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

Part III: Detailed Curriculum

Sixth Semester

Course Name:	**Software Engineering**		
Course Code:	PC-IT601	**Category:**	Professional Core Course
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concepts of Computer Programming.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Introduction to Software Engineering Principles and activities involved in building large software programs.
2	Describe the process of Software Project Management.
3	Fundamental concepts of Software Testing.
4	To develop the ability to Functional and Object oriented design using UML.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**System Analysis and Process Models:** Overview of System Analysis & Design, Business System Concept, System Development Life Cycle, and Software Development process models: Waterfall Model, Prototyping Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, and Requirement Engineering.	8L
2	**System Design:** Context diagram and DFD, Cohesion, Coupling, Problem Partitioning, Top-Down and Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.	6L
3	**Software Project Management:** Project Management Process, Planning, LOC, Function Point, Project Estimation Techniques, COCOMO, Staffing Level Estimation, Project Scheduling, Software Quality Assurance, Software Configuration Management, Risk Management, Project Monitoring and Control.	8L

4	**Software Coding and Testing:** Coding Standard, Guidelines and Review. Levels of Testing, Black Box and White Box Testing, Integration Testing, System Testing, Performance Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics, and Debugging.	8L
5	**Object Modeling and Design:** Static and dynamic models, why modeling, UML diagrams - Use Case Diagram, Class diagram, interaction diagram, collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.	8L
Total		**38L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify software process model and main aspects of software engineering.
2	Explain the role of project management including planning, scheduling, cost estimation, risk management, etc
3	Design software test cases and study software in object oriented paradigm using UML diagram.

Learning Resources:	
1	Pressman, Software Engineering : A practitioner's approach– (TMH)
2	Rajib Mall, Software Engineering- (PHI)
3	Pankaj Jalote, Software Engineering- (Wiley-India)
4	Agarwal and Agarwal, Software Engineering – (PHI)
5	Sommerville, Software Engineering – Pearson
6	Martin L. Shooman, Software Engineering – TMH
7	Grady Booch, James Rumbaugh, Ivar Jacobson, the unified modeling language User guide, Pearson education, New York

Course Name:	**Computer Networks**		
Course Code:	PC-IT 602	**Category:**	Professional Core Course
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of computer.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.
2	Acquire knowledge of Application layer and Presentation layer paradigms and protocols. Study Session layer design issues, Transport layer services, and protocols.
3	Gain core knowledge of Network layer routing protocols and IP addressing. Study data link layer concepts, design issues, and protocols.
4	Read the fundamentals and basics of Physical layer, and will apply them in real time applications.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Overview of Data Communications and Networking. Introduction, Network Models	2L
2	Physical Layer: Signals, Digital Transmission, Analog Transmission, Multiplexing, Transmission Media, Circuit Switching and Telephone Network.	7L
3	Data Link Layer: Error Detection and Correction, Data Link Control and Protocol, Point to Point Access :PPP, Multiple Access, Local Area Networks : Ethernet, Wireless LAN, Connecting LAN, Backbone Networks, Virtual LAN, Cellular Telephone and Satellite Networks, Virtual Circuit Switching	8L
4	Network Layer: Host-to-Host Delivery :Internetworking, Addressing and Routing, Network Layer Protocols : ARP, IPv4, ICMP, IPv6, and ICMPv6, Unicast and Multicast Routing : Routing Protocols	8L
5	Transport Layer: Process-to-Process Delivery: UDP and TCP, Congestion Control and Quality of Service.	5L
6	Application Layer: Client-Server Model: Socket Interface, Domain Name System (DNS), Electronic Mail (SMTP), and File Transfer (FTP), HTTP and WWW, Multimedia.	7L
7	Security: Cryptography, Message Security, User Authentication, and Key Management, Security Protocols in the Internet.	3L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Familiarize with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.
2	Identify the different types of network devices and their functions within a network.
3	Solve network administration problems by applying Computer Networking Concepts.

Learning Resources:	
1	Book of B A Forouzan : Data Communications and Networking, TMH, 2003
2	Book of A S Tanenbaum : Computer Networks, PHI, 2004
3	Book of W Stallings : Data and Computer Communications , PHI/Pearson

Course Name:	**Advanced Algorithm**		
Course Code:	PE-IT601A	**Category:**	Professional Elective Courses
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Concept of Design & Analysis of Algorithms
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Introduce students to the advanced methods of designing and analysing algorithms
2	The student should be able to choose appropriate algorithms and use it for a specific problem
3	To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems
4	Students should be able to understand different classes of problems concerning their computation difficulties
5	To introduce the students to recent developments in the area of algorithmic design

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Sorting: Review of various sorting algorithms, topological sorting	3L
2	Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis	4L
3	Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST	3L
4	Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	3L
5	Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.	3L

6	Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	3L
7	Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.	3L
8	Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem	3L
9	Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	3L
10	Linear Programming: Geometry of the feasibility region and Simplex algorithm	3L
11	NP-completeness: Examples, proof of NP-hardness and NP-completeness	3L
12	Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	3L
13	Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	3L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Analyze the complexity/performance of different algorithms.
2	Determine the appropriate data structure for solving a particular set of problems.
3	Categorize the different problems in various classes according to their complexity.
4	Students should have an insight of recent activities in the field of the advanced data structure.

Learning Resources:	
1	"Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2	"The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3	"Algorithm Design" by Kleinberg and Tardos.
4	“Design and Analysis of Algorithms” by Gajendra Sharma
5	"Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

Course Name:	**Data Analytics and Big Data**		
Course Code:	PE-IT601B	**Category:**	Professional Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand about commonly used terms and techniques related to data analytics that can be used by managers to make better decisions.
2	Learn to use Python and its libraries to perform various Data Analytic tasks on Structured, Unstructured Data.
3	Understand the Big Data Platform and its Use cases
4	Provide an overview of Apache Hadoop and HDFS
5	Understand Map Reduce Jobs and Hadoop Eco System

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Data Analytics concepts and Techniques:** Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning, Regression analysis, Classification techniques, Clustering, Association rules analysis, Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, and Collaborative Filtering.	10L
2	**Introduction to Big Data and Hadoop:** Types of Digital Data, Introduction to Big Data, Big Data Analytics, Data Lake Overview, History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Info sphere Big Insights and Big Sheets.	8L
3	**HDFS (Hadoop Distributed File System):** The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization,	8L

	Avro and File-Based Data structures.	
4	**Map Reduce:** Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	5L
5	**Hadoop Eco System:** Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction	5L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Learn the importance of proper data analysis in decision making using Python.
2	Identify Big Data and its Business Implications.
3	Understand the components of Hadoop and Hadoop Eco-System
4	Access and Process Data on Distributed File System
5	Develop Big Data Solutions using Hadoop Eco System

Learning Resources:	
1.	C. Bishop, Pattern Recognition and Machine Learning, Springer 2007
2.	Tom White "Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
3.	Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
4.	Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
5.	Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.

Course Name:	**Computer Graphics**		
Course Code:	PE-IT601C	**Category:**	Professional Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Knowledge of Algorithm
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Knowledge of fundamental concepts of Computer Graphics and different related algorithms.
2	To understand various transformation techniques and related applications
3	To understand rendering of curves and surfaces.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to computer graphics & graphics systems:** Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.[7] **Scan conversion:** Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill Algorithm, boundary fill algorithm, flood fill algorithm.[5]	12L
2	**2D transformation & viewing:** Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method.[10] **3D transformation & viewing:** 3D transformations: translation, rotation, scaling & other Transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.[6]	16L
3	**Curves:** Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.[3] **Hidden surfaces:** Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal - geometry.[3] **Color & shading models:** Light & color model; interpolative shading model; Texture.[2] **Introduction to Ray-tracing:** Human vision and color, Lighting, Reflection and transmission models.[2]	12L

	GPU Computing: History, Clock speed, CPU vs. GPU, Features of GPU. [2]	
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basics of computer graphics, different graphics systems and applications of computer graphics.
2	Illustrate various algorithms in Computer graphics and study their comparative analysis
3	Choose appropriate algorithm in Computer Graphics for relevant usage.

Learning Resources:	
1	Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education, 2019.
2	Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH, 2019.
3	D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH, 2019

Course Name:	**Advanced Computer Architecture**		
Course Code:	PE-IT601D	**Category:**	Professional Elective Courses
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concepts of Computer organization and Architecture course
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Describe computer architecture.
2	Measure the performance of Computer architectures in terms of different parameters.
3	Summarize parallel architecture

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Computer Architecture and Organization-Review, Fundamentals of Computer Design, Technology Trends Cost Performance Analysis. Parallel Processing Architectures- Taxonomy- SISD, MISD, SIMD, MIMD, PRAM models.	6L
2	Data and Resource Dependencies, Program Partitioning and scheduling, Control Flow vs. Data Flow. Network topologies-Static, Dynamic, Types of Networks (3L) RISC vs. CISC, Memory Hierarchy, Virtual Memory.	11L
3	Concepts of Pipelining, Instruction Pipelining, dynamic pipelining, arithmetic pipelines. Multiprocessors- Multistage Networks, Cache Coherence, Synchronization, Message- passing. Vector Processing Principles- Instruction types, Compound, Vector Loops, and Chaining.	12L
4	Array Processors- Structure, Algorithms. Data Flow Architecture- Graphs. Petri Nets, Static and Dynamic DFA, VLSI Computations. Parallel Programming Models, Languages, Compilers.	11L
Total		**40L**

Course Outcomes:	
The student will be able to :	
1	Explain the concepts of parallel computing and hardware technologies
2	Compare and contrast the parallel architectures
3	Illustrate parallel concepts

Learning Resources:	
1	Kai Hwang and Naresh Jotwani, Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability, McGraw Hill Education
2	John L. Hennessy and David A. Patterson, Computer Architecture: A quantitative approach, 5th edition, Morgan Kaufmann Elseveir,2013

Course Name:	**Artificial Intelligence**		
Course Code:	PE-IT602A	**Category:**	Professional Elective Courses
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Data Structure, Concept of Probability
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn the basics concepts of Artificial Intelligent System
2	To know the special data structure for the domain
3	To understand reasoning process
4	To know how the system learns
5	To have idea about Expert System

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction:** Overview of Artificial intelligence- Problems of AI, AI technique, Water Jug problem.	4L
2	**Intelligent Agents :** Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents	4L
3	**Search techniques:** Solving problems by search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. **Heuristic search strategies:** Hill climbing search, Best-first search, A* search. **Adversarial search** : Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, **Memory bounded heuristic search**: simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems.	8L
4	**Using predicate logic**: Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction.	6L
5	**Probabilistic reasoning**: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets &fuzzy logics.	8L
6	**Learning** : Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning	4L
7	**Planning:** Role of planning in AI, planning vs problem solving, planning as a logical inference problem, planning vs deduction: Situation Calculus, need of special purpose algorithm, STRIPS language, plan by searching for a satisfactory sequence of actions, representation of plans. Case study: Plan for Shoes and Sock problem	4L
8	**Expert System**: expert system shells, knowledge acquisition.	2L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand how an intelligent agent works
2	Learn specific data structure for this field
3	Understand the application of logic and concept of probability in reasoning
4	Understand the importance of learning
5	Have idea about Expert System

Learning Resources:	
1	"Artificial Intelligence, Ritch & Knight, TMH
2	"Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3	"Introduction to Artificial Intelligence & Expert Systems", Patterson, PHI
4	"Logic & Prolog Programming", Saroj Kaushik, New Age International
5	"Expert Systems", Giarranto, VIKAS

Course Name:	**Introduction to Information Security**		
Course Code:	PE-IT602B	**Category:**	Theory
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Concepts of Computer Networking
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand key terms and critical concepts of information security.
2	Understand risk management and professional issues in Information security
3	Understand the basic principles of cryptography and algorithms.
4	Understand the various security technologies and security tools.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	NEEDS FOR SECURITY: Information Security: Introduction- Components of Information System - Approaches to Information Security Implementation - The Security Systems Development Life Cycle-Security professionals and organization –Needs for Security: Threats, Attacks, Secure Software development.	10L

2	PROFESSIONAL ISSUES IN INFORMATION SECURITY & RISK MANAGEMENT: Law & Ethics in Information Security - Risk Management: Risk Identification-Risk Assessment-Risk Control Strategies- Planning for security: Information Security planning and Governance- Information Security Policy, Standards, and Practices.	10L
3	CRYPTOGRAPHY: Cryptology Terminology - Cipher methods – Cryptographic Algorithms – Cryptographic tools – Protocol for secure communications - Attacks on cryptosystems - Physical Security.	10L
4	SECURITY TECHNOLOGIES: Security Technologies: Firewall and VPNs – Intrusion Detection -Prevention systems – Security tools.	10L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Define key terms and critical concepts of information security.
2	Explain risk management and professional issues in Information security.
3	Explain the basic principles of cryptography and algorithms.
4	Describe the various security technologies and security tools.

Learning Resources:	
1	Michael E. Whitman, Herbert J. Mattord, "Principles of Information Security", Fourth Edition, Cengage Learning, 2012.
2	William Stallings, "Cryptography and Network Security", Fourth Edition, Pearson Education, 2011.
3	Forouzan Mukhopadhyay, "Cryptography and Network Security", Fourth Edition, McGraw Hill, 2010
4	C K Shyamala, N Harini, Dr T R Padmanabhan, "Cryptography and Network Security", First Edition, Wiley, India
5	Bernard Menezes, "Network Security and Cryptography", First Edition, Cengage Learning, 2010.

Course Name:	**Internet of Things**		
Course Code:	PE-IT602C	**Category:**	Engineering Science
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Fundamentals of Computer Network,

			Network Security, Internet Technology.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand students various components of Internet of things such as Sensors, internetworking and cyber space.
2	To design and implement IoT circuits and solutions.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT	6L
2	Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc	7L
3	Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modeling of Sensors Importance and Adoption of Smart Sensors	9L
4	Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel	8L
5	Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor	6L
6	Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	4L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the vision of IoT from a global context.
2	Determine the Market perspective of IoT.
3	Use of Devices, Gateways and Data Management in IoT.
4	Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.
5	Building state of the art architecture in IoT.

Learning Resources:	
1	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT, 2014
3	Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
4	Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

Course Name:	**Signals and System**		
Course Code:	PE-IT602D	**Category:**	Engineering Science Courses
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics & Circuit Knowledge
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To Design simple systems for generating and demodulating AM, DSB, SSB and VSB signal.
2	To Understand the concepts in Angle modulation for the design of communication systems.
3	To Analyze pulse modulation and sampling techniques.
4	To Learn the concepts of random process and various types of noise.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**ANALOG MODULATION:** (i) Introduction to Signals, Different Types of Signals. Overview of Communication- Different Communication Channel [4L] (ii) Modulation- Need- Types-Amplitude Modulation – AM, DSBSC, SSBSC, VSB –modulators and demodulators – Angle modulation – PM and FM -Bandwidth of FM Signals using Bessel's Function, FM Modulators and Demodulators, PM-modulators and demodulators – Radio Transmitter & Super heterodyne receivers. Pre-emphasis, De-Emphasis. Simple Numerical. [10L] (iii) NOISE: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth, Sources of Noise, SNR.(Concepts Only) [2L]	16L
2	**PULSE MODULATION:** Pulse Modulation- Digital Transmission of Analog Signals- Sampling theorem – Quantization – PAM, PPM, PWM – Line coding – PCM, DPCM, DM, and ADM– Time Division Multiplexing, Frequency Division Multiplexing & Differences. (No Mathematical Derivation)	10L
3	**DIGITAL MODULATION:** ASK, PSK & FSK- Block Diagram Only- Concept of QPSK – Principles of M-ary signaling. QAM – Companding, ISI – Pulse shaping – Eye pattern, equalizers.	8L
4	**INFORMATION THEORY:** Measure of information – Entropy – Source coding theorem –Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes.	6L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the concept of Basic data Communication and carrier signal
2	Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems
3	Understand the basic introductory knowledge of Noise and Information Theory.

Learning Resources:	
1	Communication Systems, Simon Haykins & Moher, John Willey, India Pvt. Ltd.
2	Modern Digital and Analog Communication Systems, B. P. Lathi, Oxford University

	Press.
3	Principles of Communication Systems, H.Taub & D.L.Schilling, TMH
4	Communication Systems: Analog and Digital, R.P.Singh and S.Sapre: TMH,
5	Analog and Digital Communications by H.P.Hsu & D. Mitra, Tata Mcgraw Hill Publications.
6	Principles of Communication Engineering by A.K.Chhabra, S. Chand Publishing.
7	Principles of Communication by Sanjay Sharma S. K. Kataria & Sons

Course Name:	**E-Commerce and ERP**		
Course Code:	OE-CS601H	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concepts of web and general commerce
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To focus on a strong emphasis upon practices of theory in Applications and Practical oriented approach of E-Commerce Business
2	To provide a contemporary and forward-looking on the theories and practices of Enterprise Resource Planning Technology
3	To train the students to develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth
4	To aim at preparing the students technologically competitive and make them ready to self-upgrade with the respective technical skills

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction**: Overview, definitions, advantages & disadvantages of e-commerce over traditional commerce, threats of e-commerce, managerial prospective, rules & regulations for controlling e-commerce, cyber laws.	2L
2	**Business to Business E-commerce:** **Technologies:** Relationship Between E-Commerce & Networking, Different Types of Networking Commerce, Internet, Intranet & Extranet, EDI Systems Wireless Application Protocol: Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E-Commerce.	9L

	Business Models of E-commerce: Financial, Marketing, Personnel, Production, Materials Information System, DSS, EIS, KMS, GIS, International Information System. **E-strategy:** Security, Testing, Error detection, Controls, IS Vulnerability, Computer Crimes, Securing the Web, Intranets and Wireless Networks, Software Audit, Ethics in IT.	
3	**FOUR C'S: (Convergence, Collaborative Computing, Content Management & Call Center):** Convergence: Technological Advances in Convergence – Types, Convergence and its implications, Convergence & Electronic Commerce. Collaborative Computing: Collaborative product development, contract as per CAD, Simultaneous Collaboration, Security. Content Management: Definition of content, Authoring Tools & Content Management, Content-partnership, repositories, convergence, providers, Web Traffic & Traffic Management; Content Marketing. Call Center: Definition, Need, Tasks Handled, Mode of Operation, Equipment, Strength & Weaknesses of Call Center, Customer Premises Equipment (CPE).	6L
4	**Related Issues in E-Commerce:** **Supply Chain Management:** E–logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain Power. **E-Payment Mechanisms:** Payment through card system, E-Cheque, E-Cash, E-Payment Threats & Protections. **E-Marketing:** Home-shopping, E-Marketing, Tele-marketing **Electronic Data Interchange (EDI):** Meaning, Benefits, Concepts, Application, EDI Model	7L
5	**Risk of E-commerce:** Overview, Security for E-Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital Certificates, Digital signatures.	4L
6	**Enterprise Resource Planning (ERP):** Features, capabilities and Overview of Commercial Software, re-engineering work processes for IT applications, Business Process Redesign, Knowledge engineering and data warehouse. Business Modules: Finance, Manufacturing (Production), Human Resources, Plant Maintenance, Materials Management, Quality Management, Sales & Distribution ERP Package. ERP Implementation. ERP Market Place: SAPAG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation. ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP	10L
Total		**38L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify the various technologies used in e-commerce, and become familiar with important business, legal, security and ethical issues.
2	Explain the key components of Electronic Commerce such as e-marketplace, EDI, supply chain and Collaborative Commerce, customer relationship management, EC security and ePayment schemes.
3	Describe the contemporary ecommerce concepts, terminologies, the processes and management decisions that are involved in launching, operating and managing business activity on the World Wide Web.
4	Use the application software skills such as database creation, web page designing etc. to solve the real world business problems.

Learning Resources:	
1	E-Commerce, M.M. Oka, EPH
2	Kalakotia, Whinston : Frontiers of Electronic Commerce , Pearson Education.
3	Bhaskar Bharat : Electronic Commerce - Technologies &Applications.TMH
4	Enterprise Resource Planning – A Managerial Perspective by D P Goyal, Tata McGraw Hill Education, 2011
5	Enterprise Resource Planning by Ashim Raj Singla, Cengage Learning, 2008.
6	Enterprise Resource Planning, 2nd Edition by Alexis Leon, Tata McGraw Hill Education, 2008
7	Global E-Commerce, J. Christopher & T.H.K. Clerk, University Press

Course Name:	**Microprocessor**		
Course Code:	OE-EC601D	**Category:**	Open Elective Courses
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Concepts of basic Electronics and Computer Organization
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Explain hardware details of 8085 microprocessor with the related signals and their implications
2	Learn programming and interfacing of 8085 & understand the difference between the architecture of 8085 and 8086
3	Learn about 8051 microcontroller architecture and its programming.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction to Microcomputer based system. History of evolution of Microprocessor and Microcontrollers and their advantages and disadvantages. Architecture of 8085 Microprocessor, Pin description of 8085. Address/data bus De-multiplexing, Status Signals and the control signals. Instruction set of 8085 microprocessor, Addressing modes, and Timing diagram of the instructions (a few examples).	10L
2	Assembly language programming with examples, Counter and Time Delays, Stack and Subroutine ,Interrupts of 8085 processor(software and hardware), I/O Device Interfacing-I/O Mapped I/O and Memory Mapped I/O , Serial (using SID and SOD pins and RIM, SIM Instructions) and Parallel data transfer.	10L
3	The 8086 microprocessor- Architecture, Addressing modes, Interrupts. Introduction to 8051 Microcontroller –Architecture, Pin Details. Addressing modes, Instruction set, Examples of Simple Assembly Language.	10L
4	Memory interfacing with 8085, 8086. Support IC chips- 8255, 8251, 8237/8257, 8259 Interfacing with 8085.	10L
Total		**40L**

Course Outcomes:	
The student will be able to :	
1	Understand hardware details of 8085, 8086 and 8051 with the related signals and their implications.
2	Understand programming of 8085 and 8051.
3	Understand how to interface various devices to the microprocessor.

Learning Resources:	
1	MICROPROCESSOR architecture, programming and Application with 8085 - R.Gaonkar (Penram international Publishing LTD.)
2	Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan (Oxford university press)
3	8051 Microcontroller – K. Ayala (Cengage learning)
4	8086 Microprocessor –K Ayala (Cengage learning)
5	Microcontrollers: Principles&Applications, Ajit Pal, PHI 2011.
6	8051 Microprocessor –V. Udayashankara and M.S Mallikarjunaswami (TMH).
7	Microprocessor 8085 and its Interfacing—S Mathur (PHI)

8	Naresh Grover, "Microprocessor comprehensive studies Architecture, Programming and Interfacing" Dhanpat Rai, 2003

Course Name:	**Wireless Communication**		
Course Code:	OE-EC601F	**Category:**	Open Elective
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Knowledge of Computer Networks
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	An understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
2	An ability to compare recent technologies used for wireless communication.
3	An ability to explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.
4	An ability to explain multiple access techniques for Wireless Communication
5	An ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Overview of wireless communication, cellular communication, different generations and standards in cellular communication system, satellite communication including GPS, wireless local loop, cordless phone, paging systems, RFID.	8L
2	Recent wireless technologies: multicarrier modulation, OFDM, MIMO system, diversity multiplexing trade-off, MIMO-OFDM system, smart-antenna; beam forming and MIMO, cognitive radio, software defined radio, communication relays, spectrum sharing.	8L
3	Multiple access techniques in wireless communication: contention-free multiple access schemes (FDMA TDMA, CDMA, SDMA and Hybrid), contention-based multiple access schemes (ALOHA and CSMA).	8L
4	Wireless personal area networks (Bluetooth, UWB and ZigBee), wireless local area networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), wireless metropolitan area networks (WiMAX).	8L

5	Ad-hoc wireless networks: Design Challenges in Ad-hoc wireless networks, concept of cross layer design, security in wireless networks, energy constrained networks. MANET and WSN. Wireless system protocols: mobile network layer protocol (mobile IP, IPv6, dynamic host configuration protocol), mobile transport layer protocol (traditional TCP, classical TCP improvements), support for mobility (wireless application protocol).	8L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
2	Compare different technologies used for wireless communication systems.
3	Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks
4	Demonstrate an ability explain multiple access techniques for Wireless Communication
5	Demonstrate an ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks.

Learning Resources:	
1	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2	Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts" River Publishers, Denmark, 2015 (Indian reprint).
3	Vijay K Garg, "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint)
4	J. Schiller, "Mobile Communication" 2/e, Pearson Education, 2012.
5	Iti Saha Misra, "Wireless Communication and Networks: 3G and Beyond", 2/e, McGraw Hill Education (india) Private Ltd, New Delhi, 2013.

Course Name:	**Software Engineering Lab**		
Course Code:	PC-IT691	**Category:**	Professional Core Course
Semester:	Sixth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Basic concepts of Computer Programming.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To prepare Software Requirement Specification document.
2	To prepare Software Schedule and can estimate Software project Size
3	To draw Functional and Object oriented diagram using UML
4	To design Test Script/Test Plan

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Preparation of requirement document (SRS) for proposed project in standard format (IEEE standard) utilizing Requirement analysis.	6P
2	Project Schedule preparation using tools like MS Project. Generation of Gnatt and PERT chart from schedule. Prepare Project Management Plan in standard format.	6P
3	Draw DFD and prepare Functional Design Document using tools like MSVisio.	3P
4	Draw Use Case Diagram, Class diagram, Sequence diagram and prepare Object Oriented Design Document using tools like MS Visio.	6P
5	Estimate project size using Function Point (FP)/Use Case Point. Use Excel/Open Office template for calculation.	6P
6	Design Test Script/Test Plan (both Black box and White Box approach) for a small component of the proposed project.	6P
7	Generate Test Result and perform defect root cause analysis using Pareto or Fishbone diagram.	3P
Total		**36P**

Following projects can be used as dummy projects:

- Library Management System
- Railway Reservation System
- Employee Payroll System
- Online Banking System
- Online Shopping Cart
- Online Examination System

Course Outcomes:	
After completion of the course, students will be able to:	
1	Prepare Requirement document (SRS), Project management plan in standard format.
2	Scheduling a project using an appropriate Software Engineering methodology & Estimate project size using Function point (FP)/Use case point.
3	Design UML diagram, Test Script/Test Plan for a small component of the proposed project and generate Test result.

Learning Resources:	
1	Grady Booch, James Rumbaugh, Ivar Jacobson, the unified modeling language User guide, Pearson education, New York
2	Pressman, Software Engineering : A practitioner's approach– (TMH)
3	Rajib Mall, Software Engineering - (PHI)
4	Lab Manual of Software Engineering Lab

Course Name:	**Computer Networks Lab**		
Course Code:	PC-IT 692	**Category:**	Professional Elective Course
Semester:	Sixth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Knowledge of programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment:35	Attendance: 05

Course Objectives:	
1	To familiarize the students with the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.
2	To familiarize the students with the Application layer and Presentation layer paradigms and protocols. Study Session layer design issues, Transport layer services, and protocols.
3	To familiarize the students with the Network layer routing protocols and IP addressing. Study data link layer concepts, design issues, and protocols.
4	To familiarize the students with fundamentals and basics of Physical layer, and will apply them in real time applications.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	NIC Installation & Configuration (Windows/Linux)	4P
2	Understanding IP address, subnet etc Familiarization with Networking cables (CAT5, UTP), Connectors (RJ45, T-connector), Hubs, Switches	4P
3	TCP/UDP Socket Programming Simple, TCP based, UDP based, Multicast & Broadcast Sockets, Implementation of a Prototype Multithreaded Server	16P
4	Implementation of Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window) Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)	12P

	Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)	
5	Server Setup/Configuration FTP, TelNet, NFS, DNS, Firewall	12P
Total		**48P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic protocols of computer networks.
2	Identify the different types of network devices and their functions within a network.
3	Solve network administration problems by applying Computer Networking Concepts.

Learning Resources:	
1	Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.
2	Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI
3	An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
4	Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI
5	Computer Networking: A Top-Down Approach - James Kurose and Keith Ross, Pearson ,7th edition
6	Red Hat Linux Networking & System Administration by Terry Collings & Kurt Wall
7	System Programming by John J Donovan
8	Laboratory Manual

Course Name:	**Advanced Algorithm Lab**		
Course Code:	PE-IT691A	**Category:**	Professional Elective Courses
Semester:	Sixth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Concept of Design & Analysis of Algorithms
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Introduce students to the advanced methods of designing and analysing algorithms
2	The student should be able to choose appropriate algorithms and use it for a specific problem

3	To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems
4	Students should be able to understand different classes of problems concerning their computation difficulties
5	To introduce the students to recent developments in the area of algorithmic design

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Sorting: various sorting algorithms, topological sorting	4P
2	Graph: Shortest path by BFS, DFS, in edge-weighted case (Dijkasra's)	8P
3	Matroids: to compute a maximum weight maximal independent set	4P
4	Graph Matching: to compute maximum matching. Edmond's Blossom algorithm to compute augmenting path.	4P
5	Flow-Networks: Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.	8P
6	Matrix Computations: Strassen's algorithm.	4P
7	Shortest Path in Graphs: Floyd-Warshall	4P
8	Discrete Fourier Transform (DFT): Schonhage-StrassenInteger Multiplication algorithm	4P
9	Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	8P
Total		**48P**

Course Outcomes:

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

1	Analyze the complexity/performance of different algorithms.
2	Determine the appropriate data structure for solving a particular set of problems.
3	Categorize the different problems in various classes according to their complexity.
4	Students should have an insight of recent activities in the field of the advanced data structure.

Learning Resources:

1	"Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2	"The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3	"Algorithm Design" by Kleinberg and Tardos.

4	"Design and Analysis of Algorithms" by Gajendra Sharma
5	"Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

Course Name:	**Data Analytics and Big Data Lab**		
Course Code:	PE-IT691B	**Category:**	Professional Elective
Semester:	Sixth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries)
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1.	Understand about commonly used terms and techniques related to data analytics that are in use today.
2.	Make students learn to use Python and its libraries to perform various Data Analytic tasks on Structured, Unstructured Data.
3.	To set up single and multi-node Hadoop Clusters
4.	To solve Big Data problems using Map Reduce Technique.
5.	To design algorithms that uses Map Reduce Technique to apply on Unstructured and structured data
6.	To learn NoSQL query
7.	To learn Big Data Databases: HBase/ Hive/Pig

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Lab 1,2 & 3: **Data Analytics with Python:** Uses of different data mining algorithms with Python	9P
2	Lab 4&5: **Installation and Setup:** Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves). File Management tasks in Hadoop:	6P

3	Lab 6 & 7 : **Introduction to Map Reduce**: Map Reduce application for word counting on Hadoop cluster	6P
4	Lab 8 & 9: **Operations on Unstructured data**: Unstructured data into NoSQL data and do all operations such as NoSQL query with API.	6P
5	Lab 8, 9 & 10: **Big Data Databases:** Hive Databases, Tables, Views, Functions and Indexes Implement an application that stores big data in Hbase / Mongo DB / Pig using Hadoop	9P
Total		36P

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use Python to analyze data and provide useful information for decision making.
2	Set up single and multi-node Hadoop Clusters
3	Apply Map Reduce technique for various algorithms
4	Design new algorithms that use Map Reduce to apply on Unstructured and structured data.
5	Represent NoSQL data.
6	Use Big Data Databases : Hbase/Hive/Pig

Learning Resources:	
1	C. Bishop, Pattern Recognition and Machine Learning, Springer 2007
2	Python Machine Learning by Example" by (Hayden) Liu and Yuxi
3	Tom White "Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
4	Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
5	Big Data Analytics Lab Manual: Step by Step Guide to Hadoop, Pig, Hive and MongoDB ,Dr. M.S.Vijaya Dr. N.Radha V. Pream Sudha, Dr. N. Radha Narayanan, et al.
6	Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
7	Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.

Course Name:	**Computer Graphics Lab**		
Course Code:	PE-IT691C	**Category:**	Laboratory
Semester:	Sixth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Knowledge of Algorithm design and Coding in C Language and Open Gl.
Full Marks:	100		
Examination	Semester Examination:	Continuous	Attendance: 05

Scheme:	60	Assessment: 35	

Course Objectives:	
1	Understand graphics programming
2	Design and Experiment Algorithms for Image Transformation and Enhancement.
3	Design and Experiment using Open Gl to create a mini-Project.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Implementation of Algorithms for drawing 2D Primitives – Line (DDA, Bresenham) – all slopes, Circle, Ellipse (Midpoint) using C Programming Language. 1. Write a program to draw a line using Digital Differential Analyzer (DDA) Algorithm 2. Write a program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes negative and less than 1. 3. Write a program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes positive and less than 1. 4. Write a program to draw a circle using Bresenham's Circle Algorithm. 5. Write a program to draw a circle using MidPoint Circle Algorithm 6. Write a program to draw an ellipse using MidPoint Ellipse Algorithm.	6P
2	Implementation of 2D Geometric transformations – Translation, Rotation, Scaling, Reflection Shear, Window-Viewport using C Programming Language. 1. Write a menu driven program for Implementation of 2D transformation: Translation, Scaling, Rotation, Mirror reflection and Shearing. 2. Write a program to implement Window to Viewport transformation.	6P
3	Implementation of Line Clipping algorithms using C Programming Language. 1. Write a program for Implementation of Line Clipping using Cohen- Sutherland Algorithm and Bisection method.	3P
4	Implementation of Polygon Clipping algorithm using C Programming Language. 1. Write a program for Implementation of Polygon Clipping using Sutherland- Hodgeman Algorithm.	3P

5	Implementation of Polygon Filling algorithms using C Programming Language. 1. Write a program Implementation of Polygon filling using flood fill, boundary fill, and scan line algorithms.	6P
6	Implementation of Bezier Curve drawing algorithm using C Programming Language. 1. Write a program to draw a Bezier Curve having four control points.	3P
7	Mini Project using Open Gl. 1. Write a program to draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the surfaces of the solid object used in the scene.	9P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	To understand Graphics Programming
2	To design Algorithms and Experiment on Image Transformation and Enhancement.
3	To understand and experiment using Open GL Programming language.

Learning Resources:	
1	Francis Hill, Stephen Kelley, "Computer Graphics Using OpenGL", Pearson 3rd Edition. 2007.
2	Donald Hearn and M. Pauline Baker. "Computer Graphics with OPENGL" 3rd Edition, Pearson Publishers, 2011.
3	Donald Hearn and M. Pauline Baker. "Computer Graphics using C" 3rd Edition, Pearson Publishers, 2002.
4	Harrington, S. "Computer Graphics: A Programming Approach" Mc-Graw Hill Book Co. 1986.
5	John Vince, "Mathematics for Computer Graphics", Springer-Verlag, 2013.

Course Name:	**Advanced Computer Architecture Lab**		
Course Code:	PE-IT691D	**Category:**	Professional Elective Courses
Semester:	Sixth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Basic concepts of Computer organization and Architecture course
Full Marks:	100		

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

Course Objectives:	
1	Explain Computer Architecture technology perspective.
2	Explain Memory Interfacing
3	Learn ALU and CPU functions

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	HDL introduction (All laboratory assignments are based on Hardware Description Language (VHDL or Virology) Simulation.)	6P
2	Basic digital logic base programming with HDL	9P
3	8-bit Addition, Multiplication, Division	3P
4	8-bit Register design	3P
5	Memory unit design and perform memory operations.	3P
6	8-bit simple ALU design	3P
7	8-bit simple CPU design	3P
8	Interfacing of CPU and Memory	6P
Total		**36P**

Course Outcomes:	
The student will be able to :	
1	Understand Computer Architecture technology perspective.
2	Develop understanding of Processing and Memory Interfacing.
3	Understand ALU and CPU Design

Learning Resources:	
1	Kai Hwang and Naresh Jotwani, Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability, McGraw Hill Education.
2	W. Stallings, "Computer Organization and Architecture - Designing for Performance", Prentice Hall of India

Course Name:	**Project-II**		
Course Code:	PW-IT681	**Category:**	Sessional Course
Semester:	Sixth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Knowledge of engineering, science and management subjects
Full Marks:	100		
Examination Scheme:	Semester Examination: 20		Continuous Assessment: 80

Course Objectives:	
1	In depth knowledge gain in the domain of the assigned topic.
2	To be able to formulate the problem in the assigned topic.
3	To be able to execute the action plan for conducting the project as a team work.
4	To be able to perform development of product/process, testing, analysing the results and future scope.

Course Outcomes:	
After completion of the course, students will be able to:	
1	Work as a team member.
2	Prepare a report in the standard format.
3	Perform Seminar Presentation before any standard body.

Course Name:	**Aptitude Skill Development - II**		
Course Code:	MC671	**Category:**	**Mandatory Courses**
Semester:	Sixth	**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