6th SEM							
THEORY							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	PC(CS/IT)617	Computer Networks	3	1	0	4	4
02	PC(CS)618	Compiler Design	3	0	0	3	3
03	PEC(CS)602	Elective-II A. Real Time System B. Information and Coding Theory C. Software Engineering D. AI in Bioinformatics E. Digital Signal Processing F. Cyber Security	3	0	0	3	3
04.	PEC(CS)603	Elective-III A. Machine Learning B. Operation Research C. Cryptography D. Advance Architecture E. Cloud Computing F. Ad-Hoc Sensor Network	3	0	0	3	3
05	HS(CS/IT)604	Industrial Management	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PCL(CS/IT)619	Computer Network lab	0	0	3	3	1.5
02	PROJ(CS)601	Project 1	0	0	6	6	3
03	CLA(CS)-6	Comprehensive Laboratory Assessment	0	0	0	0	1
		TOTAL	15	1	9	25	21.5

Name of the course:	Computer Network
Course Code: PC(CS/IT) 617	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 1 hrs./week	Mid Semester-2 Exam: 15 Marks
Credit Point: 4	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:			
1.	To study the concept of computer network and protocol suite		
2.	To study Physical and data link layer and related hardware and protocol		
3.	To study network layer, routing protocols, IP addressing		
4.	To study transport layer, TCP and socket		
5.	To study Application layer and network security		
Pre-Requisite			
1.	Communication engineering (ES(CS/IT)409)		
Module	Content	Hrs	Marks
1.	Introduction: Overview of Data Communication and Networking; Layered Network Architecture; Mode of communication, topology, Data and Signal; Transmission Media: Guided, Unguided, categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.	04	
2.	Physical Layer: Transmission Media: Guided, Unguided; switching: time division & space division switch, TDM bus, Banyan switch; MODEM, Repeater and hub, Multiplexing: TDM, FDM, SDM, WDM.	04	
3.	Data link Layer: Medium Access sub layer: MAC address and LLC; Error Control: Types of errors, framing (character and bit stuffing), error detection & correction; Flow control: Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC; Point to Point Protocol, LCP, NCP, Token Ring; Access mechanism: Reservation, Polling, Random access: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA, TDMA, FDMA, CDMA, Traditional Ethernet, fast Ethernet.	08	
4.	Network layer: Internetworking & devices: Bridges, Switches, Router, Gateway; Addressing: IP addressing (IPV4, IPv6), masking, Classful and Classless Addressing, Subnetting, NAT; Routing : Intra and Inter	10	

	Domain Routing, Unicast, Multicast Broadcast routing. static vs. dynamic routing, Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP and RARP, IP, ICMP, IPV6; Mapping between IP and MAC address: ARP & RARP Switching Communication Networks: Circuit switching; Packet switching; Routing in packet switched networks; X.25; Frame Relay; ATM, SONET.		
5.	Transport layer : Process to Process delivery; UDP; TCP, Features, Segment, Three-Way Handshaking, socket and port addressing, Flow Control, Error Control, Congestion Control: Open Loop, Closed Loop, choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.	08	
6.	Application Layer : Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW	05	
7.	Security: Attacks, Cryptography, Firewalls, IDS & IPS, Malware, IP and transport layer security, DMZ.	03	
8.	Modern topics: ISDN services & ATM, DSL technology, Wireless LAN, Bluetooth, VPN.	02	
Course Outcome: After completion of this course the students will be able to -			
CO1	investigate two protocol suits and different topologies, transmission media of computer network		
CO2	investigate different random and controlled access mechanism , flow and error control		
CO3	assess different routing models for computer network and IP addressing		
CO4	assess quality of services (Qos) in Transport layer		
CO5	investigate different security protocols and encryption mechanism		
CO6	design of real life problems and solution for IP addressing and DMZ		
Learning Resources:			
1.	B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH		
2.	A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI		
3.	W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education		
4.	Black, Data & Computer Communication, PHI		
5.	Kurose and Rose – "Computer networking -A top down approach featuring the internet" – Pearson Education		

Name of the course		Compiler Design	
Course Code: PC(CS)618		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To learn concepts of language translation and phases of compiler design		
2.	To describe the common forms of parsers		
3.	To acquire knowledge of parser by parsing LL parser and LR parser		
4.	To demonstrate intermediate code using technique of syntax directed translation		
5.	To illustrate the various optimization techniques for designing various optimizing compilers		
Pre-Requisite			
1.	Formal Language and Automata Theory PC(CS/IT)407		
Module	Content	Hours	Marks.
1	Introduction to Compiling [2L] Compilers, Analysis-synthesis model, phases of the compiler, Cousins of the compiler, Basic concepts of NFA, DFA. Lexical Analysis [4L] The role of the lexical analyzer, Tokens, Patterns, Lexemes, Specifications of a token, Recognition of tokens, lexical analyzer generator (Lex).	6	
2	Syntax Analysis [7L] The role of a parser, Top down Parsing, Predictive parsing (LL), Bottom up parsing, Operator precedence parsing, LR parsers (SLR, LALR,CLR), Parser generators (YACC). Syntax directed translation [4L] Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions.	11	
3	Type checking [3L] Type systems, Specification of a simple type checker. Run time environments [6L] Activation trees, Control stack, scope of declaration, Binding of names, Activation records, Storage allocation strategies, Parameter passing (call by	9	

	value, call by reference, copy restore, call by name), Symbol tables.		
4	Intermediate code generation [4L] Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples). Code optimization [4L] Basic blocks & flow graphs, Transformation of basic blocks, DAG representation of basic blocks, the principle sources of optimization, Loops in flow graph, Peephole optimization. Code generations [2L] Issues in the design of code generator, Register allocation & assignment.	10	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	describe the basic concepts and application of Compiler Design
CO 2	design Symbol Table, Lexical Analyser, Intermediate Code Generation, Parser (Top Down and Bottom Up Design) using basic knowledge of Data Structure, Grammar and Programming Language.
CO 3	explain various Code optimization Techniques and Error Recovery mechanisms.
CO 4	design and Implement a Parser.
CO 5	design syntax directed translation schemes for a given context free grammar.
CO 6	apply the optimization techniques to intermediate code to have a better code for code generation
Learning Resources:	
1.	Alfred Aho, Ravi Sethi, Jeffrey D Ullman.- Compilers Principles, Techniques, and Tools, 2nd Edition, Pearson Education, New Delhi, 2006
2.	A.I.Holub -Compiler Design in C, Prentice Hall of India, New Delhi, 1995
3.	J.P. Tremblay - The Theory and Practical of Compiler Writing, McGraw Hill, Singapore, 1993.
4.	K.C. Louden- Compiler Construction: Principles and Practice, Thomson Learning, New Delhi, 2005.
5.	Chattopadhyay , S- Compiler Design (PHI)

Name of the course	Real Time System
Course Code: PEC(CS)602A	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0hrs./week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs./week	Assignment, quiz, Attendance: 20Marks
Credit Points: 3	End Semester Exam:75 Marks (to be mapped into 50 marks)

Objective:	
1.	To understand the concept of real-time system
2.	To determine Real-time scheduling and schedulability analysis
3.	To observe the advantages of using a RTS using examples
Pre-Requisite	
1.	Operating Systems [PC(CS/IT)511]

Unit	Content	Hrs	Marks
1	Introduction: Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Dead-lines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints.	6	
2	Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.	10	
3	Resources Sharing: Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module	8	

	Resources, Controlling Concurrent Accesses to Data Objects.		
4	Multiprocessors and distributed systems: Multiprocessor priority ceiling protocol, End-to-end scheduling.	6	
5	Real Time Operating Systems: Basic operating-system functions, Commercial Real Time Operating System.	6	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	explain the concept of modelling of Real-Time systems.
CO 2	analyze the characteristics of a real-time system.
CO 3	evaluate the characteristics of a real-time system in context of real time scheduling.
CO 4	classify various resource sharing mechanisms and their related protocols.
CO 5	apply the basics of RTOS in interpretation of real time systems.
Learning Resources:	
1.	Real Time Systems – Jane W. S. Liu, Pearson Education Publication
2.	Real Time Systems – Mall Rajib, Pearson Education.
3.	Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

Name of the course	Information & Coding Theory
Course Code: PEC(CS)602B	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 0 hrs./week	Mid Semester-2 Exam: 15 Marks
Practical Contact Hrs.: 0 hts./week	Assignment, Quiz & class attendance: 20 Marks
Credit Points: 3	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To compute the information content within a transmitted message in the aspect of codification
2.	To evaluate the effectiveness of different encoding strategies in the aspect of message transmission
3.	To study different memory less error control coding schemes applicable for the block codes
4.	To explain memory based decoding concepts and multiple error correction facilities
Pre-Requisite	
1.	Computer Network [PC(CS/IT)617]
2.	Communication Engineering ES(CS/IT)409

Unit	Content	Hrs	Marks
1	MODULE-1: INFORMATION & CODING THEORY Uncertainty and Information, Self and Mutual Information, conditional self-information, Average Mutual Information and Entropy, Information measures for continuous random variables, source coding theorem.	6	
2	MODULE-2: CODING SCHEMES Fixed and variable length coding, prefix code, study of static and dynamic dictionary based encoding schemes- Shannon-Fano Coding, Huffman encoding, Run length encoding, idea of Lempel-Ziv encoding.	6	
3	MODULE-3: ERROR CONTROL CODING Idea of channel transmission, objective of good error control coding scheme, hamming weight and hamming distance, concept of block code, Linear Block-code, Galois Field, Matrix description of linear block codes with generator matrix, equivalent codes, systematic form of generator matrix, concept of parity check matrix, error syndrome, error detection and corrections with parity check matrix, error correction using nearest neighbour decoding concept of linear block code.	10	
4	MODULE-4: CYCLIC CODING Idea of cyclic codes, polynomial representation of cyclic codes, cyclic shift in terms of polynomials, monic polynomials, addition and multiplication of polynomials, division algorithm for polynomials, ring of polynomials, generator polynomial, systematic and non-systematic encoding of cyclic codes, error detection and correction for cyclic codes, concept of prime polynomial, factorization or reducibility aspect of polynomials related to cyclic codes, method for generating cyclic codes.	10	
5	MODULE-5: BCH CODES Introduction to BCH codes, primitive elements, primitive polynomials, minimal polynomials, concept of conjugates, generator polynomial for error correcting BCH code	2	
6.	MODULE-6: CONVOLUTION CODES	2	

	Basic idea, parameters, designing of convolution codes, convolution encoder states and trees.		
Course Outcome: After completion of this course the students will be able to			
CO1	find the actual information content within a codified transmitted message based on the probability of symbol occurrences		
CO2	discuss the concepts of various encoding schemes focused on redundancy of symbol occurrences		
CO3	identify linear block code and its propagated error which is to be tracked during the decoding phase		
CO4	inspect cyclic code and its propagated error which is to be tracked during the decoding phase		
CO5	explain the working procedure of memory based efficient decoding concepts and multiple error correction facilities		
Learning Resources:			
1	Ranjan Bose, Information theory, coding and cryptography, Second Edition, McGraw Hill Education		
2	Salvatore Gravano, Introduction to Error Control Codes, South Asia Edition, Oxford.		
3	K.S. Shivaprakasha and Murlidhar Kulkarni, Kindle Edition, Information Theory and Coding, Kindle Edition, Wiley		
4	Arijit Saha, Nilotpal Manna, Surajit Mandal, Information Theory, Coding and Cryptography, Kindle Edition, Pearson		

Name of the course		Software Engineering	
Course Code: PEC(CS)602C		Semester:6th	
Duration:6months		Maximum Marks:100	
Teaching Scheme		Examination Scheme	
Theory:3hrs/week		Mid Semester1 Exam:15Marks	
Tutorial:0hrs/week		Mid Semester2 Exam:15Marks	
Practical:0hrs/week		Other Assessment tools (Assignment, Quiz etc.):20Marks	
Credit Points: 3		End Semester Exam:75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To learn the different models for the development of a software product		
2.	To explore the designing, coding and testing to develop software product		
3.	To asses quality of software product to sustain in the market		
Pre-Requisite			
1.	Programming for problem solving ES(CS/IT) 204		
2.	Object Oriented Programming PC(CS/IT)513		
Module	Content	Hours	Marks.
1	Software Development Process Models: Waterfall, Spiral, Prototyping, RAD, Evolutionary, Software Requirement and Feasibility Analysis, Cost- Benefit Analysis, etc.	5	
2	Software Design: Context Diagram, DFD, Data Dictionary, ER diagram, Decision Tree, Decision Table, Structured Chart, Structured English, Top-Down and Bottom-Up design, Modular Programming, Module Relationship- Coupling, Cohesion, Functional vs. Object- Oriented approach etc.	8	
3	Software Testing: Different types of Testing, Test case specification, Verification vs. Validation etc.	6	
4	Software Quality: Quality Attributes, Total Quality Management, Software Quality Assurance and Quality Control, Reliability, MTTF, MTBF, Reliability Models etc.	6	
5	Coding & Documentation: Structured Programming, OO Programming, UML, Information Hiding, Reuse, Software Metrics, Cyclomatic complexity, System Documentation etc.	5	
6	Software Project Management: Software Project Management concepts, Software Project Management Plan, Tools for project plan – WBS, PERT, GANTT, Project Scheduling & Monitoring, Staffing, Cost Estimation, COCOMO, Software Configuration Management, Software Reengineering Process model; Case study on software development process etc.	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	differentiate different types of models for software development.		
CO 2	evaluate different design approaches for development of software product		
CO 3	apply various testing techniques in software product		

CO 4	assess the quality of software product
CO 5	estimate the cost of software product
CO 6	evaluate the activity of software project management with CASE study
Learning Resources:	
1.	Software Engineering: A practitioner's approach– Pressman (TMH)
2.	Software Engineering: Pankaj Jalote (Wiley-India)
3.	Software Engineering: Rajib Mall (PHI)
4.	Software Engineering: Agarwal and Agarwal, (PHI)
5.	Software Engineering: Sommerville, Pearson
6.	Fundamentals of Software Engineering – C. Ghezzi, M. Jazayeri, D. Mandrioli
7.	Software Engineering Martin L. Shooman,– TMH

Name of the course		AI in Bioinformatics	
Course Code: 602D		Semester: 6TH	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	Applications of AI in Bioinformatics.		
2.	To learn different machine learning techniques to understand various biological processes.		
3.	To develop the ability to deal with different biological data in machine learning algorithms.		
Pre-Requisite			
1.	NA		
Module	Content	Hours	Marks.
1	Introduction Cell and organisms; Prokaryotes, Eukaryotes; Cellular molecules; Basic cellular functions; Cell division; Biomolecules – nucleic acids, proteins; Genetic expression – genes, genomes, and genetic code, RNA, genetic regulation, Central Dogma; Metabolic pathways, Genetic mechanism of Evolution; Source of biological knowledge – model organisms; Experimental methods – Imaging, Gel Electrophoresis, Cloning, Hybridization and Immunological Staining, Gene Mapping and Sequencing, Crystallography and NMR, Computational Biology.	6	
2	Computation Linguistic of Biological Sequences Basic of Formal Language Theory; Computational language and Pattern Recognition; Developmental Grammars; Gene Grammars; Structural linguistics of Nucleic acids;	3	
3	RNA secondary structure prediction Primary and Secondary structure of RNA; Mathematical Models – Structure and Free Energy; The Tinoco-Uhlenbeck Theory; Serial Algorithms; 2˚RNA as a Search Problem; Optimal Algorithms and Exhaustive Search, Approximation and Heuristic Algorithms, Local Search, Monte Carlo Methods, Simulated Annealing, Dynamic Programming, MFT Network Search, Future work.	4	
4	Predicting Protein structural features Brief introduction to Artificial neural network; Protein structure and sequence database; Protein structures – primary, secondary, and tertiary; Secondary structure prediction using neural network – alpha-helix prediction, beta-turn prediction, coil prediction; Prediction of amino acid residues on the Protein surface; Tertiary Structure Prediction with Neural Network;	4	
5	Integrating AI with Sequence Analysis Comparing Primary Sequences to each other; Comparing Primary Sequences to patterns; ARIADNE; ARIADNE Protein Representation; ARIADNE Pattern Language; ARIADNE Pattern Matching Algorithm; ARIEL; ARIEL Protein and pattern representations; Pattern Matching in parallel hardware; ARIEL Pattern Induction Mechanisms; Pattern-Induced Multiple Alignment (PIMA); Application of PIMA; Pattern Library SEARCH (PLSEARCH) Significance, Validity, and Pattern Quality.	4	
6	Learn about Protein Structure Selecting Data; Knowledge Goals; Problem Transformation; Characterizing the Desired Knowledge; Knowledge Acquisition Strategy; Selecting Relevant Data; Reducing the Size of the Problem Space; Choosing and Applying an Induction Method; Evaluating the	4	

	Outcome of Learning.		
7	Identification of Qualitatively Feasible Metabolic Pathways Thermodynamic Feasibility; Synthesis of Pathways – Stoichiometric Constraints; Description of the Algorithm – Reaction-Processing Phase, Metabolite-Processing Phase, Pathway-Marking Phase, Correctness, Completeness, Computational Complexity Issues; A Case Study: Lysine Pathways.	3	
8	Knowledge-Based Simulation of DNA Metabolism DNA Metabolism; Representation of Objects; Representation of Interactions and Behaviors; Inference; Explanation; Prediction of Enzyme Action; Envisionment of Metabolic Pathways.	4	
9	AI Approach to the Interpretation of the NMR Spectra of Proteins Nature of Proteins; Protein Structure; Protein NMR; Two-Dimensional NMR; Protein Structure Prediction; Assignment of Spin Systems; Connecting the Spin Systems; Secondary Structure Prediction; 3D Structure Determination; Computational Aspects of NMR; AI Applications & NMR; Computational Aids for Protein NMR; Protein NMR Assistant (PNA); Blackboard Architecture; PNA Blackboard; PNA Knowledge Sources; Control.	4	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	Learn the basics of collecting, analysing, and modeling bioinformatics data using AI.
CO 2	Map different biological problems in computation domain.
CO 3	Understand various biological datasets.
CO 4	Design a machine learning framework to C different biological problems.
CO 5	Developthe understanding of different cases of AI-based bioinformatics research, including genome sequencing, protein function prediction, and gene expression examination.

Learning Resources:	
1.	Machine Learning in Bioinformatics by Yan-Qing Zhang, Jagath C. Rajapakse
2.	Bioinformatics: The Machine Learning Approach by Pierre Baldi & Saren Brunak
3.	Introduction to Machine Learning and Bioinformatics by Sushmita Mitra, et al.
4.	Artificial Intelligence and Molecular Biology by Lawrence Hunter
5.	Artificial Intelligence in Bioinformatics by Hari Om Sharan

Name of the Course	Digital Signal Processing
Course Code: PEC(CS)602E	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term Exam I: 15 Marks
Tutorial: Nil	Mid Term Exam II: 15 Marks
Practical: Nil	Assignment & Quiz etc.: 20 Marks
Credit Points: 3	Semester End Exam: 75 Marks (to be mapped into 50 marks)

Objective:

1.	To understand the features of Signals.
2.	To gather knowledge on Fourier Series and Fourier Transform Properties.
3.	To design Discrete Fourier Transform and Fast Fourier Transform Circuits.
4.	To simulate circuits of Finite Impulse Response Filters.

Pre-Requisite:

1.	Communication Engineering [ES(CS/IT) 409]

Module	Content	Hours	Marks.
1	Representation of Signals and Systems: Deterministic and Non- deterministic Signal, Periodic and Aperiodic Signal, Unit-step Function and Unit Impulse Function. Causal and Non-causal System, Recursive and Non-recursive System. Convolution Theorem, High Pass and Low Pass Filter, 3dB Frequency.	6	
2	Fourier Series and Fourier Transform: Fourier Series and its explanation, conditions for existence of Fourier Series, exponential form of Fourier Series. Fourier Transform and Inverse Fourier Transform.	6	
3	Discrete Fourier Transform and First Fourier Transform: Discrete Fourier Transform (DFT), Twiddle Factor, Periodicity and Symmetry Property of Twiddle Factor. Computation of addition and multiplication operations of DFT. Fast Fourier Transform (FFT), Decimation in Time FFT & Decimation in Frequency FFT, Butterfly operation. Computation of addition and multiplication operations of FFT.	10	
4	Finite Impulse Response and Infinite Impulse Response Filter: Basic concepts of FIR Filter, Calculation of Filter Coefficients, Impulse Response Sequence. Rectangular Window, Hamming Window and Hanning Window Function. Calculation and determination of the Order of FIR Filter. Basic concepts of IIR Filter. Transfer Function of IIR Filter. Advantages and disadvantages of FIR Filter and IIR Filter.	8	
5	DSP Processor and Programming: Block Diagram of TMS320C54x Processor and brief explanation including Accumulator, Memory and MAC Unit. Basic Instruction Sets and simple Assembly Language Programming using TMS320C54x. FIR Filter design and implementation using TMS320C54x	6	

Course Outcomes

After completion of the course, a student would be able to:

CO 1	explain the features of different types of signals.
CO 2	explain the properties of Fourier Series and Fourier Transform.
CO 3	calculate Addition and Multiplication operations of Discrete Fourier Transform and Fast Fourier Transform.
CO 4	design Finite Impulse Response Filter with various Window Methods.
CO 5	simulate Digital Filters.

Learning Resources:

1.	Digital Signal Processing by S. Salivahanan, A. Vallavaraj and C. Gnanapriya, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2.	Signal Processing and Linear Systems by B. P. Lathi, Oxford University Press, New Delhi.
3.	Digital Signal Processing: A Computer Based Approach by S.K. Mitra, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4.	Digital Signal Processing: Principles, Algorithms, and Applications by J.G. Proakis and D.G. Manolakis, Pearson Education, India.
5.	Theory and Application of Digital Signal Processing by L.R. Rabiner and B. Gold, Prentice Hall of India

	Private Limited, New Delhi.
6.	Digital Signal Processing: System Analysis and Design by P.S.R Diniz, E.A.B da Silva and S.L. Netto, Cambridge University Press, Delhi.
7.	https://www.ti.com/microcontrollers-mcus-processors/processors/digital-signal-processors/overview.html

Name of the course	Cyber Security
Course Code: PEC(CS)602F	Semester: 6th
Duration: 6 month	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial: NIL	Mid Semester-2 Exam: 15 Marks
Practical: NIL	Assignment, Quiz & class attendance: 20 Marks
Credit Points: 3	End Semester Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:	
1.	To know about Classification of Cyber Security.
2.	To identify the key features and approaches of Cyber Crime and Security.
3.	To analyze the key features and approaches of Cyber Crime and Security
4.	To examine human and intellectual issues and jurisdictional challenges critically.

Pre-Requisite	
1.	Computer Network PC(CS/IT) 617
2.	Operating System PC(CS/IT)511

Unit	Content	Hrs	Marks
1	Introduction of Cybercrime: Cybercrime definition and origins of the word, Cybercrime and information security, Different types of Cyber Crime and data frauds, A global Perspective on cybercrimes.	3	
2	Cyber Offenses: How Criminals plan them, Categories of Cyber Crimes, How Criminal Plans the Attack: Active Attacks, Passive Attacks, Cyber stalking.	4	
3	Cyber crime on Mobile & Wireless devices: Proliferation of Mobile and Wireless devices, Trends in Mobility, Credit card Frauds in Mobile and wireless devices, Authentication Service Security, Attacks on Mobile/Cellphones, Security Implications for Organizations, Organization Security polices and Measures in Mobile Computing Era.	7	
4	Tools and Methods used in Cybercrime: Proxy servers, password checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow ,Attacks on Wireless Networks,	8	
5	Phishing and Identity theft: Methods of Phishing, Phishing Techniques, Types of Phishing Scams, Identity theft, Types and Techniques of identity thefts.	6	
6	Security Policy: Intrusion detection system (IDS), Digital signatures and the Indian ITA act, Cybercrime and punishment, Indian laws and IT act, Public key certificate.	8	

Course Outcome: After completion of the course the students will be able to-	
CO1	describe Cyber-crime vulnerabilities and exploitations of the Internet
CO2	implement different methods to prevent cyber-criminal activities.
CO3	distinguish between various types of cyber crimes with respect to the motivations and methods of operation of offenders.
CO4	identify the law with regards to the investigation and prosecution of cyber criminals.
CO5	apply appropriate law enforcement strategies to both prevent and control cyber-crime.

Learning Resources:	
1	Cyber Security : Understanding Cyber Crimes , Computer Forensics and Legal Perspectives By Nina Godbole, Sunit Belapur , Wiley

2	Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi.
3	The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
4	The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
5	Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai

Name of the course		Machine Learning	
Course Code: PEC(CS)603A		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	Develop an appreciation for what is involved in Learning models from data		
2.	Understand a wide variety of learning algorithms		
3.	Understand how to evaluate models generated from data		
4.	Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models		
Pre-Requisite			
1.	Mathematics I BS(CS/IT) 101		
2.	Mathematics II BS(CS/IT) 205		
Module	Content	Hours	Marks.
1	Introduction: Introduction to Analytics and Machine Learning, Framework for Developing Machine, Learning Models, Prepare the Data for Machine Learning Algorithms, Data Cleaning, Handling Text and Categorical Attributes, Handling Missing Values, Exploration of Data using Visualization, Types of Machine Learning Systems	5	
2	Linear Regression: Linear regression, Gradient Descent Algorithm for Linear Regression Model, Polynomial model, Regularization, Multi-Collinearity, Logistic Regression	7	
3	Classification: Training a Binary Classifier, Measuring Performance, Using Linear Regression for Classification, Using Logistic Regression, Multiclass Classifier, Multi-label Classification, Multi-output Classification	8	
4	Some Supervised Machine Learning Algorithms: k-Nearest Neighbors (KNN), Naive Bayes Classifiers, Decision Trees, Ensembles of Decision Trees: Random Forests, Kernelized Support Vector Machines, Model Evaluation and Improvement	7	
5	Dimensionality Reduction: Dimensionality Reduction, Feature Extraction, and Manifold Learning, Principal Component Analysis (PCA),Randomized PCA, Incremental PCA, Kernel PCA, Selecting a Kernel and Tuning Hyper-parameters, Other Dimensionality Reduction Techniques	7	
6	Unsupervised Learning: Clustering: K-Means, Image Segmentation using clustering, Creating Product Segments Using Clustering, Finding Optimal Number of Clusters Using Elbow Curve Method, Normalizing the Features, Hierarchical Clustering, Compare the Clusters Created by K-Means and Hierarchical Clustering, Anomaly Detection using Gaussian Mixtures, Assessment Metrics for Clustering Algorithms.	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	describe the concepts of Machine Learning.		
CO 2	implement algorithms of Machine Learning.		
CO 3	develop Machine Learning models.		

CO 4	apply Machine Learning Models to classification and recognition problems.
CO 5	design various Machine Learning algorithms for real-world applications for model optimization.
Learning Resources:	
1.	Christopher Bishop. Pattern Recognition and Machine Learning. 2e
2.	Machine Learning by Tom Mitchell, McGraw Hill Education
3.	Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
4.	R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

Name of the course		Operation Research	
Course Code: PEC(CS)603B		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0hrs./week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs./week		Other Assessment tools (Assignment, quiz, Attendance): 20Marks	
Credit Points: 3		End Semester Exam: 75Marks(to be mapped into 50 marks)	
Objective:			
1.	To classify and formulate real-life problem for modelling, solving and applying for decision making.		
2.	To study the formulation and various methods of solutions for linear programming, transportation, assignment, CPM and PERT problems.		
3.	To solve problems using dynamic programming method.		
Pre-Requisite			
1.	Mathematics I BS(CS/IT) 101		
2.	Mathematics II BS(CS/IT) 205		
Module	Content	Hrs	Marks
1.	Linear Programming Problems (LPP): Basic LPP and Applications; Various Components of LP Problem Formulation. Solution of Linear Programming Problems: Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution, Convex set and explanation with examples. Solution of LPP by Simplex Method; Big-M Method; Duality Theory. Transportation Problems and Assignment Problems.	17	
2.	Network Analysis: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).	5	
3.	Game Theory: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance.	5	
4.	Queuing Theory: Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞/ FIFO) and (M/M/1: N / FIFO) and problems.	5	
5.	Dynamic Programming: Basic Concepts, Bellman's optimality principles, Dynamic programming approach in decision making problems, optimal subdivision problem.	4	
Course Outcome: After completion of this course the students will be able to:			
CO1	apply various techniques to solve linear programming problems.		
CO2	implement different network flow algorithms and cost analysis techniques.		
CO3	solve Game Theory problems.		
CO4	explain Queuing Theory.		
CO5	design dynamic programming solutions to different problem.		
Learning Resources:			

1.	H. A. Taha, “Operations Research”, Pearson
2.	P. M. Karak – “Linear Programming and Theory of Games”, ABS Publishing House
3.	Ghosh and Chakraborty, “Linear Programming and Theory of Games”, Central Book Agency
4.	Ravindran, Philips and Solberg - “Operations Research”, WILEY INDIA
5.	KantiSwaroop — “Operations Research”, Sultan Chand & Sons
6.	Rathindra P. Sen—“Operations Research: Algorithms and Applications”, PHI
7.	R. Panneerselvam - “Operations Research”, PHI
8.	A.M. Natarajan, P. Balasubramani and A. Tamilarasi - “Operations Research”, Pearson
9.	M. V. Durga Prasad – “Operations Research”, CENGAGE Learning 6. J. K. Sharma- “Operations Research”, Macmillan Publishing Company

Name of the course	Cryptography
Course Code: PEC(CS)603C	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 0 hrs./week	Mid Semester-2 Exam: 15 Marks
Practical Contact Hrs.: 0 hts./week	Assignment, Quiz & class attendance: 20 Marks
Credit Points: 3	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To explain the need of information security in the aspects of various attacks and forgery issues
2.	To discuss various cryptographic techniques related to the codification of plain text message
3.	To construct suitable data encryption algorithm for secret transmission of confidential data
4.	To justify the effectiveness of client-server authentication protocol in the aspect of client user identification
5.	To explain the idea of some network security services
Pre-Requisite	
1.	Computer Network [PC(CS/IT)617]

Module	Content	Hrs	Marks
1	MODULE-1: IDEA OF INFORMATION SECURITY Need for information security, principles of information Security- authentication, confidentiality, integrity, non-repudiation, access control, availability, types of attacks- application-level and network-level attacks, passive & active attacks, malicious software based attacks-virus, worms, trojan hoarse, some specific attacks- packet sniffing, packet spoofing, DNS spoofing.	6	
2	MODULE-2: CRYPTOGRAPHIC CONCEPTS & TECHNIQUES Idea of cryptographic system- plaintext & cipher text, cryptanalysis, plain text codification with substitution technique- caser cipher, mono-alphabetic cipher, homophonic substitution cipher, polygram substitution cipher, polyalphabetic substitution cipher, plain text codification with transposition technique- rail fence technique, columnar transposition technique, vernam cipher, concept of symmetric & asymmetric key cryptography, key distribution, key ranges & key sizes	10	
3	MODULE-3: DIFFERENT ENCRYPTION ALGORITHMS Symmetric key encryption algorithm types- stream cipher and block cipher, confusion and diffusion, symmetric key encryption algorithm modes- Electronic Code Book, Cipher Block Chaining, Cipher Feedback, Output Feedback, some standard symmetric key encryption algorithm- DES, variations of DES- double DES, triple DES, asymmetric key encryption algorithm- RSA, elliptic curve cryptography, concept of digital signature and message digest, combining symmetric & asymmetric key encryption for secure data transmission.	12	
4	MODULE-4: USER OWNERSHIP VALIDATIONS Authentication basics, password-based authentication, random challenge based authentication, authentication token- challenge/response based and time based token, certificate based authentication, basic idea of steganography & watermarking, domain & types of watermarking.	6	
5	MODULE-5: SECURITY SERVICES Concept of firewall and their types- application gateway, packet filtering, limitation of firewall, basic idea of mail security protocol	2	

Course Outcome: After completion of this course the students will be able to -	
CO1	explain the need of information security in the aspects of various attacks and forgery cases
CO2	compare the effectiveness of different cryptographic techniques for generation of cipher text message

CO3	design secure data encryption algorithm for secret transmission of confidential data
CO4	justify the effectiveness of user validation scheme through client-server authentication protocols
CO5	discuss document ownership validations and different network security services
Learning Resources:	
1	William Stallings, Cryptography and Network Security Principles and Practices, 5th Edition, Prentice Hall
2	C. Kaufman, R. Perlman and M. Speciner, Network Security: Private communication, 2nd Edition, Pearson Education
3	Atul Kahate, Cryptography & Network Security, 3rd Edition, McGraw Hill Education (India) Private Limited
4	Merike Kaeo, Designing Network Security, 2nd Edition, Pearson Books

Name of the course		Advanced Architecture	
Course Code: PEC(CS) 603D		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Assignment, Quiz, Attendance: 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To identify different processor architectures and their performance measurement parameters.		
2.	To apply different techniques for improving the performance of processor.		
3.	To develop the concept of multiprocessor architecture.		
4.	To design pipeline processor architecture.		
Pre-Requisite			
1.	Computer Architecture PC(CS/IT)408		
2.	Computer Organization PC(CS/IT)301		
Module	Content	Hours	Marks.
1	The evolution of modern Computer systems – from DEC PDP-11, IBM 360/370 family, CDC Cyber 6600, Intel X86 architecture, Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. Introduction to high performance Computing – Overview, Flynn's classifications – SISD, SIMD, MISD, MIMD, Examples from Vector & Array Processors, Performance comparison of algorithms for Scalar, Vector and Array Processors, Fundamentals of UMA, NUMA, NORMA architectures, Performance measurement for parallel architectures – Flynn's measure, Feng's measure	10	
2	Pipelined processor design, Pipeline performance measurement parameters – speedup factor, efficiency, throughput of a linear pipeline, comparing performance of a N stage pipeline with a N processor architecture, Pipeline design principles, Examples of Arithmetic pipelines, Floating point Adders, Multipliers, Dividers etc., Classifications of Unifunction, Multifunction & Dynamic pipelines, Scheduling in a pipelines with feedback , Pipeline hazards and their solutions	10	
3	RISC architecture, characteristics of RISC instruction set & RISC pipeline, its comparisons with CISC, necessity of using optimizing compilers with RISC architecture, Examples from POWER PC and SPARC architectures, Superpipelining (MIPS architecture), Superscalar architecture , Diversified pipelines and out of order execution, VLIW architecture	10	
4.	Memory hierarchy – Techniques for improving Cache memory performance parameters,(reduce cache miss rate, reduce hit time, reduce miss penalty), Main memory performance enhancement – interleaved memory, improvement of memory bandwidth, use of TLB for performance enhancement.	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	explain the concepts of parallel computing and hardware technology		
CO 2	explain multiprocessor architecture and taxonomy of parallel architecture		
CO 3	design the hierarchical memory structure and ~~design~~ cache		
CO 4	analyze RISC and CISC architecture		
CO 5	design pipeline processor		
Learning Resources:			
1.	Advanced computer architecture: Parallelism, Scalability, Programmability - Kai Hwang and Naresh		

	Jotwani (McGraw Hill)
2.	Computer Architecture: A Quantitative Approach – Patterson & Hennessy (Elsevier)
3.	Computer Architecture & Parallel Processing – Hwang &Briggs(TMH)
4.	Computer organization and architecture, designing for performance – Stallings (PHI)
5.	Advanced Computer Architecture – Hwang (TMH) 5. Structured Computer Organization – Tanenbaum (PHI)
6.	Computer Architecture & Organization – J P Hayes (McGraw Hill)

Name of the course		Cloud Computing	
Course Code: PEC(CS)603E		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Assignment, Quiz, Attendance: 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To identify the technical foundations of cloud systems architectures.		
2.	To analyze the problems and solutions to cloud application problems.		
3.	To apply principles of best practice and technical challenges in cloud application design		
4.	To understand the key security and compliance challenges of cloud computing		
Pre-Requisite			
1.	Database Management System PC(CS/IT)512		
2.	Computer Networks PC(CS/IT)617		
Module	Content	Hours	Marks.
1	Definition of Cloud Computing and its Basics: Defining a Cloud, Cloud Types – NIST model, Cloud Cube, model, Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software as a Service with examples of services/ service providers, models – Infrastructure as a Service, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing, A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients	6	
2	Use of Platforms in Cloud Computing : Concepts of Abstraction and Virtualization technologies Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network	6	
3	Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance, Concepts of Platform as a Service, Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks	8	
4.	Cloud Infrastructure: Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle).	6	
5	Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)	5	
6	Concepts of Services and Applications : Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service	5	

	Bus, Service catalogs, Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs		
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	apply fundamental concepts in cloud infrastructures to tradeoffs in power, efficiency and cost.		
CO 2	analyze storage virtualization in cloud computing system model.		
CO 3	implement the principles of Parallel and Distributed Computing in server side		
CO 4	develop different types of Virtualization technologies and Service Oriented Architecture systems		
CO 5	elucidate the concepts of NIST Cloud Computing architecture and its design challenges		
CO 6	analyze Resource provisioning and Security governance in clouds		
Learning Resources:			
1.	Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,2013		
2.	Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill		
3.	Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill		
4.	Cloud Computing, Miller, Pearson		
5.	Building applications in cloud: Concept, Patterns and Projects, Moyer, Pearson		
6.	Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India		

Name of the Course		Ad Hoc and Sensor Networks	
Course Code: PEC(CS)602F		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	To understand the features of Ad Hoc and Sensor Networks.		
2.	To learn the techniques of Wireless Sensor Networks.		
3.	To design Transceiver System for Ad Hoc and Sensor Networks.		
4.	To apply IEEE Standards for the implementation of Ad Hoc and Sensor Networks.		
Pre-Requisite			
1.	Communication Engineering [ES(CS/IT) 409]		
Module	Content	Hrs	Marks
1	Basics of Ad Hoc Networks and Sensors: Features of Ad Hoc Networks, classification of Ad Hoc Networks, routing in Ad Hoc Networks, Destination Sequence Distance Vector (DSDV) routing protocol and Ad Hoc On-demand Distance Vector (AODV) routing protocol, Hybrid routing protocols, format of a Routing Request Packet. Principles of Sensors and Actuators, different types of Optical Sensors, Magnetic Sensors, Ultrasonic Sensors, Biological and Chemical Sensors, Motion Sensors etc.	8	
2	Sensor Networks and Spectrum of Electromagnetic Waves: Characteristics of Wireless Sensor Networks (WSN), Sensor Nodes, Protocol Stack of Sensor Networks. Frequency Spectrum of Radio Waves, Microwaves, Infrared Rays, Visible Lights and UV rays. Calculation of Energy from their Wavelengths.	6	
3	Uses of Communication Technology for Ad Hoc Networks: Wi-Fi Technology (IEEE 802.11): Wi-Fi based Ad Hoc Networks, Communication distance and data rate, Wi-Fi Direct (P2P) Communication. Bluetooth Technology (IEEE 802.15.1): Bluetooth Classic, Bluetooth Low Energy, Bluetooth Low Energy Channels and Advertising Intervals. ZigBee Technology (IEEE 802.15.4): Features of ZigBee Technology, Frequency Band, Data Rates, Communication Distance. IEEE 802.15.4e	12	

	Standards, Hopping Systems: Frequency Hopping, Channel Hopping, Time Slot, Frame Slot.		
4	Transceiver Architecture: Structure of Transceiver for Sensor Networks. Key components of Sensor Network System. Useful Frequency Bands for Sensor Networks. Receiver Sensitivity and calculation of Sensitivity Level.	6	
5	Power Management and Challenges: Design of Low Power Wireless System, Power Management of Wireless Sensor Networks, various Power Modes: Active Mode, Modern Sleep Mode, Light Sleep Mode, Deep Sleep Mode. Challenges in designing of Ad Hoc Networks.	4	

Course Outcomes	
After completion of the course, a student would be able to:	
CO 1	explain the features of Ad Hoc Networks.
CO 2	describe Protocol Stacks of Wireless Sensor Networks.
CO 3	analyze Ad Hoc Networks using Wireless Communication Technologies.
CO 4	design Ad Hoc and Sensor Network System.
CO 5	implement Ad Hoc Networks deploying Sensor Nodes at various locations.
Learning Resources:	
1.	Wireless Ad Hoc and Sensor Networks: Protocols, Performance, and Control by J. Sarangapani, CRC Press, New York.
2.	Wireless Ad Hoc and Sensor Networks: Management, Performance, and Applications by Jing (Selena) He, S. Ji, Y. Pan and Y. Li, CRC Press, Boca Raton (Florida).
3.	Wireless Ad Hoc and Sensor Networks: Theory and Applications by Xiang-Yang Li, Cambridge University Press, England.
4.	Ad Hoc Wireless Networks: Architectures and Protocols by C. S. Ram Murthy and B. S. Manoj, Pearson Education, Inc. New Jersey.
5.	Wireless Sensor and Actuator Networks: Technologies, Analysis and Design by R. Verdone, D. Dardari, G. Mazzini and A. Conti, Elsevier Academic Press, London.
6.	Deploying Wireless Sensor Networks: Theory and Practice by M. R. Senouci and A. Mellouk, ISTE Press Ltd., London.

Name of the Course	Industrial Management
Course Code: HS(CS/IT)604	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term Exam I: 15 Marks
Tutorial: Nil	Mid Term Exam II: 15 Marks
Practical: Nil	Assignment & Quiz etc.: 20 Marks
Credit Points: 3	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:	
1.	To understand what is industrial Management
2.	To understand different corporate structures and management techniques.
3.	To understand quality management and financial management.
4.	To understand the union and State budget
Pre-Requisite	
1.	NIL

Module	Content	Hrs	Marks
1	Human resource Management: Introduction of Human Resource Management, recruitment and selection, performance appraisal, industrial , trade , collective bargaining.	3	
2	Organisational behaviour: Different schools of Management thought:	5	

	scientific management, administrative theory, theory of bureaucracy, human relations theory . Motivation: different theories, Communication: purpose, process, barriers to effective communication, guidelines to make communication effective, Perception: process, important factors influencing perception, shortcuts for judging people, Halo effect, stereotyping projection		
3	Quality management: concepts, dimensions for goods and services, cost of quality, statistical quality control, control , acceptance sampling, total quality management, new quality tools	4	
4	Marketing management: basic concepts of marketing, difference between selling and marketing, elements of marketing mix, brief idea about marketing environment, simple marketing strategies, SWOT analysis	4	
5	Introduction to accounting: basic accounting concepts, important definitions, uses, limitations, advantages, types of accounting, financial statements, introduction to general accounting, different types of vouchers, double entry, bookkeeping, different types of transaction related to financial accounting	10	
6	Financial control: posting of ledgers and preparation of trial balance, preparation of balance sheet and profit and loss accounts, controlling other departments by financial accounting (a practical approach)	6	
7	Budget analysis: union and State budget analysis of the concerned year, budget at a glance, annual financial statement economic survey of concerned year	4	

Course Outcomes	
After completion of the course, a student would be able to:	
CO 1	explain the features of Human Resource Management.
CO 2	analyse about different quality control methods and organisational behaviour
CO 3	create strategic management in future
CO 4	comprehend and analyse accounts and its related management .
CO 5	analyse union and State Government budgets
Learning Resources:	
1.	Industrial Management volume 1 LC, Jhamb, EPH
2.	Industrial relations trade unions and labour legislation- Sinha Pearson education Asia
3.	Financial Management and accounting- P.k JaJain, S Chand
4.	Organisational behaviour- SP Robbins, Prentice Hall
5.	Production and operations management Joseph Monks, TMH

Name of the course	Computer Network Lab		
Course Code:PCL(CS/IT)619	Semester: 6th		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme	Examination Scheme, Total Marks: 100		
Theory: Nil	Attendance : 10		
Tutorial: Nil	Preparation of Lab Report : 30		
Practical: 3 hrs./week	Experimental data/ Precision of work done : 30		
Credit Points: 1.5	Presentation/ analysis of the result : 10		
	Viva Voce: 20		
Module	Content	Hrs	Marks
1.	NIC Installation & Configuration (Windows/Linux)	01	

2.	Understanding IP address, subnet, MAC address, IP configuration	02	
3.	Networking cables (CAT5, UTP), Connectors (RJ45, T-connector)	01	
4.	Physical verification of existing LAN	02	
5.	5.TCP/UDP Socket Programming i) UDP time client server program ii) UDP echo client server program iii) TCP time client server program iv) TCP echo client server program v) TCP chat client server program Vi) Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)	18	
6.	Server Setup/Configuration FTP, Telnet, DNS.	06	
7.	Firewall configuration in client level	03	
8.	Mini project: Multiple user chat server implementation	06	

Course Outcome: After completion of this course the students will be able to -	
CO1	Investigate configuration of existing LAN
CO2	Configure different components of computer network
CO3	Implement client server model using socket programming
CO4	Implement different server configuration
CO5	Configure firewall
CO6	Design of real life problems and solution for multiple client chat server
Learning Resources:	
1	TCP/IP Sockets in Java, Practical Guide For Programmers Second Edition Kenneth L. Calvert and Michael J. Donahoo, The Morgan Kaufmann Practical Guides Series
2	TCP/IP Sockets in C, Practical Guide For Programmers Second Edition Kenneth L. Calvert and Michael J. Donahoo, The Morgan Kaufmann