the structure of a LAN and the components required to install it.
2	Configure NIC for multiple operating systems.
3	Write programs in C for inter process communication using Pipe in Linux environment.
4	Write network programs in C using Socket in Linux environment.

Learning Resources:	
1	Comer - "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" - Pearson Education/PHI
2	Stevens, "TCP/IP Illustrated, Volume 1", (2nd Edition), Addision Wesley
3	Lab Manual

Course Name:	**Electronic Instrumentation and Measurement Lab**		
Course Code:	OE-EE691A	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electrical & Electronics [ES-EE 101], Analog Electronic Circuits[PC-EC302]
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart the concept of instrument characteristics.
2	To impart the knowledge about error.
3	To understand the operation of different required measuring instrument.
4	To understand the basic principle of operation of LVDT.
5	To develop an insight into the construction and working of VCO or PLL.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Study of Static Characteristics of a Measuring Instrument	6
2	Study of Dynamic Characteristics of a Measuring Instrument	2
3	Statistical analysis of errors in measurement .	2
4	Calibration of Load cell and measurement of unknown load	2
5	Acquaintance with basic structure of DMM and measurement of different electrical parameters	4
6	Wave analysis using Q meter.	2
7	Study the operation of LVDT.	2
8	Study of CRO and detection of usual faults	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the instrument characteristics.
2	Understand the clear knowledge about error.
3	Execute the operation of different required measuring instrument.
4	Understand the basic principle of operation of LVDT.
5	Understand the insight of construction and working of VCO or PLL.

Learning Resources:	
1	Electronic instrumentation: H.S.Kalsi, TMH, 2nd Edition 2004.
2	Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI, 5th Edition, 2003
3	Electronic Measurements and Instrumentations by K. Lal Kishore, Pearson Education, 2010.
4	Electronic Instrumentation and Measurements, David A. Bell, Oxford Uiv. Press, 1997.
5	Electronic Measurements and Instrumentation: B. M. Oliver, J. M. Cage TMH Reprint.
6	A Course in Electronics and Electrical Measurements and Instrumentation: S K Kataria and Sons,2013.

Course Name:	**Algorithm Lab**		
Course Code:	OE-CS691A	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Data Structure, Basic Programming Ability
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The aim of this course is to study about various designing paradigms of algorithms for solving real world problems.
2	Through this course one can apply appropriate algorithms and methods of analysis.
3	To pick an appropriate data structure for a design situation is also under consideration.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
The contents should include about 10 assignments with the focus given as outlined below:		
UNIT - I Divide and Conquer, Greedy Method, Dynamic Programming		

1	Implement Binary Search, Merge Sort, Quick Sort FindMaximum and Minimum Element from an Array of Elements Implement Knapsack Problem, Job sequencing with deadlines Find the minimum number of scalar multiplication needed for Chain of Matrix	12
UNIT - II Graph Traversal Algorithm, Minimum Cost Spanning Tree Generation Algorithms, Shortest Path Algorithms		
2	Implement Breadth First Search (BFS), Depth First Search (DFS) Implement Minimum Cost Spanning Tree by Prim's Algorithm Implement Single Source shortest Path for a graph (Dijkstra Algorithm) and All pair of Shortest path for a graph (Floyd-Warshall Algorithm)	08
UNIT – III Backtracking		
3	Implement N Queen problem Implement Graph Coloring Problem	04
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate and implement BinarySearch, Merge Sort, Quick Sort, and Max-min Problem usingD&C Algorithm Design Techniques.
2	Implement Fractional Knapsack, Job Sequencing with Deadline, MatrixChain, Graph Traversals, MST problems, Shortest Path, N- Queens, and Graph Coloring using proper Algorithm Design Techniques.
3	Apply suitable algorithm for solving a particular problem.
4	Analyze the complexities and memoryusages of different algorithms.

Learning Resources:	
1	Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2	Fundamentals of Algorithms – E. Horowitz et al.
3	Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai
4	Design and Analysis of Algorithm, Biswas and Dey, JBBL

Course Name:	**Object Oriented Programming lab**		
Course Code:	OE-IT691B	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Knowledge of Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make the students learn an object oriented way of solving problems
2	To develop their ability to understand a problem and develop solutions using Java as a programming Language.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Assignments on class, constructor, overloading, inheritance, overriding	6
2	Assignments on wrapper class, arrays, vectors	2
3	Assignments on developing interfaces- multiple inheritance, extending interfaces	4
4	Assignments on creating and accessing packages	2
5	Assignments on multithreaded programming	4
6	Assignments on AWT and Swing programming	4
7	Assignments on Database Connectivity through JDBC	4
8	Assignments on Implementation of Networking concept	2
Note: Use Java language for programming		
Total		**28**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use I/O to communicate with the user to populate variables and control program flow
2	Write programs to solve the problems using the features of Object Oriented programming and java technology
3	Develop applications with an event-driven graphical user interface using databases and networking concepts
4	Practice efficient mapping of the real world interdisciplinary problems into object oriented programming methodologies.

Learning Resources:	
1	Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
2	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
3	Ivor Horton's Beginning Java 2 SDK – Wrox
4	E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Name:	**Mini Project/ Electronic Design Workshop**		
Course Code:	PW-EC681	**Category:**	Sessional
Semester:	Sixth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Analog Electronics, Digital Electronics, Microprocessor & Microcontrollers
Full Marks:	100		
Examination Scheme:	Semester Examination: 40	Continuous Assessment: 55	Attendance: 05

Course Objectives:	
1	To impart the essential knowledge of electronic circuit design.
2	To enhance hands on experience and to encourage innovativeness.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
	Guidelines: 1. The mini-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design. 2. The mini project may be a complete hardware or a combination of hardware and software. 3. Mini Project should cater to a small system required in laboratory or real life. 4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced. 5. After interactions with mentor and based on comprehensive literature survey/need analysis; the student shall identify the title and define the aim and objectives of mini-project. The project should provide enough room for the student to learn and innovate. If same job is assigned to more than one group, it must be with different parameter values. 6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within two weeks from the starting of the semester.	

	7. The student is expected to follow the timeline as given for design, development and testing of the proposed work. 8. Layout should be made using CAD based simulation software, if required. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design. 9. The student must always make a comparative study between the theoretical and measured performance parameters and analyze their causes. 10. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester. 11. Few sessions should be considered for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing. **Grading System:** 1. The total score of 100 will be in three parts, a) Continuous evaluation: 55 b) Semester end viva: 40 c) Attendance: 05 2. The teacher will evaluate the performance of each student on the basis of initiative, innovativeness, speed, ability to follow timeline and insight for continuous evaluation. 3. At the end of the semester, the student will be interviewed by a panel of examiners to assess his/her expertise in various facets of the work.	
Total		**40**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify a problem statement, analyze it after literature survey or from given conditions.
2	Design the prototype in order to solve the conceived problem.
3	Implement and test the prototype in order to solve the conceived problem.

Learning Resources:	
1	The Art of Electronics, Paul Horowitz and Winfield Hill, 2nd edition, Cambridge University Press
2	Electronics for You, EFY Group

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

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	Solve company oriented campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability.	20
2	Mock test	10
Total		**30**

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