Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester V(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	ES-301A	Microprocessor & Interfacing	3:0:0	3	3	75	25	0	100	3
2	PC-CS-301A	Database Management Systems	3:0:0	3	3	75	25	0	100	3
3	PC-CS-303A	Formal Language & Automata Theory	3:0:0	3	3	75	25	0	100	3
4	PC-CS-305A	Essential of Information Technology	3:0:0	3	3	75	25	0	100	3
5	PC-CS-307A	Computer Organization & Architecture	2:0:0	2	2	75	25	0	100	3
6	PEC	Elective-I	3:0:0	3	3	75	25	0	100	3
7	PC-CS-309LA	Database Management Systems Lab	0:0:4	4	2	0	40	60	100	3
8	PC-CS-311LA	Essential of Information Technology Lab	0:0:4	4	2	0	40	60	100	3
Total				**25**	**21**	**450**	**230**	**120**	**800**	
9	MC-904A	Energy Resources & Management	3:0:0	3	0	0	100	0	100	3
10	SIM-301A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

PEC Elective-I
Digital Data Communication: PE-CS-T301A
Parallel and Distributed Computing: PE-CS-T303A
Information Theory and Coding: PE-CS-T305A
Advanced Algorithms: PE-CS-T307A

***Note:** SIM-301*is a mandatory credit-less course in which the students will be evaluated for the Summer Internship undergone after 4th semester and students will be required to get passing marks to qualify.

ES-301A	Microprocessor & Interfacing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	3	75	25	100	**3 Hour**
Purpose	To learn the architecture and programming of Intel family microprocessors and its interfacing.						
Course Outcomes							
CO 1	To study the Architecture of 8086 microprocessors						
CO 2	To implement the interfacing of memories to 8086 Microprocessor						
CO 3	To learn and analyze the instruction set of 8086 Microprocessor and implementation of assembly language programming of 8086 Microprocessor.						
CO 4	To design and implement the interfacing of interrupts, basic I/O and DMA with 8086 Microprocessor						

Unit I

8086 CPU ARCHITECTURE: 8086 Block diagram; description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU. 8086 Pin diagram descriptions. Generating 8086 CLK and reset signals using 8284. WAIT state generation. Microprocessor BUS types and buffering techniques, 8086minimum mode and maximum mode CPU module.

UNIT-II

Main Memory System Design: Memory devices,8086 CPU Read/Write timing diagrams in minimum mode and maximum mode. Address decoding techniques. Interfacing SRAMS; ROMS/PROMS. Interfacing and refreshing DRAMS.

UNIT-III

8086 Instruction Set: Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions; Assembler directives.

8086 Programming Techniques: Writing assembly Language programs for logical processing, arithmetic processing, timing delays; loops, data conversions.

UNIT-IV

Basic I/O Interface: Parallel and Serial I/O Port design and address decoding. Memory mapped I/O Vs Isolated I/O Intel's 8255 and 8251- description and interfacing with 8086. ADCs and DACs, - types, operation and interfacing with 8086. Interfacing Keyboards, alphanumeric displays, multiplexed displays, and stepper motor, optical encoder with 8086.

Interrupts and DMA: 8086 Interrupt mechanism; interrupt types and interrupt vector table. Applications of interrupts, Intel's 8259. DMA operation. Intel's 8237.

Suggested Books:

1. Barry B. Brey, "The Intel Microprocessor8086/8088, 80186", Pearson Education, Eighth Edition, 2009
2. D.V. Hall, Microprocessors and Interfacing, McGraw Hill 2nd ed.
3. Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2nd Edition, PHI,2005
4. Kenneth Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC", Cengage Learning,
5. Indian Edition, 2008
6. Kip Irvine, "Assembly language for IBM PC", PHI, 2nd Edition, 1993
7. Peter Abel, "Assembly language programming", Pearson Edu,5th Edition,2002
8. Uffenback, "The 8086 Family Design" PHI, 2nd Edition.
9. Walter A Triebel and Avtar Singh; The 8088 and 8086 Microprocessors

PC-CS-301A	Database Management Systems						
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 Data Base Management system						
Course Outcomes							
CO 1	To provide introduction to relational model and ER diagrams.						
CO 2	To realize about Query Processing and Transaction Processing.						
CO 3	To comprehend about the concept of functional dependencies.						
CO 4	To learn the concept of failure recovery and concurrency control.						

UNIT I

Introduction: Concept & Overview of DBMS, Data Models-, Network, Hierarchical and Relational Model, Levels of abstraction. Administrator, Database Users, Three Schema architecture of DBMS, Application. **Entity-Relationship Model:** : Entities, Attributes and Entity Sets, Relation and Relationships sets, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

UNIT II

Relational Model: Structure of relational Databases, Relational Algebra and Relational Calculus, Operations on Relational Algebra, Operations on Relational Calculus, Tuple Relational Calculus, Domain Relational Calculus.

SQL and Integrity Constraints: Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, Introduction to views, Querying, Nested Sub queries, Database security application development using SQL, Stored procedures and triggers.

UNIT III

Relational Database Design:

Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF.

Internals of RDBMS: Physical data structures, Query optimization: join algorithm, statistics and cost base optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols, two phase locking.

UNIT IV

Recovery System: Types of Failures, Recovery Techniques, ARIES.

Concurrency Control: Serial and Serializable Schedules-Conflict Serializability –Enforcing Serializability by Locks-Locking Systems with Several Lock Modes-Concurrency Control by Timestamps, validation. **Transaction Management:** ACID Properties, Transaction states, Serializability and Recoverability-View, Serializability-Resolving Deadlocks-Distributed Databases: Commit and Lock

Suggested Books:

- RamezElmasri,ShamkantB.Navathe,"Fundamentals of Database systems", Pearson
- Korth, Silberschatz, Sudarshan: database concepts, MGH,
- R. Ramakrishnan and J. Gehrks database management system; MGH, International edition,
- C. J. Date, data base systems: 7th edition, Addison Wesley, Pearson Education,
- Chakrabarti, Advance database management systems , Wiley Dreamtech

PC-CS-303A	Formal Language & Automata Theory						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	3	75	25	100	**3 Hour**
Purpose	To understand the challenges for Theoretical Computer Science and its contribution to other sciences						
Course Outcomes							
CO 1	Students are able to explain and manipulate the different fundamental concepts in automata theory and formal languages.						
CO 2	Simplify automata and context-free grammars; Prove properties of languages, grammars and automata with rigorously formal mathematical methods, minimization.						
CO 3	Differentiate and manipulate formal descriptions of push down automata, its applications and transducer machines.						
CO 4	To understand basic properties of Turing machines and computing with Turing machine, the concepts of tractability and decidability.						

Unit - I

Introduction to Automata: Study and Central Concepts of Automata Theory, Applications of Finite Automata, An Introduction of Deterministic Finite Automata(DFA) and Non-Deterministic Finite Automata(NFA), Finite Automata with Epsilon (€) Transitions.

Regular Expression and Languages: Regular Expressions (RE), Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws of Regular Expressions, Closure Properties of Regular Languages, RE to NFA, DFA Conversion and DFA to RE, Equivalence and Minimization of NFA and DFA automata.

Unit-II

Context free Grammars and Languages: Parse Trees, Context Sensitive Grammar, Context Free Grammar, Regular Grammar, Applications of Context Free Grammars, Ambiguity in Grammars and Languages. Closure Properties of CFL, Chomsky Theorem, Chomsky Hierarchy, Normal forms of context free grammars: Chomsky Normal Form, Greibach Normal Form.

Pumping Lemma: Introduction to Pumping Lemma, pumping lemma for context free languages, Applications of Pumping Lemma, Minimization of Finite Automata, and Recursive Language.

Unit-III

Mealey and Moore Machines: Definitions, Representation, Equivalence of Moore and Mealey Machines and its Designing.

Push Down Automata: Introduction of Push Down Automata (PDA), Language of PDA, Equivalence of PDA's and CFG's, Deterministic Push Down Automata, Designing of PDA, Applications of PDA.

Unit-IV

Introduction to Turing Machine: The Turing Machine, Programming Techniques for Turing Machine, Extensions of Turing Machine, Restricted Turing Machines, Universal Turing Machines and Designing of Turing Machines, Time and Tape Complexity Measures of Turing machines

Decidability: Post's Correspondence Problem (PCP), Rice's Theorem, Decidability and Undecidability properties, P-NP class and completeness.

Suggested Books:

- J.E.Hopcroft, R.Motwani and J.D.Ullman , "Introduction to Automata Theory Languages and
- computation", Pearson Education Asia , 2001.
- K.Krithivasan and R.Rama; Introduction to Formal Languages, Automata Theory and Computation; Pearson Education, 2009.
- Peter Linz, "An Introduction to Formal Language and Automata", 4th Edition, Narosa Publishing house , 2006.
- M.Sipser; Introduction to the Theory of Computation; Singapore: Brooks/Cole, Thomson Learning, 1997.
- John.C.martin, "Introduction to the Languages and the Theory of Computation", Third edition, Tata McGrawHill, 2003

PC-CS-305A	Essential of Information Technology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To introduce the concepts of Advanced Java Programming**						
Course Outcomes (CO)							
CO1	Study fundamental concepts of Java.						
CO2	Design of user interfaces using Java applets.						
CO3	To study and implement JDBC and Jbeans.						
CO4	To study concepts of servlets and its applications.						

UNIT-I

Introduction: Importance and features of Java, Concepts of Java Virtual machine (JVM), Keywords, Constants, Variables and data types, operators and expressions, Control statements, Conditional statements, loops and iterations. Class definition, adding variables and methods, creating objects, constructors, defining methods, calling methods, method overloading. Creating an array, one and two dimensional array, string array and methods String and String Buffer classes, Wrapper classes. Packages and Interfaces, exception handling.

UNIT-II

Design of User Interfaces: Swing, Applet, Icons and Labels, Text Fields, Buttons, button Class, Check Box, Radio Buttons, The Container, Panel, Windows, and Frame Classes, Combo Box, Tabbed Panes, Scroll Panes, Trees, Tables.

UNIT-III

Servlets: Introduction to Servlets, Life cycle of Servlets, Creating, Compiling and running servlet, Reading the servlet Parameters, Reading Initialization parameter, Packages- javax.servlet Package, Handling HTTP Request and Response (GET / POST Request), Cookies and Session Tracking.

UNIT-IV

Advance Java: Collection, list, Map, Tree, Hashing.

JDBC: JDBC Fundamentals, Establishing Connectivity and working with connection interface, working with statements, Creating and Executing SQL statements, working with Result Set Object & Result Set Meta Data.

Suggested Books:

1. Gary Cornell and Horstmann Cay S., Core Java, Vol I and Vol II, Sun Microsystems Press.
2. Herbert Schildt, Java: The Complete Reference, McGraw-Hill.
3. Philip Hanna, JSP: The Complete Reference, McGraw-Hill.
4. Deital and Deital, Java How to Program, Prentice Hall (2007).

PC-CS-307A	Computer Organization & Architecture						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Student will be able to understand the basic concepts of computer architecture and organization, and understand the key skills of constructing cost-effective computer systems.						
Course Outcomes (CO)							
CO1	Be familiar with the internal organization and operations of a computer.						
CO2	Be familiar with the design trade-offs in designing and constructing a computer processor.						
CO3	Be aware with the CPU design including the RISC/CISC architectures.						
CO4	Be acquainted with the basic knowledge of I/O devices and Select the appropriate interfacing standards for I/O devices.						

Unit- I

Data representation and Computer arithmetic: Introduction to Computer Systems, Organization and architecture, Von Neumann Architecture, evolution and computer generations; Fixed point representation of numbers, digital arithmetic algorithms for Addition, Subtraction, Multiplication using Booth's algorithm and Division using restoring and non restoring algorithms. Floating point representation with IEEE standards and its arithmetic operations.

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

Unit-II

Basic Computer organization and Design: Instruction codes, stored program organization, computer registers and common bus system, computer instructions, timing and control, instruction cycle: Fetch and Decode, Register reference instructions; Memory reference instructions. Input, output and Interrupt: configuration, instructions, Program interrupt, Interrupt cycle, Micro programmed Control s

organization, Control Memory, address sequencing, Micro program Example, micro instruction format, Horizontal Vs Vertical micro-programming, design of control Unit, microprogram sequencer, Hardwired v/s Micro-programmed Control Unit.

Unit-III

Central Processing Unit: General register organization, stack organization, instruction formats (Zero, One, Two and Three Address Instruction), addressing modes, Data transfer and manipulation, Program control. CISC and RISC: features and comparison. Pipeline and vector Processing , Parallel Processing, Flynn's taxonomy, Pipelining, Instruction Pipeline, Basics of vector processing and Array Processors.

Unit-IV

Input-output organization: I/O interface. I/O Bus and interface modules, I/O versus Memory Bus. Asynchronous data transfer: Strobe control, Handshaking, Asynchronous serial transfer. Modes of Transfer: Programmed I/O, Interrupt driven I/O, Priority interrupt; Daisy chaining, Parallel Priority interrupt. Direct memory Access, DMA controller and transfer. Input output Processor , CPU-IOP communication, Serial communication.

Suggested Books:

- William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003.
- Morris Mano, M., "Computer System Architecture," 3/e, Pearson Education, 2005.
- John P. Hayes, "Computer Architecture and Organization," 3/e, TMH, 1998.
- David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Third Edition, Elsevier, 2005.
- V.P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004.
- Carl Hamacher, ZvonkoVranesic and SafwatZaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.

PC-CS-309LA	Database Management Systems Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**40**	**60**	**100**	**3 Hours**
Purpose	**To familiarize the students with the basics of Data base management system.**						
Course Outcomes							
CO1	To understand basic DDL commands						
CO 2	To learn about DML and DCL commands						
CO 3	To understand the SQL queries using SQL operators						
CO 4	To understand the concept of relational algebra						
CO5	To learn various queries using date and group functions						
CO6	To understand the nested queries						
CO7	To learn view, cursors and triggers.						

1. Write the queries for Data Definition Language (DDL) in RDBMS.
2. Write the queries for Data Manipulation Language (DML) in RDBMS.
3. Write the queries for Data Control Language (DCL) in RDBMS.
4. To perform various integrity constraints on relational database.
5. Create a database and perform the following operations:-
   a. Arithmetic and Relational operations
   b. Group by & having clauses
   c. Like predicate for pattern matching in database
6. Write SQL queries for relational algebra
7. Write SQL queries for extracting data from more than one table
8. Write SQL queries for sub queries, nested queries
9. Concepts for ROLL BACK, COMMIT & CHECK POINTS
10. Using two tables create a view, which shall perform natural join, equi join, outer joins.
11. Write a procedure for computing income tax of employee on the basic of following conditions:-
    a. if gross pay<=40,000 then I.T rate is 0%.
    b. if gross pay>40,000 but <60000 then I.T rate is 10%.
    c. if gross pay>60,000 but <1,00,0000 then I.T rate is 20%.
    d. if gross pay>1,00,0000 then I.T rate is 30%.

    For this purpose create a table with name, ssn, gross salary and income tax of the employee.
12. Write trigger for before and after insertion, deletion and updation process.

PC-CS-311LA	Essential of Information Technology Lab

Lecture	Tutorial	Practical	Credit	Minor Test	Practical	Total	Time
0	**0**	**4**	**2**	**40**	**60**	**100**	**3 Hrs.**
Purpose	To introduce the concepts of Advanced Java Programming						
Course Outcomes (CO)							
CO1	Study fundamental concepts of Java.						
CO2	Design of user interfaces using Java applets.						
CO3	To study and implement JDBC and Jbeans.						
CO4	To study concepts of servlets and its applications.						

1. Write a Java Package with Stack and queue classes.
2. Design a class for Complex numbers in Java .In addition to methods for basic operations on complex numbers, provide a method to return the number of active objects created.
3. Develop with suitable hierarchy, class for point, shape rectangle, square, circle, ellipse, triangle, polygenetic.
4. Design a simple test application to demonstrate dynamic polymorphism.
5. Design a java interface for ADT Stack.
6. Develop two different classes that implement this interface. One using array and other using linked list.
7. Develop a simple paint like program that can draw basic graphical primitives
8. Develop a scientific calculator using event driven programming.
9. Develop a template for linked list class along with its members in Java.
10. Write a program to insert and view data using Servlets

PE-CS-T301A	Digital Data Communication

Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3
Purpose	To provide the conceptual knowledge of data preparation and signal transmission methodologies used in data communication and networking.						
Course Outcomes							
CO 1	To study various analog communication techniques and with their characteristics.						
CO 2	To study and understand the requirements for analog/digital data to analog/digital signal conversion techniques.						
CO 3	To study the error and flow control techniques in communication and networking.						
CO 4	To study the concept of multiplexing and applied multiple access techniques specially in satellite communication.						

UNIT-1

MODULATION TECHNIQUES

Basic constituents of Communication Systems need of modulation, Amplitude modulation, spectrum of AM wave, modulation index, DSBSC modulation, SSB Modulation, vestigial side band modulation.
ANGLE MODULATION: Frequency and Phase Modulation, spectrum of FM Wave, Modulation Index and Bandwidth of FM Signal, NBFM and WBFM.

UNIT-II

DATA ENCODING

Digital data, Digital signals: Encoding schemes: NRZ-L, NRZ-I, Manchester-Diff-Manchester-encoding,Pseudoternary-Bipolar-AMI,B8ZS- HDB3 – Evaluation factors-Digital data, analog signals: Encoding Techniques –ASK-FSK-PSK-QPSK-Performance comparison-Analog data, digital signals: Quantization- Sampling theorem-PCM-Delta modulation-Errors- comparison- Analog Data, analog signals: Need for modulation -0 Modulation methods – Amplitude modulation- Angle modulation- Comparison.

UNIT-III

DIGITAL DATA COMMUNICATION TECHNIQUES

Asynchronous and synchronous transmission –Error Detection techniques: Parity checks – Cycle redundancy checks-Checksum-Error Correcting codes: Forwards and backward error corrections, Transmission media. Communication Topologies.
DTE & DCE interface: Characteristics of DTE-DCE interface. Interfaces: Rs-232-C, Rs-449/422, A/423-A.

UNIT-IV

SATELITE COMMUNICATION

Multiplexing: Advantages, Types of Multiplexing: FDM, Synchronous TDM, Statistical TDM/Asynchronous TDM, Study of their characteristics.

Satellite Communication Systems: Satellite parameters and configurations – Capacity allocation, Frequency Division FDMA; Time Division TDMA- Fixed assigned multiple access (FAMA), Demand assign multiple access (DAMA) – The concept of spread spectrum: FHSS, DSSS – CDMA – Transmission and reception.

Suggested Books

1. Forouzen, “Data Communication &Networking”,TataMcgraw Hill
2. Proakin, “Digital Communications”,McGraw Hill.
3. W. Stalling, “Wireless Communication and Networks” Pearson.
4. Stallings, “Data & computer Communications”,PHI.
5. Roden, “Digital & Data Communication Systems”,PHI.
6. Irvine, Data communications & Networks An engineering approach, wileyindia

PE-CS-T303A	Parallel and Distributed Computing						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time

3	0	0	3	75	25	100	3 Hrs.
Purpose	To enable students to evaluate various architectural taxonomies, design paradigms, parallelism approaches, performance measures, parallel programming models and case studies, scheduling and parallel architecture and their programming constructs.						
Course Outcomes (CO)							
CO1	Classify various synchronous and asynchronous paradigms of parallel and distributed computing as well as identify some of the taxonomies and parallel algorithms.						
CO2	Evaluate various parallel computation models and approaches and analyze different performance metrics for parallel and distributed computing.						
CO3	Analyze the importance of pipelining and superscalar techniques, parallel programming models and case studies of parallel processors.						
CO4	Examine various techniques of parallelizing loops, sequential programs and scheduling and parallel architecture for cognitive functions.						

Unit-I

Introduction: The state of computing, system attributes to performance, multiprocessors and multicomputer, multivector and SIMD computers, basics of parallel programming models, parallel algorithms and distributed processing, Conditions of parallelism: Data, control and resource dependencies, Hardware and software parallelism. Hardware Taxonomy: Flynn's classification, Shore's classification, Feng's classification, Handler's classification. Software taxonomy: Kung's taxonomy.

Unit-II

Abstract parallel computational models: combinational circuits, sorting network, PRAM models, VLSI complexity model, architecture development tracks, program partitioning and scheduling, program flow mechanisms. Performance metrics and measures: parallelism profile in programs, mean performance, efficiency, utilization and quality, benchmarks and performance measures.

Parallel processing applications: Massive parallelism for grand challenges, application models for parallel computing, scalability of parallel algorithms. Speedup performance laws: Amdahl's law for fixed workload, Gustafson's Law for scaled problems and memory bounded speedup model. Scalability analysis and approaches: Scalability metrics and goals, evaluation of scalable computers.

Unit-III

Pipelining and Superscalar Techniques: Linear pipeline processors, nonlinear pipeline processors, arithmetic pipeline design, and superscalar pipeline design. Parallel programming models: Shared-variable model, message-passing model, data-parallel model, object-oriented model and functional and logic models.

Case studies of parallel processors: ICL distributed array processor (DAP), ILLIAC IV Computer, Tilera's TILE64 system, Sun UltraSparc T2 processor, Intel Pentium Processors.

Unit-IV

Scheduling and parallelization: Loop parallelization and pipelining-Loop transformation theory, parallelization and wave fronting, tiling and localization, software pipelining, program partitioning and scheduling: Grain size, latency, grain packing and scheduling. Parallel Architecture for cognitive functions: Artificial neuron model (perceptron), neural network as classifiers, learning by perceptrons, supervised training of perceptron networks, SLT model and Hopfield network.

Suggested Books

1. A.Grama, A. Gupta, G.Karypis, V.Kumar, Introduction to Parallel Computing, Pearson.
2. M.R. Bhujade, Parallel Computing, New Age International Publishers.
3. Kai Hwang and Naresh Jotwani, Advanced Computer Architecture-Parallelism, Scalability, Programmability, McGraw Hill.
4. D.Sima, T.Fountain, P.Kasuk, Advanced Computer Architecture-A Design space Approach, Pearson Education, India, 2009.
5. C Lin, L Snyder, Principles of Parallel Programming, Addison-Wesley Publishing Company.
6. M.J. Quinn, Parallel Computing: Theory and Practice, Second Edition, McGraw Hill.
7. T.G.Lewis and H. EI-Rewini, Introduction to parallel computing, Prentice Hall.

PE-CS-T305A	Information Theory and Coding						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**

3	0	0	3	75	25	100	3 Hrs.
Purpose	To introduce information theory, the fundamentals of error control coding techniques and their applications, and basic cryptography.						
Course Outcomes (CO)							
CO1	Students will be introduced to the basic notions of information and channel capacity.						
CO2	Students will be introduced to convolutional and block codes, decoding techniques.						
CO3	Students will understand how error control coding techniques are applied in communication systems.						
CO4	Students will understand the basic concepts of cryptography and able to implement cryptography to real life applications.						

Unit I : Information Theory & Source Coding

Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, The Lempel Ziv algorithm, Run Length Encoding, Discrete memory less channel, Mutual information, Examples of Source coding-Audio and Video Compression.

Unit II : Information Capacity & Channel Coding

Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem, Linear Block Codes: Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding, Encoding and decoding circuit, Single parity check codes, Repetition codes and dual codes, Hamming code, Golay Code, Interleaved code.

Unit III : Cyclic Codes, BCH and Convolutional Codes

Galois field, Primitive element & Primitive polynomial, Minimal polynomial and generator polynomial, Description of Cyclic Codes, Generator matrix for systematic cyclic code, Encoding for cyclic code, Syndrome decoding of cyclic codes,

Binary BCH code, Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes, Cyclic Hamming code and Golay code. Introduction of convolution code, State diagram, Tree diagram, Trellis diagram, Sequential decoding and Viterbi decoding

UNIT-V: Cryptography

Encryption, Decryption, Cryptogram (cipher text), Concept of cipher, Cryptanalysis, Keys: Single key (Secret key), Cryptography, two-key (Public key) cryptography, Single key cryptography, Ciphers, Block Cipher code, Stream ciphers, Requirements for secrecy, The data Encryption Standard, Public Key Cryptography, Diffie-Hellmann public key distribution, The Rivest- Shamin Adelman(R-S-A) system for public key cryptography, Digital Signature.

Suggested Books:

- Jorge Castiñeira Moreira, Patrick Guy Farrell , Essentials of Error-Control Coding John Wiley, 2006. ISBN: 978-0-470-02920-6
- G. A. Jones and J. M. Jones, "Information and Coding Theory," Springer ISBN 1-85233-622-6, 3rd Edition.
- Dominic Welsh, Codes and Cryptography, Oxford Science Publications, 1988
- T. M. Cover, J. A, Thomas, "Elements of information theory," WielyInterscience, 2nd Edition, 2006/
- R. W. Hamming, "Coding and information theory," Prentice Hall Inc., 1980

PE-CS-T307A	Advanced Algorithms

Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To introduce advanced algorithm concepts and their implementation for solving complex applications.						
Course Outcomes(CO)							
CO1	Learn the basic concepts of Algorithms and their analysis.						
CO2	Study the concept of dynamic programming and various advanced data structures.						
CO3	Learn various graph algorithms.						
CO4	Study various Flow and Sorting Networks.						

UNIT – I: Introduction

Algorithms and its complexity (Time and Space), Algorithm Analysis (Worst, Best & Average case), Pseudocode Conventions, Asymptotic Notations, Binary Search Trees.
Recurrence Relation:- Methods for solving Recurrence(Substitution, Recursion Tree , Master Theorem).

UNIT – II: Advanced Design Techniques

Dynamic Programming:- Elements, Matrix-chain multiplication, longest common subsequence.
Greedy Algorithms:- Elements, Activity Selection problem, Huffman codes, Task scheduling problem, Knapsack Problem, .
Probabilistic analysis concepts, Hiring Problem and its probabilistic analysis.

UNIT – III: Graph Algorithms

Review of Graph Algorithms:- Traversal methods(Depth first and Breadth first search), Topological sort, Strongly connected components, Minimum Spanning Trees- Kruskal and Prims, Single Source shortest path, Relaxation, Dijkstra's Algorithm, Bellman-Ford Algorithm, Single source shortest path for directed acylic graphs, All pair shortest path- Floyd Warshall Algorithm.

UNIT – IV: String Matching Algorithms

The Naïve string-matching algorithm, Rabin-Karp Algorithm, String matching with finite automata, Knuth-Morris-Pratt Algorithm.

Suggested Books:

1. L.K. Vermani, S. Vermani, An Elementary Approach to Design and Analysis of Algorithms, World Scientific, 2019
2. Cormen, Leiserson and Rivest : Introduction to Algorithms, 3/e, PHI
3. Harsh Bhaisn, Algorithms: Design And Analysis Oxford University Press,2015.
4. Aho, Hopcroft and Ullman : The Design and Analyses of Computer Algorithms. Addison Wesley.
5. R.B.Patel& M.M.S Rauthan, Expert Data Structures with C++, Khana Publications, Delhi , India, 2ndEdition 2004,ISBN : 87522-03-8.
6. Horowitz, Ellis and Sahni, Sartaj : Fundamentals of Computer Algorithms, Galgotia Publications

MC-904A	Energy Resources & Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**0**	**100**	**-**	**100**	**3**
Purpose	To make the students conversant with the basics concepts and conversion of various form of Energy						
COURSE OUTCOMES							
CO1	An overview about Energy Resources, Conventional and Non-conventional sources						
CO2	Understand the Layout and working of Conventional Power Plants						
CO3	Understand the Layout and working of Non-Conventional Power Plants						
CO4	To understand the Energy Management, Audit and tariffs, Role of Energy in Economic development and Energy Scenario in India						

UNIT-I

Introduction: Types of energy, Conversion of various forms of energy, Conventional and Non-conventional sources, Need for Non-Conventional Energy based power generation.

UNIT-II

Conventional Energy sources: Types of Conventional Energy sources, Selection of site**,** working of Thermal, Hydro, Nuclear and Diesel power plants and their schematic diagrams & their comparative advantages/ disadvantages.

UNIT-III

Non-Conventional Energy sources: Types of Non-Conventional Energy sources , Basic principle, site selection of Solar energy power plant, photovoltaic technologies, PV Systems and their components, Wind energy power plant , Bio energy plants ,Geothermal energy plants and Tidal energy plants.

UNIT-IV

Energy Management: General Principles of Energy Management, Energy Management Strategy, Modern trends and developments towards Computerizations of Power System.

Energy Audit: Need, Types, Methodology and Approach.

Energy Scenario: Lay out of power system, Role of Energy in Economic development, energy demand, availability and consumption, Indian energy scenario, long term energy scenario, energy sector reforms in India, energy strategy for the future.

References:

1. Energy Studies-Wiley Dream Tech India.
2. Non-conventional energy resources- Shobhnath Singh, Pearson.
3. Electrical Power Systems : Soni, Gupta, Bhatnagar – Dhanpat Rai & Sons
4. NEDCAP: Non Conventional Energy Guide Lines
5. Non conventional energy sources : G.D. Roy
6. Non Conventional energy resources :B H Khan - McGraw Hill
7. Applied Solar Energy : Meinel A B - Addison Wesley Publications
8. Direct Energy ConversionGeorge: Sutton -McGraw

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