		Bachelor of Technology (Computer Science & Engineering)								
		Credit-Based Scheme of Studies/Examination								
		Semester VI (w.e.f. session 2020-2021)								
S. No.	Course Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-302A	Complier Design	3:0:0	3	3	75	25	0	100	3
2	PC-CS-304A	Computer Networks	3:0:0	3	3	75	25	0	100	3
3	PEC	Elective-II	3:0:0	3	3	75	25	0	100	3
4	PEC	Elective-III	3:0:0	3	3	75	25	0	100	3
5	OEC	Open Elective-I	3:0:0	3	3	75	25	0	100	3
6	PROJ – CS-302A	Project-1	0:0:6	6	3	0	40	60	100	3
7	PC-CS-306LA	UNIX and Linux Programming Lab	0:0:4	4	2	0	40	60	100	3
8	PC-CS-308LA	Computer Networks Lab	0:0:4	4	2	0	40	60	100	3
Total				29	22	375	245	180	800	

PEC Elective-II	PEC Elective-III
Advanced Computer Architecture: PE-CS-S302A	Simulation & Modeling: PE-CS-S310A
Distributed Systems: PE-CS-S304A	Mobile Computing: PE-CS-S312A
Fault Tolerant Computing: PE-CS-S306A	Unix & Linux Programming: PE-CS-S314A
Mobile Ad-hoc and Wireless Sensor Networks: PE-CS-S308A	Real Time Systems: PE-CS-S316A

OEC Open Elective-I
Soft Skills and Interpersonal Communication: OE-CS-302A
Management Information System: OE-CS-304A
Enterprise Resource Planning: OE-CS-306A

Note: Students be encouraged to go to 6-8 weeks summer internships mandatory during the summer break after the completion of sixth semester exams.

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

PC-CS-302A	Complier Design						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	To introduce complier design concepts and their implementation						
Course Outcomes(CO)							
CO1	To understand the role and designing of a lexical analyzer.						
CO2	To analyzethe role and designing of syntax analyzer or parser.						
CO3	To identifythe role of semantic analyzer and intermediate code generation.						
CO4	To explore thedesign importance of optimization of codes and error detection						

UNIT I

Introduction to Language Processing System, Compiling Analysis of the Source Program, Phases of a Compiler, Compiler Construction Tools. Lexical Analysis –Regular Expression, Introduction to Finite Automata and Regular Expression, Conversion of Regular Expression to NFA, Role of Lexical Analyzer, Specification of Tokens.

UNIT II

Syntax Analysis:Role of the Parser, Abstract Syntax Trees, Ambiguity in Context-Free Grammars, Types of Parsing:- Top Down Parsing, Recursive Descent Parsing, LL Parser, Back Tracking, Bottom Up Parsing, SLR Parser, Canonical LR Parser, LALR Parser.

UNIT III

Semantic Analysis : Semantic Errors, Attribute Grammar, Synthesized attributes, Static Allocation, Stack Allocation, Heap Allocation, Activation Trees, Symbol Table, Intermediate Code Generation and Code Intermediate languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, DAG representation of Basic Blocks, A simple Code generator from DAG, Issues in the Design of Code Generator
.

UNIT 1V

Code Optimization and Run Time Environments, Principal Sources of Optimization, Machine-independent Optimization, Machine-dependent Optimization, Optimization of Basic Blocks, Loop Optimization , Peephole Optimization, Introduction to Global Data Flow Analysis, Storage Organization, Static Storage Management, Heap Storage management, Parameter Passing. Error Recovery, Panic mode, Statement mode, Global correction.

Suggested Book :
1. Alfred Aho, Ravi Sethi, Jeffrey D Ullman, "Compilers Principles, Techniques and Tools", Pearson Education Asia, 2018.
2. Allen I. Holub "Compiler Design in C", Prentice Hall of India, 2003.
3. C. N. Fischer and R. J. LeBlanc, "Crafting a compiler with C", Benjamin Cummings, 2003.
4. V Raghavan , " Principles of Compiler Design", Second Edition, Tata McGraw-Hill, 2018.
5. HenkAlblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
6. Kenneth C. Louden, "Compiler Construction: Principles and Practice", Thompson Learning, 2003

PC-CS-304A	Computer Networks						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	To introduce the architecture and layers of computer network, protocols used at different Layers.						
Course Outcomes(CO)							
CO1	To understand the basic concept of networking, types, networking topologies and layered architecture.						
CO2	To understand data link layer and MAC sub-layer`						
CO3	To understand the network Layer functioning						
CO4	To understand the transport layer and application layer operation						

Unit -I

Introduction to Computer Networks : Data Communication System and its components, Data Flow, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Wireless and Wired networks, broadcast and point-to-point networks, Network topologies, protocols, interfaces and services, ISO- OSI reference model, TCP/IP architecture.

Physical Layer: Concept of Analog & Digital Signal, Bandwidth, Transmission Impairments: Attenuation, Distortion, Noise, Multiplexing : Frequency Division, Time Division, Wavelength Division, Transmission Media: Twisted pair, Coaxial cable, Fiber optics, Wireless transmission (radio, microwave, infrared), Switching: Circuit Switching, Message Switching ,Packet Switching & comparisons, narrowband ISDN, broadband ISDN.

Unit -II

Data link layer: Error Control, Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, sliding window protocols, Selective repeat ARQ, HDLC;

Medium access sub layer: Point to point protocol, FDDI, token bus, token ring; Reservation, polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA, LLC, Traditional Ethernet, fast Ethernet, Network devices-repeaters, hubs, switches, Bridges, Router, Gateway .

Unit-III

Network layer: Addressing : Internet address, sub-netting; Routing techniques, static vs. dynamic routing , routing table, DHCP, IEEE standards 802.x, Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IGMP, IPV6; Unicast and multicast routing protocols, ATM.

Unit-IV

Transport layer: Process to process delivery; UDP; TCP, RPC, Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets; Quality of service: techniques to improve QoS.

Application layer: DNS; SMTP, SNMP, FTP, HTTP & WWW; Firewalls, Bluetooth, Email, S/MIME, IMAP,

Network Security: Cryptography, user authentication, security protocols in internet, public key encryption algorithm, digital signatures

Suggested Books:
1. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw Hill, Fourth Edition, 2011.
2. Computer Networks, 4th Edition, Pearson Education by Andrew S. Tanenbaum
1. Larry L.Peterson, Peter S. Davie, "Computer Networks", Elsevier, Fifth Edition, 2012.
2. William Stallings, "Data and Computer Communication", Eighth Edition,Pearson Education, 2007.

3. James F. Kurose, Keith W. Ross, "Computer Networking: A Top–Down Approach Featuring the Internet", Pearson Education, 2005.

PC-CS-306LA	UNIX and Linux Programming Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**3.0**	**40**	**60**	**100**	**3 Hrs.**
Purpose	Experimental knowledge of programming skills with expertisation on Unix/Linux platform						
Course Outcomes(CO)							
CO1	Learning of simple and advanced commands of Unix /Linux operating systems.						
CO2	Develop shell programming using Bash or any other shell scripts.						
CO3	Develop advanced shell programming skills.						
CO4	Analyzing & evaluation of performance of various c language based programs with the help of Make file & debug utilities.						
CO5	Creation of user accounts, Learning of package installation, backup and shutdown process on Unix /Linux operating systems.						

List of Practical
1. Familiarize with Unix/Linux Log In/Log Out and various other commands &vi editor.
2. Develop simple shell programs using Bash or any other shell in Linux.
3. Develop advanced shell programs using grep, fgrep&egrep.
4. Compile and debug various C language based programs using 'makefile' & 'debug' utility.
5. Learning of installation of dual operating systems with Linux having previously installed   other window based operating system. Both OSs should be in working operating mode.
6. As Supervisor create and maintain user accounts, learn package installation, taking backups, creation of scripts for file and user management, creation of startup and shutdown scripts using at, batch, cron etc.

NOTE : At least 8 to 12 more programs exercises based on Unix/Linux plateform are to be assigned by the concerned teacher.

PC-CS-308LA	Computer Networks Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**40**	**60**	**100**	**3 Hour**
Purpose	**To explore networking concepts using Java programming & networking tools.**						
Course Outcomes (CO)							
CO1	Do Problem Solving using algorithms.						
CO2	Design and test simple programs to implement networking concepts using Java.						
CO3	Document artifacts using applied addressing & quality standards.						
CO4	Design simple data transmission using networking concepts and implement.						

COMPUTER NETWORKS LAB

1. Create a socket for HTTP for web page upload and download.
2. Write a code simulating ARP /RARP protocols.
3. Study of TCP/UDP performance.
4. Performance comparison of MAC protocols
5. Performance comparison of routing protocols.
6. Write a program:
   a. To implement echo server and client in java using TCP sockets.
   b. To implement date server and client in java using TCP sockets.
   c. To implement a chat server and client in java using TCP sockets.
7. Write a program:
   a. To implement echo server and client in java using UDP sockets
   b. To implement a chat server and client in java using UDP sockets.
   c. To implement a DNS server and client in java using UDP sockets.
8. To flood the server from a spoofed source address leading to a DoS attack.
9. To sniff and parse packets that pass through using raw sockets.
10. To implement simple calculator and invoke arithmetic operations from a remote client.
11. To implement bubble sort and sort data using a remote client.
12. To simulate a sliding window protocol that uses Go Back N ARQ.

PE-CS-S302A	Advanced Computer Architecture						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	To enable students to learn various computational models, design paradigms of advanced computer architecture, parallelism approaches and techniques for static and dynamic interconnections.						
Course Outcomes (CO)							
CO1	Classify and interpret various paradigms, models and micro-architectural design of advanced computer architecture as well as identify the parallel processing types and levels for achieving optimum scheduling.						
CO2	Identify the roles of VLIW & superscalar processors and branch handling techniques for performance improvement.						
CO3	Analyze and interpret the basic usage of various MIMD architectures and relative importance of various types of static and dynamic connection networks for realizing efficient networks.						
CO4	Examine the various types of processors and memory hierarchy levels and cache coherence problem including software and hardware based protocols to achieve better speed and uniformity.						

Unit-I

Computational Model: Basic computational models, evolution and interpretation of computer architecture, concept of computer architecture as a multilevel hierarchical framework, classification of parallel architectures, Relationships between programming languages and parallel architectures.

Parallel Processing: Types and levels of parallelism, Instruction Level Parallel (ILP) processors, dependencies between instructions, principle and general structure of pipelines, performance measures of pipeline, pipelined processing of integer, Boolean, load and store instructions, VLIW architecture, Code Scheduling for ILP Processors - Basic block scheduling, loop scheduling, global scheduling.

Unit-II

Superscalar Processors: Emergence of superscalar processors, Tasks of superscalar processing – parallel decoding, superscalar instruction issue, shelving, register renaming, parallel execution, preserving sequential consistency of instruction execution and exception processing, comparison of VLIW & superscalar processors.

Branch Handling: Branch problem, Approaches to branch handling – delayed branching, branch detection and prediction schemes, branch penalties, multiway branches, guarded execution.

Unit-III

MIMD Architectures: Concepts of distributed and shared memory MIMD architectures, UMA, NUMA, CCNUMA & COMA models, problems of scalable computers.

Static connection networks: Linear array, ring, chordal ring, barrel shifter, star, tree, mesh and torus, fat Tree, systolic array, barrel shifter, hypercubes and Cube connected cycles.

Dynamic interconnection networks: single shared buses, comparison of bandwidths of locked, pended & split transaction buses, arbiter logics, crossbar networks, multistage networks, omega networks, butterfly.

UNIT – IV

Processors and Memory Hierarchy: Advanced processor technology, memory hierarchy technology and virtual memory technology. Cache Coherence and Synchronization Mechanisms: Cache coherence problems, hardware based protocols – snoopy cache protocols, directory schemes, hierarchical cache coherence protocols, software based protocols.

Suggested Books
1. D.Sima, T.Fountain, P.Kasuk, Advanced Computer Architecture-A Design Space Approach, Pearson Education.
2. Kai Hwang and Naresh Jotwani, Advanced Computer Architecture-Parallelism, Scalability, Programmability, McGraw Hill.
3. M.J. Quinn, Parallel Computing: Theory and Practice, Second Edition, McGraw Hill.

4.   J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative approach, Morgan Kaufmann/Elsevier.
5.   T.G.Lewis and H. EI-Rewini, Introduction to parallel computing, Prentice Hall.
6   Nicholas Carter, Computer Architecture, McGraw Hill.

PE-CS-S304A	Distributed Systems						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	To impart knowledge of distributed systems and process management in distributed systems using various techniques.						
Course Outcomes(CO)							
CO1	Understand foundations of Distributed Systems.						
CO2	Introduce the idea of peer to peer services and file system.						
CO3	Understand in detail the system level and support required for distributed system and able to apply remote method invocation and objects.						
CO4	The student should be able to design process and resource management systems.						

UNIT: I INTRODUCTION

Examples of Distributed Systems–Trends in Distributed Systems – Focus on resource sharing – Challenges. Case study: World Wide Web.

UNIT II: COMMUNICATION IN DISTRIBUTED SYSTEM

System Model – Inter process Communication – the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation and Objects: Remote Invocation – Introduction – Request-reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish-subscribe systems – Message queues – Shared memory approaches – Distributed objects – Case study: Enterprise Java Beans -from objects to components.

UNIT III: PEER TO PEER SERVICES AND FILE SYSTEM

Peer-to-peer Systems – Introduction – Napster and its legacy – Peer-to-peer – Middleware – Routing overlays. Overlay case studies: Pastry, Tapestry- Distributed File Systems –Introduction – File service architecture – Andrew File system. File System: Features-File model -File accessing models – File sharing semantics Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

UNIT IV: SYNCHRONIZATION, REPLICATION AND PROCESS MANAGEMENT

Introduction – Clocks, events and process states – Synchronizing physical clocks- Logical time and logical clocks – Global states – Coordination and Agreement – Introduction – Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study – Coda.

Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction- Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.

BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
   Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
4. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

PE-CS-S306A	Fault Tolerant Computing						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	To learn and implement fault tolerant computing						
Course Outcomes(CO)							
CO1	To Understand the importance of fault tolerance and reliability						
CO2	To learn the design and testing techniques of fault tolerant system						
CO3	To recognize the fault tolerance in real time and distributed systems.						
CO4	To analyze dependability evaluation techniques						

UNIT I

Introduction to Fault Tolerant Computing, Dependability concepts: dependable system, techniques for achieving dependability, dependability measures, fault, error, failure, faults and their manifestation, classification of faults and failures.

Fault tolerant strategies: Fault detection, masking, containment, location, reconfiguration, and recovery.

UNIT II

Fault tolerant design techniques: Hardware redundancy, software redundancy, time redundancy, and information redundancy.

Testing and Design for Testability. Self-checking and fail-safe circuits.

UNIT III

Information Redundancy : coding techniques, error detection and correction codes, burst error detection and correction, unidirectional codes..

Fault tolerance in distributed systems: Byzantine General problem, consensus protocols, check pointing and recovery, stable storage and RAID architectures, and data replication and resiliency.

UNIT 1V

Dependability evaluation techniques and tools: Fault trees, Markov chains.

Analysis of fault tolerant hardware and software architectures.

System-level fault tolerance and low overhead high-availability technique

Fault tolerance in real-time systems: Time-space tradeoff, fault tolerant scheduling algorithms.

Suggested Books:
1. Fault Tolerant Computer System design by D. K. Pradhan, Prentice Hall.
2. Reliable Computer Systems: Design and Evaluation by D. P. Siewiorek and R. S. Swarz, Digital Press.
3. Design and Analysis of Fault Tolerant Digital Systems by B.W. Johnson, Addison Wesley
4. Fault Tolerance in Distributed Systems, Pankaj Jalote, PTR Printice Hall.

PE-CS-S308A	Mobile Ad-hoc and Wireless Sensor Networks						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to describe and deal with computer communication and networking, various reference models and architectures along with implemented wireless communication techniques and various security and privacy parameters are also studied.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Classify traditional networks and discuss various wireless networking standards, compare and contrast various IEEE wireless LAN and Ethernet standards.						
CO2	Describe cellular architecture and IPv4 and IPv6 header formats has to be discussed along with mobile IP.						
CO3	Recently deployed high performance computing standards, VPN, routing protocols as to be gone through.						
CO4	Various security and privacy standards/tools to be described.						

Unit I

Introduction to Mobile Ad hoc Networks (MANET) – Mobility Management, Characteristics and Attributes related to MANETs, Modeling distributed applications for MANET, MAC mechanisms and protocols.

Unit II

MANET Routing Protocols: Ad hoc network routing protocols, destination sequenced distance vector algorithm, cluster based gateway switch routing, global state routing, fish-eye state routing, dynamic source routing, ad hoc on-demand routing, OLSR & TORA routing, location aided routing, zonal routing algorithm.

Unit III

Ad-Hoc Network Security: Link layer, Network layer, Trust and key management. Self policing MANET – Node Misbehaviour, secure routing, reputation systems.
Wireless Sensor Networks (WSN) : Design Issues, Clustering, Applications of WSN.

Unit IV

MAC layer and Routing Protocols in WSN
Data Management: Retrieval Techniques in WSN, Sensor databases, distributed query processing, Data dissemination and aggregation schemes, Operating Systems for WSN, Security issues in WSN.

Suggested Books:
1   C. Siva Ram Murthy & B.S. Manoj, Mobile Ad hoc Networks – Architectures & Protocols, Pearson Education, New Delhi, 2004
2   C M Cordeiro& D.P. Agrawal, Adhoc& Sensor Networks – Theory and Applications, ISBN 981256-682-1, World Scientific Singapore, 2006
3   C. S. Raghvendra, Wireless Sensor Networks, Springer-Verlag, 2006.

PE-CS-S310A	Simulation and Modeling						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hour
PO	To introduce the principles and paradigms of Computer Modeling and Simulation for solving a wide variety of problems. And how to use simulator to simulate the live systems.						
Course Outcomes (CO)							
CO 1	To introduce the basic concepts of System, System Modeling, types of Models, simulation and need of simulation.						
CO 2	To introduce the simulation of continuous and discrete systems with the help of different examples.						
CO 3	To introduce the concept of generation of uniformly and non-uniformly distributed random numbers.						
CO 4	To introduce the concept of simulation of live systems and PERT.						
CO5	To introduce the concept of simulation of inventory control systems and simulation languages.						

Unit-I

Modeling: System Concepts, continuous and discrete systems, system boundaries, system modeling, types ofModels, model validation, Principles & Nature of Computer modeling.
Simulation: Introduction, Basic nature of simulation, When to simulate, Pros and cons of simulation, concepts of simulation of continuous and discrete system with the help of example.

Unit-II

Continuous System Simulation: Analog vs. digital simulation, continuous simulation vs. numerical integration, simulation of a chemical reactor, simulation of a water reservoir system.
Discrete system simulation: Fixed time-step vs. event-to-event model, Monte-Carlo computation vs. stochastic simulation, generation of random numbers, generation of non-uniformly distributed random numbers.

Unit-III

Simulation of the Live systems: Simulation of queuing Systems: basic concepts of queuing theory, simulation of single server, two server and more general queuing system.
Simulation of PERT network: Network model of a project, analysis of an activity network, critical path computation, uncertainties in activity durations, simulation of an activity network.

Unit-IV

Simulation of inventory control systems: Elements of inventory theory, inventory models, generation of Poisson and Erlang variates, simulator for complex inventory systems,
Variance reduction techniques and validation.
Simulation Languages: Continuous and discrete simulation languages, factors in selection of a discrete system simulation languages.

Suggested Books:
1. Gordon G.: System simulation, Prentice-Hall of India Pvt. Ltd. New Delhi 1993
2. NarsinghDeo: System Simulation with Digital Computer, PHI New Delhi, 1993
3. Neelankavil Frances: Computer Simulation and Modelling, John Wiley & Sons, NewYork, 1987.
4. Payne, James A.: Introduction to simulation: Programming TechniquesandMethodsof Analysis, McGraw-Hill International Editions, Computer Science services, New York (1998).

PE-CS-S312A	Mobile Computing						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	To impart knowledge of mobile and wireless computing systems and techniques.						
Course Outcomes(CO)							
CO1	Describe the concepts of mobile computing and cellular networks.						
CO2	Learn the basic concepts of wireless networks.						
CO3	Study of various issues of mobile computing and basics of cloud computing.						
CO4	Description and applications of Ad hoc networks.						

UNIT – I

Introduction, Issues in mobile computing, Overview of wireless telephony: cellular concept- Cell, Co-Channel Interference, Frequency reuse, HLR-VLR, handoffs, channel allocation in Cellular systems, Mobile computing Architecture, Design considerations for mobile computing, Mobile Computing through Internet, Making existing applications mobile enabled, 3G, 4G.

UNIT – II

Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Bluetooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP : Architecture, Traditional TCP, Classical TCP, improvements in WAP, WAP applications.

UNIT – III

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.
Cloud Architecture model, Types of Clouds: Public Private & Hybrid Clouds, Resource management and scheduling, Clustering, Data Processing in Cloud: Introduction to Map Reduce for Simplified data processing on Large clusters.

UNIT – IV

Ad hoc networks, Manet's& its Applications, Routing & Routing protocols- Global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), Fish eye routing protocol, QoS in Ad Hoc Networks.

Suggested Books:
1. Rajkamal, Mobile Computing, 2/E Oxford University Press,2011.
2. J. Schiller, Mobile Communications, Addison Wesley
3. Yi Bing Lin, Wireless and Mobile Networks Architecture , John Wiley.
4. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.
5. Charles Perkins, Mobile IP, Addison Wesley.
6. Charles Perkins, Ad hoc Networks, Addison Wesley.
7. Judith Hurwitz, Robin Bllor, Marcia Kaufmann, Fern Halper, Cloud Computing for Dummies, 2009.

PE-CS-S314A	UNIX and Linux Programming						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	Expertisation in computational programming skills on Unix/Linux Environment.						
Course Outcomes(CO)							
CO1	Learning of simple & advanced commands with features and characteristics of Unix /Linux Systems.						
CO2	Exploring knowledge of programming development skills using Shell, Filters, editors and other utilities.						
CO3	Analyzing the programming behaviour based on programming development/management on Unix /Linux Systems.						
CO4	Developing creativity as system administrative with networking expertisation in Unix /Linux Systems.						

UNIT I : Unix/Linux Commands with Usages

History of Unix, Structure of Unix System & its environment, Unix/Linux Startup, User accounts, accessing Linux – starting and shutting processes, Logging in and Logging out, various types of Unix Commands, zip, unzip, compress, uncompress, pack, unpack, various types of shells, shell programming, Unix file system, Mounting & Unmounting File System, Linux/Unix files, i-nodes, files system related commands, shell as command processor, shell variables, scripting, Unix architecture, Handling ordinary files, General purpose utilities and advanced Unix Commands.

UNIT II : Filters and File Compression

Regular Expression and Filters : Introducing regular expression patterns, syntax, character classes, Quantifiers, Bourne Shell Programming, shell scripting, grep : searching pattern, egrep : searching extended regular expression, Editors in Unix/Linux : Stream Editor, Visual Editor, Emac Editor, programming with AWK and PERL, File compression techniques, delta compression, parallel compression with Xdelta utility, data similarities elimination for data reduction.

UNIT III : Program Development Tools

The C Environment : C language programming in Unix/Linux using vi editor & C compiler, various modes of vi editor, C compiler options, C Shell operators, C Shell Script & programming, Program Development Tools, MakeFile Utility for keeping program up-to-date & its use for dependency calculations, dynamic linking and loading of libraries modules, static and shared libraries, dynamic loader, debugging tools like gdb for handling errors, Memory management and managing large projects in Unix programming environment.

UNIT IV : System Administration and Networking

Processes in Linux : Processes, starting and stopping processes, initialization of processes, rc and init files, job control – at, batch, cron, time, network files, security, authentication, password administration, signals handlers, threading, Linux I/O system, Networking tools : Ping, Telnet, FTP, Router, Firewalls, Backup and Restore tar, cpio, dd utility, mail command, Unix Network Security.
Case Study : LINUX Operating System as open source free software.

Suggested Books :
1. Sumitbha Das : Unix – Concept and Applications, Fourth Edition TMH, 2015
2. B.M Harwani, Unix and Shell Programming, Oxford University Press, 2013
3. Neil Matthew, Richard Stones : Beginning Linux Programming, 4th. Edition, Wrox-Shroff, 2011.
4. Welsh &Kaufmann : Running Linux, O'Reiley& Associates, 2013.

PE-CS-S316A	Real Time Systems						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	Purpose Student will be able to understand the basic concepts of Real time systems and structure, performance measures, real time databases and understand the real time operating systems.						
Course Outcomes (CO)							
CO1	To introduce the real time systems and performance measures for real time systems.						
CO2	To understand the scheduling algorithms for real time systems.						
CO3	To analyze real time system databases and memory management.						
CO4	To familiarize the real time operating systems and system integration tools.						

Unit I

Definition, Issues in Real time computing, structure of a real time system.
Task classes and timing parameters, common myths about real time systems, characteristics and applications of Real time systems.
Performance measures for real time systems: Traditional performance measurement, Performability, cost functions and hard deadlines.

Unit-II

Task Assignment and scheduling: Introduction, various types of scheduling algorithms: Cyclic, deterministic, capacity based Dynamic priority, Value function. Scheduling Real time tasks in multiprocessors, fault tolerant scheduling.

Unit-III

Real time memory management: Process Stack management, dynamic allocation, static system.
Real time databases: Introduction, Real time databases and general purpose databases, Main memory databases, concurrency control issues, databases for hard real time systems.

Unit-IV

Real time Operating system : Introduction, features, UNIX and windows NT as RTOS, Comparison of UNIX and Windows NT as RTOS.
Hardware software Integration: Goals of real time system integration tools, methodology.

Suggested books:
1. Real Time Systems: Liu;Pearson Education
2. Real Time Systems:satinderBal Gupta &Yudhvir Singh; University Science Press
3. Real Time Systems Design and analysis:An Engineer's Handbook Philp A. Laplante,2nd Edition,PHI

OE-CS-302A	Soft Skills & Interpersonal Communication						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3Hrs.**
	Course Outcomes (CO)						
CO1	Develop basic understanding of Communication.						
CO2	Understand the process of communication and speaking.						
CO3	Develop the Personality concepts and its implementation.						
CO4	Develop the basic of group Discussion and interview.						

UNIT-I

Communication: Introduction Verbal, Types of communication, extra personal communication, inter personal communication, intrapersonal communication, mass communication, Creativity in communication, Role of communication, flow of Communications and its need, Speaking Skills, Main features of speaking skills.

UNIT-II

Barriers in the way of communication, noise, inter personal barriers, intrapersonal barriers, organizational barriers, Extra personal barriers, **Basics of communication:** importance of communication, process of communication, objectives and characteristics of communication.

UNIT-III

Personality Development, what is personality? Role of personality, Heredity, Environment, situation, Basics of personality, **Soft skills:** Need and training. Activity in soft skills, **Organizational skill:** introduction and its need, basics principles for organization skills.

UNIT-IV

Group discussion: Group discussion**,** form of group discussion, strategy for group discussion, discussing problem and solution, Oral presentation, introduction, planning, Occasion, purpose, Modes of delivery, **Resume making:** Purpose of Resume, Resume design and structure, contents in Resume, types of Resume, job interview, introduction, objective of Interview, types of interview, stages of interview, Face to face interview and campus interview.

Suggested Books:
1. Technical Communication Principles and Practice by Meenakshi Raman and Sangeeta Sharma by Oxford Publication.
2. Personality Development and soft skills by Barun K. Mitra ,Oxford Publication.
3. Communication Skills For Engineers by C. Muralikrishna and Sunita Mishra , Pearson Pub.

OE-CS-304A	Management Information System						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hour
Purpose	To familiarize the students with Management Information System.						
	Course Outcomes						
CO1	Understand and articulate fundamental concepts of information technology management.						
CO2	Assess and apply IT to solve common business problems.						
CO3	Suggest and defend effective solutions to business problems, and design a database application to solve a business problem.						
CO4	Discuss the ethical aspects of information technology use in the organization and its governance issues.						

UNIT I

Introduction: Definition information system, role and impact of MIS, The challenges of Information system, Nature of
MIS, Characteristics of MIS, Myths regarding MIS, Requirements of MIS, Problems & Solutions in implementing MIS, Benefits of MIS, Limitations of MIS, Significance of MIS, Components of MIS. Role of MIS, Major Management challenge to building and using information system in Organization, functions of management.

UNIT II

Information system and Organizations: The relationship between Organization and Information System, Information needs of different organization levels: Information concept as quality product, classification and value of information, methods of data and information collection. Strategic role of information system, Salient features of Organization, Information, management and decision making, How Organization affect Information Systems, How Information system affect Organization, Ethical and Social impact of information system.

UNIT III

Business application of Information System: Foundation Concepts Information systems in Business: Information system and technology, Business Applications, Development and Management. The internetworked E-business Enterprise: Internet, and Extranet in business. Electronic Commerce System: Electronics commerce Fundamentals, Commerce Application and issues. E-business Decision Support: Decision support in E-Business, Artificial Intelligence Technologies in business.

UNIT IV

Technical Foundation of Information System: Computers and information processing, Computer Hardware, Computer software, Managing data resources, Telecommunication, Enterprise: wide computing and networking.
Strategic and Managerial Implications of Information Systems: Strategic Information System: Introduction, Characteristics of Strategic Information Systems, Strategic Information Systems (SISP), Strategies for developing an SIS, Potential Barriers to developing a Strategic Information System (SIS), Decision Support System (DSS): Decision making concepts, methods, tools and procedures. Managing Information Resources: Introduction, IRM, Principal of Managing Information Resources, IRM functions, Computer Security: Introduction, Computer Security, Types of Computer Security, Disaster Recovery Plan.

Suggested Books:
1. W.S .Jawadakar, "Management Information System", McGraw Hill ☐ J. O. Brien, " Management Information System", TMH, New Delhi
2. Uma G . Gupta, "Management Information System" Fifth Edition TMH.
3. Kenneth C. Laudon, "Management Information System Organisation and Technology" TMH.

OE-CS-306A	Enterprise Resource Planning						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hrs.
Purpose	Classify different processes of the organization and relationship among all processes and examine systematically the planning mechanisms in an enterprise, and identify all components in an ERP system and the relationships among the components.						
Course Outcomes (CO)							
CO1	With the basic concepts of ERP systems for manufacturing or service companies, and the differences among MRP, MRP II, and ERP systems						
CO2	Apply the principles of ERP systems, their major components, and the relationships among these components						
CO3	With the knowledge of typical ERP systems, and the advantages and limitations of implementing ERP systems						
CO4	To comprehend the technical aspects of ERP systems						

Unit I

Introduction to Enterprise Resource Planning

Introduction of the term Business Process Reengineering(BPR) ,BPR Methodology, Current BPR Tools ,Introduction to material requirement planning (MRP), Definition of Enterprise Resource Planning (ERP); Evolution of ERP; Characteristics, Features, Components and needs of ERP; ERP Vendors; Benefits & Limitations of ERP Packages.

Unit II

Enterprise Modeling and Integration of ERP

Need to focus on Enterprise Integration/ERP; Information mapping; Role of common shared Enterprise database; System Integration, Logical vs. Physical System. Integration, Benefits & limitations of System Integration, ERP's Role in Logical and Physical Integration

Unit III

ERP Architecture and Implementation Methodology of ERP

Generic Model of ERP system; Core Modules functionality; Types of ERP architecture, Client Server Architecture, Web-based Architecture, Service Oriented. Architecture (SOA) ; Difficulty in selecting ERP, Approach to ERP selection, Request for Proposal approach, Proof-of-Concept approach; General Implementation. Methodology of ERP, Vanilla Implementation; Evaluation Criteria of ERP packages; Project Implementation Team Structure

Unit IV

Introduction to SAP , Oracle APPS

SAP, Integrated SAP Model, SAP Architecture, SAP R/3 System &mySAP, SAP Modules; Oracle Apps, Oracle AIM Methodology, Oracle Fusion Modules; ERP for Supply Chain Management and Customer Relationship Management : Supply Chain Management and ERP, Definition of Supply Chain Management (SCM); Supply Chain Council's SCOR Model; Stevens Model of Supply Chain Management; Aims of SCM; SCM Key Drivers; Collaborative Design & Product Development; Benefits of SCM; ERP Vs SCM; Key SCM Vendors Customer Relationship Management and ERP,

Suggested books

- Enterprise Systems for Management, Luvai F. Motiwalla, Jeff Thompson, Pearson Education., 2nd Ed., 2011. ISBN-10: 0132145766 | ISBN-13: 978-0132145763
- Enterprise Resource Planning, Ravi Shankar, S.Jaiswal, Galgotia Publication Pvt. Ltd., 1st Ed., 1999. ISBN 81-203-0417-9
- CRM at the speed of Light : Social CRM strategies, tools and techniques for engaging your customers : 4th edition by Paul Greenberg , McGraw Hill ,2009
- Supply Chain Management Casebook : The Comprehensive Coverage and Best Practices in SCM , by Chuck Munson , Pearson FT Press 2013, ISBN-13: 978-0-13-336723-2