COMPUTER ENGINEERING COURSE

SCHEME OF INSTRUCTION AND EXAMINATION REVISED COURSE 2019-2020

SEMESTER – III

Course Code	Nomenclature of theCourse	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Duratiion (Hrs)	Marks					Credits
						Th	IA	TW**	P	Total	
CE310	Mathematics III	3	1	0	**3**	100	25	25	0	**150**	**4**
CE320	Logic Design	3	0	0	**3**	100	25	0	0	**125**	**3**
CE330	Data Structures	3	0	0	**3**	100	25	0	0	**125**	**3**
CE340	Object Oriented Programming System	3	0	0	**3**	100	25	0	0	**125**	**3**
CE350	Computer Organization	3	1	0	**3**	100	25	25	0	**150**	**4**
CE360	Data Structures Programming Lab	0	0	4	**0**	0	0	25	50	**75**	**2**
CE370	Object Oriented Programming System Lab	0	0	4	**0**	0	0	25	50	**75**	**2**
HM001	Technical Communication	2	0	0	**0**	0	0	75	0	**75**	**2**
AC390	Mathematics I & II (Bridge Course)*	2	0	0	**0**	0	0	0	0	**0**	**0**
	TOTAL	**19**	**2**	**8**		**500**	**125**	**175**	**100**	**900**	**23**

*Applicable to direct second year /lateral entry students
**Term Work marks are to be awarded through continuous evaluation

LEGEND

Abbreviation	Description
L	Lecture
T	Tutorial
P	Practical
O	Oral
Th	Theory
TW	Term Work
IA	Internal Assessment

COMPUTER ENGINEERING COURSE
SCHEME OF INSTRUCTION AND EXAMINATION REVISED COURSE 2019-2020

SEMESTER – IV

Course Code	Nomenclature of the Course	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Duration (Hrs)	Marks					Credits
						Th	IA	TW*	P	Total	
CE410	Discrete Mathematics	3	1	0	**3**	100	25	25	0	**150**	**4**
CE420	Microprocessors & Microcontrollers	3	0	0	**3**	100	25	0	0	**125**	**3**
CE430	Formal Languages & Automata Theory	3	0	0	**3**	100	25	0	0	**125**	**3**
CE440	Modern Algorithm DesignFoundation	3	0	0	**3**	100	25	0	0	**125**	**3**
CE450	Object Oriented Software Engineering	3	1	0	**3**	100	25	25	0	**150**	**4**
CE460	Modern Algorithm Design Foundation Lab	0	0	4	**0**	0	0	25	50	**75**	**2**
CE470	Microprocessors & Microcontrollers Lab	0	0	4	**0**	0	0	25	50	**75**	**2**
HM100	Economics for Engineers	3	0	0	**3**	100	25	0	0	**125**	**3**
	TOTAL	18	**2**	8	**--**	**600**	**150**	**100**	**100**	**950**	**24**

*Term Work marks are to be awarded through continuous evaluation

LEGEND

Abbreviation	Description
L	Lecture
T	Tutorial
P	Practical
O	Oral
Th	Theory
TW	Term Work
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COMPUTER ENGINEERING COURSE

SCHEME OF INSTRUCTION AND EXAMINATION REVISED COURSE 2019-2020

SEMESTER – V

Course Code	Nomenclature of the Course	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Duratiion (Hrs)	Marks					Credits
						Th	IA	TW*	P	Total	
CE510	Database Management & Query Processing	3	0	0	**3**	100	25	0	0	125	3
CE520	Operating Systems	3	0	0	**3**	100	25	0	0	125	3
CE531	Graph Theory										
CE532	Neural Networks										
CE533	Object Oriented Programming using JAVA				**3**	100	25	0	0	125	3
CE534	Distributed Operating System	3	0	0							
CE541	Modern Computer Graphics										
CE542	Web-Technologies										
CE543	Testing & Quality Assurance						25	0	0	125	3
CE544	Real Time Systems	3	0	0	**3**	100					
CE550	Database Management & Query Processing Lab	0	0	2	--	0	0	25	50	75	2
CE560	Operating Systems Lab	0	0	2	--	0	0	25	50	75	2
**	Open Elective	3	0	0	3	100	25	0	0	125	3
HM300	Cyber Law and IPR	3	0	0	**3**	100	25	0	0	125	3
	TOTAL	18	0	4	**--**	600	150	50	100	900	22

*Term Work marks are to be awarded through continuous evaluation

** Students may enter the subject code of the open elective selected from the courses of other branch of Engineering.

LEGEND

Abbreviation	Description
L	Lecture
T	Tutorial
P	Practical
O	Oral
Th	Theory
TW	Term Work
IA	Internal Assessment

COMPUTER ENGINEERING COURSE

SCHEME OF INSTRUCTION ANXAMINATION REVISED COURSE 2019-2020

SEMESTER – VI

Course Code	Nomenclature of the Course	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Duratiion (Hrs)	Marks					Credits
						Th	IA	TW*	P	Total	
CE610	Modern Computer Networking	3	0	0	**3**	100	25	0	0	125	3
CE620	Artificial Intelligence	3	0	0	**3**	100	25	0	0	125	3
CE631	Computational Number Theory	3	0	0	**3**	100	25	0	0	125	3
CE632	Advanced Computer Organization & Architecture										
CE633	Speech & Natural Language Processing										
CE634	Data Mining & DataWarehousing										
CE641	High Performance Computing	3	0	0	**3**	100	25	0	0	125	3
CE642	Information Retrieval										
CE643	Image Processing & Vision										
CE644	Cloud Computing &Applications										
CE650	Computer Networks Lab	0	0	2	--	0	0	25	50	75	2
CE660	Artificial Intelligence Lab	0	0	2	--	0	0	25	50	75	2
**	Open Elective	3	0	0	3	100	25	0	0	125	3
HM200	Technical Writing & Professional Ethics	3	0	0	**3**	100	25	0	0	125	3
	TOTAL	18	0	4	--	600	150	50	100	900	22

*Term Work marks are to be awarded through continuous evaluation

** Students may enter the subject code of the open elective selected from the courses of other branch of Engineering.

LEGEND

Abbreviation	Description
L	Lecture
T	Tutorial
P	Practical
O	Oral
Th	Theory
TW	Term Work
IA	Internal Assessment

COMPUTER ENGINEERING COURSE

SCHEME OF INSTRUCTION AND EXAMINATION REVISED COURSE 2019-2020

SEMESTER – VII

Course Code	Nomenclature of the Course	Scheme of Instruction Hrs/Week			Scheme of Examination					
		L	T	P	Duratiion (Hrs)	Marks				Credits
						Th	IA	TW*	O	Total	
CE710	Compiler Design	3	0	0	**3**	100	25	0	0	125	3
CE721	Embedded Systems & Design	3	0	0	**3**	100	25	0	0	125	3
CE722	Machine Learning										
CE723	Data Analytics										
CE724	Mobile Computing & Android Programming										
CE730	Compiler Design Lab	0	0	2	--	0	0	25	50	75	2
**	Open Elective	3	0	0	3	100	25	0	0	125	3
CE740	Internship	0	0	3	--	0	0	50	50	100	3
CE750	Project Work - Phase I	0	0	3	--	0	0	50	75	125	3
	TOTAL	9	0	8	--	300	75	125	175	675	17

*Term Work marks are to be awarded through continuous evaluation

** Students may enter the subject code of the open elective selected from the courses of other branch of Engineering.

LEGEND

Abbreviation	Description
L	Lecture
T	Tutorial
P	Practical
O	Oral
Th	Theory
TW	Term Work
IA	Internal Assessment

COMPUTER ENGINEERING COURSE

SCHEME OF INSTRUCTION AND EXAMINATION REVISED COURSE 2019-2020

SEMESTER – VIII

Course Code	Nomenclature of the Course	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Duratiion (Hrs)	Marks					Credits
						Th	IA	TW*	O	Total	
CE810	Cryptography Techniques for Network Security	3	0	0	**3**	100	25	0	0	125	3
CE821	Internet of Things										
CE822	Pattern Recognition										
CE823	Multimedia Systems & Applications						25	0	0	125	3
CE824	Software Development Framework	3	0	0	**3**	100					
CE830	Elective - NPTEL / MOOC / SWAYAM	3	0	0	--	0	0	50	50	100	3
CE840	Project Work - Phase II	0	0	10	--	0	0	100	150	250	9
	TOTAL	9	0	10	**29**	200	50	150	200	600	18

*Term Work marks are to be awarded through continuous evaluation

LEGEND

Abbrevi Ation	Description
L	Lecture
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SYLLABUS

SEM III

MATHEMATHICS III

Course Code	CE310		Credits	4	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	1	0	40 hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 150 marks	25	25	100	0	0

Course Outcomes:

The student will be able to:

CO1	Compute the rank, Eigen values and Eigen vectors of a given matrix, which will enable students to handle linear systems.
CO2	Compute Laplace transforms of real valued functions and apply it to solve integral and differential equations.
CO3	Compute Fourier transforms and Z-transforms and be able to apply it in their engineering studies.
CO4	Understand the basic concepts of probability, random variables, mean, variance, standard deviation and probability distributions.

UNIT -1	
MATRICES : Types of matrices, Determinant, inverse of matrix, Elementary transformations, Elementary matrices, Rank of matrix, Reduction to normal form, Canonical form, Rank using elementary transformation, Linear independence and dependence of vectors, System of the form AX = 0, and AX = B, and their solutions, Eigen values, Eigen vectors with properties, Cayley-Hamilton theorem with its applications, minimal polynomial, Diagonalization.	10 hrs
UNIT -2	
LAPLACE TRANSFORMS: Definition. Existence conditions, properties, inverse Laplace transforms. Laplace transform of periodic functions, Convolution theorem, Laplace transform of Dirac-Delta function, Application of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations.	10 hrs
UNIT -3	
FOURIER TRANSFORM : Fourier Transform, Inverse Fourier transform, Fourier Sine and Cosine transform Convolution and application. Z-TRANSFORM: Definition, region of convergence, properties, Z-transform on impulse function, Convolution theorem, application to difference equations.	10 hrs
UNIT -4	
PROBABILITY: Definition, properties, Axioms of probability, conditional probability, theorem on total probability, Bayes theorem; Random variables-discrete & continuous; Expectation and Variance, Standard deviation, Moment Generating Function & properties, Standard distributions: discrete-Binomial, Geometric & Poisson; continuous-Uniform, Normal, exponential.	10 hrs

TEXTBOOKS	
1	B. S. Grewal;Higher Engineering Mathematics; Khanna Publications, New Delhi.
2	Erwin Kreyzing; Advanced Engineering Mathematic; New International Limited.
REFERENCES	
1	P. Kandasamy; Engineering Mathematics; Chand & Co., New Delhi.
2	Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; Oxford University Press
3	D. S. Chandrasekhraiah; Engineering Mathematics- Part III ; Prism Books Pvt. Ltd.
4	Montgomery, D. C., Probability and Statistics for Engineers; Prentice Hall of India.

LOGIC DESIGN

Course Code	CE320		Credits	3	
Scheme of Instruction Hours/ Week	L	T	P	TOTAL	
	3	0	0	40 Hrs/sem	
Scheme of Examination TOTAL = 125 marks	IA	TW	TM	P	O
	25	0	100	0	0

Course Outcomes:

The student will be able to:

CO1	Convert the numbers from one radix to another and perform arithmetic operations using Complement Arithmetic.
CO2	Solve Boolean Expressions using Boolean algebra, K-maps and VEM and implement them using logic gates. Design any given combinational circuits and explain their applications.
CO3	Explain different flip flops, registers and their applications.
CO4	Design sequential circuits,state machines ,synchronous and asynchronous counter circuits

UNIT -1	
Introduction: Digital and analog systems, Logic levels and Pulse Waveforms. Number systems – Decimal, Binary, Representation of Signed numbers and binary arithmetic, Octal number system, Hexadecimal number system. Binary codes – Classification, 8421 BCD code, XS-3 code, Gray code, Error correction and detection codes. Logic gates-AND, OR, NOT, Universal , X-OR,X-NOR gates. Boolean algebra: Logic operations, Laws of Boolean Algebra, Duality, Reducing Boolean expressions, Boolean functions and their representations, Boolean expressions in SOP and POS forms, Computation of total gate inputs, Boolean expressions and logic diagrams, Conversion of AOI to NAND / NOR logic.	10 hrs
UNIT -2	
Minimization of Switching Functions: Two, Three, Four variable K-Map, Don't Care Combinations, Quine- McCluskey method. Combinational logic Design: Adders, Subtractors, Binary Parallel Adder/ Subtractor, Look Ahead Carry Adder, Code Converters, Parity generators/checkers , Comparators, Encoders, Decoders, Multiplexers and De-multiplexers, Modular design using IC chips.	10 hrs
UNIT -3	
Flip-flops: Classification of Sequential Circuits, Latches & flip-flops - D flip-flop, JK flip-flop, T flip-flop. Flip-flop operating characteristics, Race around condition, Master slave flip-flop, conversion of one flip-flop to another, Applications of flip-flop.	10 hrs

Shift Registers: Buffer register, Data Transmission in Shift Registers, Serial-In Serial-Out Shift register, Serial-In Parallel-Out Shift register, Parallel-In Serial-Out Shift register, Parallel-In Parallel-Out Shift register, Bidirectional shift register, Universal Shift register, Applications of Shift register.	
UNIT -4	
Counters: Asynchronous counters, Design of asynchronous counters, Synchronous counters, Shift register counters. Sequential Circuits : Finite state model, Memory elements, Synthesis of synchronous sequential circuits, Serial Binary Adders, Sequence Detector.	10 hrs

TEXTBOOKS	
1	A. Anand Kumar; Fundamentals of Digital circuits; PHI, Second Edition
2	Thomas L. Floyd; Digital Fundamentals; Prentice Hall.
REFERENCES	
1	Morris Mano; Digital Logic and Computer Design; PHI Publication. .
2	Malvino& Leach; Digital Principles and Applications; TMH Publication.
3	R. P. Jain; Modern Digital Electronics; TMH Publication.

DATA STRUCTURES					
Course Code	CE330		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Outcomes:

The student will be able to:

CO1	Demonstrate the use of data structures like linked lists , stacks and queues
CO2	Explain the applications of linked lists, stacks and queues in Computer Engineering
CO3	Apply the knowledge of data structures to a given problem.
CO4	Illustrate searching, sorting and hashing techniques.

UNIT -1	
Introduction to Data Structures: Linear and Non Linear Data Structures. Linked lists: Concept of Linked Lists. Singly linked lists and its operations Stacks: Basic Stack Operations, Array implementation of Stacks , Polish Notation- Introduction to infix, prefix and postfix expressions Application of Stacks: Conversion of Infix to Postfix, Evaluation of Postfix expression Queues: Basic Queue Operations, Array implementation of Queues, Circular Queues. Application of Queues: Implementation of a palindrome	10 hrs
UNIT -2	
Linked list based implementation of Stacks, Linked list based implementation of Queues Doubly linked lists and circular linked lists and their operations Application of Linked Lists: Addition of two polynomials Binary Trees: Terms associated with binary trees, Strictly binary, Complete binary, Almost complete binary tree, Representation of trees - Linked array representation and Implicit array representation, Traversal in Binary Tree: Preorder, in-order, post-order and Level order traversal. Binary search tree - Insert, Delete, Search.	10 hrs
UNIT -3	
Threaded Binary tree – Insertion and Deletion in-threaded binary tree, Traversal: Inorder traversal of in-threaded binary tree, Preorder traversal of in-threaded binary tree AVL Tree: Insert, Delete with Rotations, Searching and sorting. B-tree: Searching, Insertion, Deletion from leaf node and non-leaf node. Graphs: Directed and undirected graphs, graph terminology, Adjacency matrix, Adjacency list, Graph Traversals - Breadth First Search, Depth First Search.	10 hrs

UNIT -4	
Searching: Linear Search, Binary Search Hashing: Hash functions, Collision resolution techniques Study of different sorting techniques: Bubble Sort, Selection Sort, Insertion Sort, Radix Sort, Mergesort, Heap sort, Shell sort	10 hrs

TEXTBOOKS	
1	S. K Srivastava, Deepali Srivastava; Data Structures through C in Depth; BPB Publications; 2011.
2	Aaron M. Tenenbaum; Data Structures using C; Pearson Education India .
REFERENCES	
1	Ellis Horowitz and SartajSahni, Fundamentals of Data Structures, Galgotia Book Source, Gurgaon, First edition/Recent edition.
2	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education, 2nd Edition.
3	Gregory L. Heilman, Data Structures, Algorithms and Object Oriented Programming, Tata Mcgraw-Hill, New Delhi, 2002.
4	Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi, 1991.
5	Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms, Pearson Education, New Delhi, 2006.

OBJECT ORIENTED PROGRAMMING SYSTEM

Course Code	CE340		Credits	3	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	0	0	40 hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 125 marks	25	0	100	0	0

Course Outcomes:

The student will be able to:

CO1	Design algorithms using principles of object oriented programming.
CO2	Demonstrate the concepts of data abstraction, encapsulation, code-reusability and data hiding using 'C++".
CO3	Explain the applications of polymorphism and inheritance in object oriented programming.
CO4	Apply the knowledge of standard template library achieve reusability

UNIT -1	
Basic concepts of Object-Oriented Programming: Objects, Classes, Data Abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing. Benefits of Object-Oriented Programming. Structure of a C++ program, Data types, Constants, tokens, expressions, control structures, functions, recursion, arrays.	10 hrs
UNIT -2	
Classes and Objects, Constructors and destructors, Friend functions and friend classes, Concepts of polymorphism: Function overloading, operator overloading. Overloading types, & rules, explicit & implicit type conversion operators, Pointers.	10 hrs
UNIT -3	
Inheritance: Introduction, Single, Multilevel, Multiple, Hierarchical, Hybrid. Virtual Base Class, Abstract classes. 'this' pointer, pointers to deriver classes Virtual functions, pure virtual functions. I/O streams and classes, managing output with Manipulators, Classes for file streams, file I/O operations and functions. String processing.	10 hrs
UNIT -4	
Functions Templates and Class Templates, Exception handling: Basics of Exception Handling, Exception Handling mechanism, Throwing Mechanism, Throwing Mechanism, Catching mechanism, Re-throwing mechanism. Introduction to the Standard Template Library: Components of STL, Containers and Adapter: stack, queue, priority queue adapter algorithms, Iterators, Applications.	10 hrs

TEXTBOOKS	
1	Paul Deitel and HarreyDietel; C++, How to Program; seventh edition.
2	E Balaguruswamy; Object oriented programming with C++; Tata McGraw Hill. 6th edition
REFERENCES	
1	K R Venugopal, Rajkumar, T. Ravishankar; Mastering C++; Tata McGraw Hill.
2	Stanley Lippman; C++ Primer; Fifth edition.
3	Herbert Schildt; Complete Reference; Fourth edition.
4	BjarneStroustrup; C++ Programming Language; Fourth edition.
5	D Ravichandran; Programming with C++; Third Edition.

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COMPUTER ORGANISATION

Course Code	CE340		Credits	4	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	1	0	40 hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 150 marks	25	25	100	0	0

Course Outcomes:

The student will be able to:

CO1	Identify high performance architecture designand perform different computer arithmetic operations.
CO2	Create an assembly language program to program a microprocessor system.
CO3	Design a pipeline for consistent execution of instructions with minimum hazards.
CO4	Demonstrate memory hierarchy and its impact on computer cost/performance.

UNIT -1	
Introduction to Computer Organization: Computer components, Functions, interconnection Structure, Bus Interconnection. Computer Arithmetic: Integer Representation-unsigned numbers, signed numbers, signed magnitude, 2's compliment, Biased Representation. Integer Arithmetic: Addition, Subtraction, Multiplication unsigned, signed (Booths Algorithm), Division- unsigned, signed. Floating-Point Representation: IEEE 32 bits, 64 bits. Floating-Point Arithmetic: Addition, Subtraction, Multiplication, Division.	10 hrs
UNIT -2	
Internal Memory: Semiconductor Memory - Memory Hierarchy, Characteristics of Memory System, Semiconductor RAM Memories, Internal Organization of Memory Chip, Static RAM, Asynchronous DRAM, Synchronous DRAM, Connection of Memory to the processor, RAM Bus memory. Cache Memory: Basics of Cache, Structure, Read operation, Elements of Cache Design. Associative Memory: External Memory: Magnetic Disk, RAID, Optical Memory. Virtual Memory: Logical VS Physical Address space, working Principle, Mapping Functions, Replacement Policy. operators, Pointers.	10 hrs
UNIT -3	
Input/Output: External Devices, I/O Modules, Programmed I/O, Interrupt Driven	10 hrs

I/O, Direct Memory Access, I/O Channel and Processor. CPU Structure and Functions: Processor Organization, Register Organization, Instruction Pipeline, Basic Concepts of Pipelining. RISC CPU Architecture: Instruction Execution Characteristics, Use of Large Register File, Compiler based register optimization, Reduced Instruction Set Architecture, RISC v/s CISC.	
UNIT -4	
Buses: Bus interconnections, VGA, Asynchronous v/s Synchronous Buses, PCI Bus, SCSI Control Unit Operation: Micro Operations, Control of the CPU, Hardwired Implementation Micro programmed Control: Basic Concepts, Microinstruction Sequencing, and Microinstruction Execution. Parallel Processing: Multi Processing, Cache Coherence /MESI Protocol.	10 hrs

TEXTBOOKS	
1	William Stalling; A textbook of Computer Organization and Architecture; EditionVI.
2	David A. Patterson, John L. Hennesy ; Computer Organization And Design, Edition III.
REFERENCES	
1	M. Morris Mano ; A textbook of Computer Organization and Architecture.
2	Douglas V. Hall ; Microprocessors and Interfacing.
3	Carl Hamacher, ZvonkoVranesic, SafalZaky ; Computer Organization; Edition

Data Structures Programming Lab

Course Code	CE360		Credits	2	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	0	0	4	28 hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 75 marks	0	25	0	50	0

At least 8 experiments out of below mentioned set are to be implemented using C

1. Implementation of Stack and Queue using Arrays.
2. Implementation of Stack and Queue using Linked lists.
3. Application of Stack: Infix to postfix Conversion, Postfix evaluation.
4. Implementation of Doubly Linked Lists .
5. Implementation of Circular Queues using Linked lists.
6. Implementation of Binary Search tree & its Operations & Traversals.
7. Implementation of Threaded Binary Search Tree.
8. Implementation of AVL Tree.
9. Implementation of Graph representations and Graph traversal techniques.
10. Implementation of Search techniques: Linear Search and Binary Search.
11. Implementation of Sorting techniques: Insertion Sort and Heap Sort.
12. Implementation of Sorting techniques: Merge Sort and Quick Sort.
13. Implementation of hash collision resolution techniques.

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Object Oriented Programming Lab

Course Code	CE370		Credits	2	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	0	0	4	28 hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 75 marks	0	25	0	50	0

At least 8 experiments out of below mentioned set are to be implemented inclusive of mini-project using OOP paradigm

1. Basics of C++ (input /output / control statements / array).
2. Classes and objects.
3. Constructors and Destructors.
4. Function Overloading.
5. Operator Overloading.
6. Inheritance and Polymorphism.
7. Console I/O and Files.
8. Templates.
9. Exception Handling.
10. Standard Template Library.
11. Mini project using OOP paradigm

TECHNICAL COMMUNICATION

Course Code	HM001		Credits	2	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	2	0	0	2 hrs/week	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 75 marks	0	75	0	0	0

Course Outcomes:

The student will be able to:

CO1	Demonstrate precise language skills with suitable vocabulary and apt style.
CO2	Develop life skills/interpersonal skills to progress professionally.
CO3	Apply traits of suitable candidature for a job/higher education.
CO4	Deliver formal presentations and effectively implementing the verbal and non-verbal skills.

UNIT -1	7
Communication **Oral Communication** Listening, Speaking, Reading, Writing (LSRW), Conversational Dialogues, Role Play, Barriers to Oral Communication, Effective Oral Communication, Principles of Communication, Dos and Don'ts of Group Discussion **Global Communication** Social Media, People Analytics, Models of Culture, Cross-Cultural Communication, Compare Cultures of the World, Impact of Cultural Differences on Managerial Communication, Effective Communicator in a Cross-Cultural setting	
UNIT -2	7
Personality Development Social Etiquette, Email Etiquette, Table Etiquette, Telephone Etiquette, SWOC Analysis, Life Coaching, Emotional Intelligence, Leadership, Time Management, Motivation, Goal Setting, Team Work and Collaboration, Critical Thinking and Problem Solving, Professional Attitude, Persuasion, Anxiety and Stress Management, Social Responsibility	
UNIT -3	6
Career Development Resume Building, Interviewing Skills, Job Search, Personal Networking and Branding, Personal Finance, Build Professional Portfolio	
UNIT -4	6
Public Speaking Methods to overcome anxiety, Build Confidence, Use of Media Aids, Craft an Impactful Speech, Design Impactful Presentations, Effective Presentation Delivery	

TEXTBOOKS	
1	Meenakshi Raman and Sangeeta Sharma; Technical Communication: Principles and Practice, 3rd ed; Oxford University Press
2	Meenakshi Raman, Prakash Singh; Business Communication; 2nd ed.; Oxford University Press
3	Dr. K. Alex; Soft Skills: Know Yourself and Know The World; 3rd ed; S. Chand Publishing

REFERENCES

1	Nicky Stanton; Mastering Communication; 5th ed.; Palgrave Master Series; Red Globe
	Press
2	Ghosh, B. N.; Managing Soft Skills for Personality Development; Tata McGraw Hill; 2012
3	Wallace and Masters; Personal Development for Life and Work;10thedition; Thomson Learning
4	Lehman, Dufrene, Sinha; BCOM : A South-Asian Perspective with CourseMate; 2ndedition; Cengage Learning
5	Ashraf Rizvi; Effective Technical Communication; Tata McGraw-Hill; 2005
6	MolefiKete Asante, William B. Gudykunst, Bella Mody; Handbook of International and Intercultural Communication; 2nd ed.; Sage Publications

MATHEMATICS-I& II (BRIDGE COURSE)					
Course Code	**AC390**		**Credits**	**0**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**2**	**0**	**0**	**28 hrs/sem**	
Scheme of Examination TOTAL = 0 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**0**	**0**	**0**	**0**

Course Outline:

This is an audit course.

This course is compulsory to direct second year/lateral entry students. It is introduced to reduce the knowledge gapin the students.

The syllabus is selected topics from FE110 Mathematics I and FE120 Mathematics II.

The Text books and References are same as shown in FE110 Mathematics I and FE120 Mathematics II.

SEM IV

DISCRETE MATHEMATICAL STRUCTURES					
Course Code	CE410		**Credits**	**4**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**1**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 150 marks	**25**	**25**	**100**	**0**	**0**

Course Outcomes:

The student will be able to:

CO1	Well versed with relations and its various types, including module congruencies relations, which are widely used in computer sciences.
CO2	Well versed in propositional calculus and predicate calculus. Principals of mathematical inductions and Boolean algebra.
CO3	Well versed with the various counting techniques including pigeonhole principle, generating functions and recurrence relations.
CO4	Well versed with graphs and its various types such as Eulerian, Hamiltonian graphs, trees and its applications.

UNIT -1	
Set Theory: Sets, Set Operations, Relations and their properties, Equivalence Relations, partial orderings. **Functions:** One-to-One and Onto Functions, Inverse Function, Composition of functions, some important functions in computer science. **Integers:** Integers and division (excluding applications of congruences and cryptology), primes and greatest common divisors, Integers and algorithms.	10 hrs
UNIT -2	
Propositional Calculus: Propositional logic, propositional equivalences, predicates and quantifiers, rules of inference. **Boolean Algebra:** Boolean functions, representing Boolean functions. **Mathematical Induction:** Principle of Mathematical Induction and applications.	10 hrs
UNIT -3	
Counting: The basics of counting, permutations and combinations, binomial coefficients, pigeonhole principle. **Advanced Counting Techniques:** inclusion –exclusion principle, applications of inclusion –exclusion principle, generating functions, and Recurrence relations, solving linear recurrence relations.	10 hrs
UNIT -4	
Graph theory: Graphs and graph models, graph terminology and special types of graphs, representing graphs and graph isomorphism, connectivity, Euler and Hamilton paths, shortest path problems, planar graphs, graph coloring. **Trees:** Introduction to Trees, applications of trees, tree traversal, Spanning Trees, Minimal Spanning Trees.	10 hrs

TEXTBOOKS	
1	Kenneth H. Rosen; Discrete Mathematics and Its Applications; Tata McGraw Hill (6th edition).
2	B Kolman, R.C. Busby and Sharon C. Ross; Discrete Mathematical Structures; Prentice Hall
REFERENCES	
1	J. P. Tremblay and R. Manohar, McGraw Hill; Discrete Mathematical Structures with Applications to Computer Science; New York McGraw Hill.
2	Swapan Kumar Sarkar; Discrete Mathematics; S. Chand Publication.
3	Dr. D. S. C ; Discrete Mathematical Structures; Prism Books Pvt. Ltd.
4	G.V.Kumbhojkar; Discrete Structures And Graph Theory; Pradeep Prakashan.

MICROPROCESSORS & MICROCONTROLLERS					
Course Code	CE420		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Outcomes:

The student will be able to:

CO1	To apply the assembly language programming to develop small real life embedded application.
CO2	To understand the architecture of the advanced processor thoroughly to use the resources for programming
CO3	To understand the higher processor architectures descended from 80386 architecture
CO4	To understand architecture and programming model of 8051 microcontroller with interfacing requirement

UNIT -1	
Systems Architecture- Systems Registers, Systems Instructions. **Memory Organization and Segmentation-** Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, Data Types, Registers, Instruction Format, Operand Selection, Interrupts and Exceptions Applications Instruction Set- Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and Character Transfer Instructions, Instructions for Block Structured Language, Flag Control Instructions, Coprocessor Interface Instructions, Segment Register Instructions, Miscellaneous Instructions.	10 hrs
UNIT -2	
Memory Management- Segment Translation, Page Translation, Combining Segment and Page Translation. **Protection-** Need of Protection, Overview of 80386DX Protection Mechanisms, Segment Level Protection, Page Level Protection, Combining Segment and Page Level Protection. Multitasking- Task State Segment, TSS Descriptor, Task Register, Task Gate Descriptor, Task Switching, Task Linking, Task Address Space. **Input-Output-** I/O Addressing, I/O Instructions, Protection and I/O Exceptions and Interrupts- Identifying Interrupts, Enabling and Disabling Interrupts, Priority among Simultaneous Interrupts and Exceptions, Interrupt Descriptor Table (IDT), IDT Descriptors, Interrupt Tasks and Interrupt Procedures, Error Code, and Exception Conditions.	10 hrs

UNIT -3	
Initialization- Processor State after Reset, Software Initialization for Real Address Mode, Switching to Protected Mode, Software Initialization for Protected Mode, Initialization Example, TLB Testing **Debugging-** Debugging Features of the Architecture, Debug Registers, Debug Exceptions, Breakpoint Exception **Virtual 8086 Mode-** Executing 8086 Code, Structure of V86 Stack, Entering and Leaving Virtual 8086 Mode. 80387 NDP- Control Register bits for Coprocessor support, 80387 Register Stack, Data Types, Load and Store Instructions, Trigonometric and Transcendental Instructions, Interfacing signals of 80386DX with 80387	10 hrs
UNIT -4	
Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming. Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.	10 hrs

TEXTBOOKS	
1	Brey, Barry B, ―8086/8088, 80286, 80386 and 80486 Assembly Language Programming‖, Prentice Hall, ISBN: 13: 9780023142475.
2	Mohammad Rafiquzzaman, ―Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011.
REFERENCES	
1	Microcontrollers –hardware ,architecture, programming- By Kenneth Ayala ,Second Edition
2	James Turley, ―Advanced 80386 Programming Techniques‖, McGraw-Hill, ISBN: 10: 0078813425, 13: 978-0078813429.
3	Walter A. Triebel, ―The 80386Dx Microprocessor: Hardware‖, Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
4	Muhammad Ali Mazidi, Janice Mazidi, DannyCausey -The x86 PC Assembly Language, Design and Interfacing, Fifth Edition, Pearson publications. ISBN 978-93-325-8404-4.Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630- 011, December 1995.

FORMAL LANGUAGE AND AUTOMATA THEORY					
Course Code	CE430		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Outcomes:

The student will be able to:

CO1	Identify formal language classes and explain the properties of languages, grammars and automata.
CO2	Apply the techniques to transform between equivalent deterministic and non-deterministic finite automata and regular expressions.
CO3	Design grammars and automata (recognizers) for different language classes. Perform the Simplification of automata and Context free grammars.
CO4	Explain the concepts of context-free languages, pushdown automata and Turing recognizable languages.

UNIT -1	
Introduction: Languages, Grammars and Automata. Finite Automata: Deterministic Finite Accepters, Nondeterministic Finite Accepters, Equivalence of Deterministic and Nondeterministic Finite Accepters, Reduction of the Number of States in Finite Automata.	10 hrs
UNIT -2	
Regular Languages and Regular Grammars: Regular Expressions, Connection Between Regular Expressions and Regular Languages, Regular Grammars, Closure properties of Regular languages , A Pumping Lemma for regular languages. Finite State Transducers: Mealy Machine, Moore Machine, Moore and Mealy Machine Equivalence.	10 hrs
UNIT -3	
Context-Free Languages: Examples of Context Free Languages, Leftmost and Rightmost Derivations, Derivation Trees, Parsing and Ambiguity, Methods for Transforming Context Free Grammars, Chomsky Normal Form, and GreibachNormal Form. Nondeterministic Pushdown Automata, Pushdown Automata and Context-Free Languages, Deterministic Pushdown Automata, Pumping Lemma for Context-Free Languages. Closure of Context Free languages.	10 hrs
UNIT -4	
Turing Machine: Standard Turing Machine, Combining Turing `s for Complicated Tasks, Turing's Thesis. Turing Machines with More Complex Storage. Nondeterministic Turing Machines. A Universal Turing Machine. Linear Bounded Automata. Computability and Decidability: Turing Machine Halting Problem. Unrestricted Grammars, Context-Sensitive Grammars.	10 hrs

TEXTBOOKS	
1	Peter Linz; An introduction to Formal Languages and Automata; Jones & Bartlett Learning, 2006
2	John C Martin; Introduction to languages and the theory of computation; Tata McGraw Hill, Fourth Edition, 2010.
REFERENCES	
1	John E. Hopcraft and Jeffery D. Ullman; Introduction to Automata Theory, Languages and Computation; Narosa Publishing House.
2	Michael Sipser; Introduction to Theory of Computation; PWS Publishing Company.
3	A.A Puntambekar; Formal Languages and Automata Theory; Technical Publications Pune.
4	K.L.P Mishra, N. Chandrasekaran; Theory of Computer Science – Automata, languages and Computation; PHI Publications; Third Edition ; 2008.

MODERN ALGORITHM DESIGN FOUNDATION					
Course Code	CE440		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Outcomes:

The student will be able to:

CO1	Demonstrate how the different algorithm design approaches are used to solve various classes of engineering problems.
CO2	Compute and analyze the time and space complexities of algorithms and understand their rate of growth.
CO3	Implement the algorithms with help of different data structures.
CO4	Describe the different algorithm classes P, NP, and NP-Complete, Randomized, Probabilistic, Approximation.

UNIT -1	
Introduction: Algorithm Specification, Performance Analysis, and Analyzing of algorithms: Insertion sort, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem. Divide and Conquer: General method, Binary search, Finding the min and max, Merge sort, Quick sort: Sorting by partitioning, Selection: Finding the kth smallest element, Stassen's Matrix Multiplication.	10 hrs
UNIT -2	
Greedy Method: General Method, Knapsack Problem, Minimum cost Spanning tree, Single soured shortest path. Dynamic Programming: General Method, Multistage Graphs, All pair shortest paths, Single source shortest path with general weights, Optimal Binary Search Tree, 0/1 knapsack problem, Travelling salesperson problem.	10 hrs
UNIT -3	
Backtracking: General Method, n-queens problem, Sum of subsets problem, graph colouring, Hamiltonian Cycles, 0/1 knapsack problem. Branch-and-Bound: General Method, 0/1 knapsack, Travelling salesperson problem.	10 hrs
UNIT -4	
Internet Algorithms: String and pattern matching, Tries, Text compression,Text similarity testing.NP-hard and NP-complete problems: Basic concepts,	10 hrs

Cooks theorem, Introduction: Randomized Algorithms, Probabilistic algorithms, Approximation algorithms.	

TEXTBOOKS	
1	Fundamentals of Computer Algorithms – E. Horowitz et al, 2nd Edition UP.
2	Introduction to Algorithms, 3th Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
REFERENCES	
1	Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
2	Fundamentals of Algorithmics, Gilles Brassard, Paul Bratley, PHI
3	Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4	Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley,Reading, MA.

OBJECT ORIENTED SOFTWARE ENGINEERING					
Course Code	CE450		**Credits**	**4**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**1**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 150 marks	**25**	**25**	**100**	**0**	**0**

Course Outcomes:

The student will be able to:

CO1	Specify a software system.
CO2	Create an object-oriented design for object oriented software engineering.
CO3	Implement with readable, reusable, modular, object-oriented techniques.
CO4	Test for validity, correctness and completenessand understand .software management process

UNIT -1	
Introduction to Software Engineering:Scope of software engineering- Historical aspects, Economic aspects, Maintenance aspects, Specification and design aspects, Team programming aspects. **The Software Process-** Client, Developer and User Phases of SDLC Life Cycle, Requirement phase, Specification phase, Design phase, Implementation phase Integration phase, Maintenance phase, **Software Life Cycle Models** Build and Fix Model, Waterfall, Rapid Prototyping Model, Incremental Model, Extreme Programming, Synchronize and Stabilize Model, Spiral Model, Object Oriented Life Cycle Model. **Software Metrics** Capability Maturity Model. **Estimating Duration and Cost** Metrics for size of product, Techniques for cost estimation and models, **Teams :** Team Organization Democratic Team Approach, Classical chief Programmer Team Approach, Synchronize and Stabilize Teams	10 hrs
UNIT -2	
Object Oriented Software Engineering: Object Oriented System Development, Object Oriented Terminology, Types of Cohesion, Types of Coupling, Data Encapsulation, Software re-usability, Portability, Interoperability, CASE tools in use for Object Oriented Software Engineering. **Requirement Phase:** Techniques for Requirement Elicitation and Analysis Metrics for Requirement Phase, Testing and CASE tools for Requirement Phase. **Specification Phase:** Specification Document, Metrics for Specification Phase, Testing and CASE tools for Specification Phase **Analysis Phase:** OO Analysis, Use Case Modeling, Class Modeling, Dynamic Modeling, Testing and CASE tools for Analysis Phase **Design Phase:** Action oriented Design and Abstraction, DFA, Data Oriented Design, Object Oriented Design, Testing and CASE tools for Design Phase	10 hrs
UNIT -3	
Software Quality Assurance: Quality Concepts, Quality Movement, Software Reviews, Formal Technical Reviews, Formal Approaches to SQA, Statistical	10 hrs

SQA, Software Reliability, SQA Plan **Software Testing:** Fundamentals, Test Case Designs, White Box Testing, Basic Path Testing, Control Structure Testing, Black Box Testing, Testing for specialized environment **Software Testing Strategies:** Strategic Approach to Software Testing, Strategic Issues, Unit Testing, Integration Testing, Validation Testing, Organizational approaches to testing, Software testing tools- for classical engineering and object oriented engineering Software testing standards **Object Oriented Testing**	
UNIT -4	
Software Project management: Managing software project, Project planning Process planning- Standard process, Requirement change management, Quality Planning, Risk management, Project management plan, Team structure, Communication, Team development and configuration management. Project execution, Project monitoring and control Project Closure, Performing closure analysis, Closure analysis report.	10 hrs

TEXTBOOKS	
1	Object Oriented and Classical Software Engineering- Stephen R.Schah(TMH)
2	Software Project Management in practice- Pankaj Jalote- PEA
REFERENCES	
1	Software Engineering – A practitioner's approach – by Roger S. Pressman, McGraw Hill
2	A discipline for Software Engineering – by Watts S. Humprey, Pearson Education
3	Software Engineering – by K. K. Aggarwal and Yogesh Singh, New Age Publications
4	'Ed-Kit'- Software testing in real world. Addison Wesley 1995
5	Effective methods for software testing(second edition) John-Wiley 1999
6	Software testing techniques(2nd edition) Van Nostrand Rein loud 1990
7	The art of software testing, Jon Wiley Mayers G.J.

MODERN ALGORITHM DESIGN FOUNDATION LAB					
Course Code	CE460		**Credits**	**2**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**0**	**0**	**4**	**28 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 75 marks	**0**	**25**	**0**	**50**	**0**

At least 8 experiments out of below mentioned set are to be implemented.

1. Write a program to implement binary search using divide and conquer.
2. Write a program to implement Merge Sort using divide and conquer.
3. Write a program to implement Quick Sort using divide and conquer.
4. Write a program to implement minimum cost spanning trees using greedy approach.
5. Write a program to implement single source shortest path algorithm using greedy approach.
6. Write a program to implement 0/1 knapsack problem using dynamic programming.
7. Write a program to implement OBST using dynamic programming.
8. Write a program to implement single source shortest path algorithm using dynamic programming.
9. Write a program to implement sum of subset problem using backtracking.
10. Write a program to implement graph colouring problem using backtracking.
11. Write a program to implement pattern matching algorithms
12. Write a program to implement text compression and text similarity testing.

MICROPROCESSORS & MICROCONTROLLERS LAB					
Course Code	CE460		**Credits**	**2**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**0**	**0**	**4**	**28 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 75 marks	**0**	**25**	**0**	**50**	**0**

At least 8 experiments out of below mentioned set are to be implemented inclusive of mini-project on 8051

1. Write a program which illustrates the programming constructs of higher level language in 80386 assembly coding.
2. Write a program which contains the following macros
    a. For calculating the Fibonacci series for N
    b. For entering the value of N.
    c. For displaying the numbers.
3. Write above program using procedures.
4. Write a procedure to implement the following sorting algorithms.
    a. Bubble Sort
    b. Insertion sort
    c. Selection sort.
5. Write a program to implement the following searching algorithms.
    a. Linear Search
    b. Binary Search
6. Write a procedures to implement the library routine to:
    a. Input integer number(Read integer number)
    b. Output Integer number(write Integer Number)
    c. Input string
    d. Output String
7. Write a program to make use of int 10h for the following:
    a. Sets the video mode and clears the screen
    b. Makes a window of a specific size and color
    c. Sets the cursor at a specified position within the window.
    d. Displays 10 times the character '*' at the cursor position.
8. Write a program to display 'Hello World' vertically downwards at the centre of the screen.
9. Store a password in memory. Enter another password through the keyboard and verify if it matches the stored password. The password entered should not be displayed as such , but each letter should be displayed as '*'.

Mini Project on 8051 microcontroller for Hardware implementation of any one application.

ECONOMICS FOR ENGINEERS					
Course Code	**EE 470**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Outcomes:

After the successful completion of the course, the student will be able to:

CO1	To acquire the skills to apply the basics of economics to Engineering
CO2	To evaluate the economic theories, cost concepts and pricing policies
CO3	To calculate National Income, Inflation and Price Index
CO4	To evaluate the different measures of Economic Growth & Development.

UNIT 1	
Central concepts of Economics- Definitions of Economics , Scarcity and Efficiency, Nature of Economics: Positive and normative economics, Microeconomics and Macroeconomics Basic Elements of Supply and Demand- The Demand Schedule, The Demand Curve, Market Demand , Forces behind the Demand Curve, Shifts in Demand. The Supply Schedule The Supply Curve, Forces behind the Supply Curve , Shifts in Supply. Equilibrium of Supply and Demand, Effect of a Shift in Supply or Demand. Supply and Demand: Elasticity and Applications to major economic issues **Estimation/Forecasting of Demand:** Meaning, importance, methods – trend, exponential smoothing, regression analysis	10 Hours
UNIT 2	
Microeconomics: Demand & Consumer Behaviour- Choice & Utility Theory. Production and Business Organization, Theory of Production and Marginal Products Basic Concepts, The Nature of the Firm, Big, Small, and Infinitesimal Businesses. Economic Analysis of Costs, Total Cost: Fixed and Variable. Production, Cost Theory, and Decisions of the Firm. Market structures.Perfect and imperfect competition, oligopoly, monopoly.	10 Hours
UNIT 3	
Macroeconomics: Key Concepts of Macroeconomics. Objectives and Instruments of Macroeconomics. Aggregate Supply and Demand. **National Income Terms:** -Gross Domestic Product: The Yardstick of an Economy's Performance. Real vs. Nominal GDP. Net Domestic Product, GNP, National Income, Per capita income, Disposable Income, Price Index, Inflation. Consumption and Investment- Consumption, Income, and Saving, Investment. Determinants of Investment. Monetary Policy and the Economy .Government Control of the Economy- The Tools of Government Policy	10 Hours
UNIT 4	
Economic Growth and Development: Economic Growth- The Long-Term	10 Hours

Significance of Growth, The Four Wheels of Growth. Economic Development- meaning, criteria, measures of development- Per Capita Income, Index of Human Development . Financial markets- Structure, Participants, functions. Capital market- Instruments, Players, trading - Primary and secondary market - Role of stock exchanges and stock indices. Money market	

	Textbooks
1	P.A. Samuelson & W.D. Nordhaus, Economics, 19th Edition McGraw Hill, New York, 1995.
2	A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975.
3	O.P. Khanna , Economics for Engineers,VK Global Publications Private Limited.
	References
1	Chandra P., Fundamentals of Financial Management, Tata McGraw Hill Education Private Limited, New Delhi

SEM V

DATABASE MANAGEMENT AND QUERY PROCESSING					
Course Code	**CE510**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	Understanding of the basic concepts and applications of database systems.
2	Understanding and use of data manipulation language to query, update, and manage database.
3	The ability to design and build a simple database system and demonstrate competence with the fundamental tasks involved in modeling, designing, and implementing a DBMS.
4	Familiarity with the basic issues of transaction processing and concurrency control.

Course Outcomes:

At the end of the course the student will be able to:

CE510.1	Demonstrate fundamental elements of relational database management systems and NoSQL.
CE510.2	Classify basic concept of relational data model, entity-relationship model, relational database design using normalization, relational algebra and SQL.
CE510.3	Discuss the basic issues of transaction processing and concurrency control techniques.
CE510.4	Evaluate query processing and query optimization.

UNIT -1	
Introduction: Characteristic of Database approach, advantages of using the DBMS approach, Three schema architecture, Data Models **Entity –Relationship Model: Entity –Relationship Model,** Constraints, removing redundant attribute in entity set, Entity-Relationship diagram, Reduction to relational schema, Extended-ER features. **The Relational Model:** Relational model concepts, Constraints and relational Database schema **Relational Algebra:** Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set theory, Binary Relational Operations: JOIN and DIVISION, Aggregate functions and Grouping.	(10 Hours)
UNIT -2	
Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE and UPDATE statement in SQL. **More SQL:** Complex Queries, Nested Queries, Aggregate Operators, Views, Specifying Constraints as Assertions and Actions as Triggers. **Relational Database Design:** Informal design guidelines for relational schemas, Functional dependencies, Normal forms: 1NF, 2NF, 3NF, BCNF. **Database Design Theory**: Inference rules, Equivalence and minimal cover.	(10 Hours)
UNIT -3	
Introduction to Transaction Processing: Transaction and system concepts, desirable properties of transaction, characterizing schedules based on recoverability, characterizing schedules based on serializability. **Concurrency Control Techniques:** Two phase locking technique for concurrency control, concurrency control based on timestamp ordering, Multiversion concurrency control technique, validation concurrency control technique.	(10 Hours)
UNIT -4	
Query Processing: Measures of Query Cost, Selection operation, Sorting, Join operation (Nested-Loop Join, Block Nested –Loop join, Indexed Nested-Loop Join, Merge Join), Evaluation of Expression. **Query Optimization:** Overview, Transformation of Relational Expressions. **No SQL:** Introduction to NoSQL, Types of NoSQL and advantages of NoSQL.	(10 Hours)

TEXTBOOKS	
1	Fundamental of Database systems,RamezElmasri, ShamkantB.Navathe,7th Edition Pearson,2018.
2	DatabaseSystem Concepts Abraham Silberschatz, Henry F. Korth, S. Sudarshan,6th Edition,MC Graw HillI,2013
3	NOSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pramod J.Sadalage, Martin Fowler.,4th Edition,Pearson,2014
REFERENCES	
1	Database Management Systems, Raghu Ramkrishnan, Johannes Gehrke,3rd Edition McGraw-Hill,2002

OPERATING SYSTEMS					
Course Code	**CE520**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	A comprehensive understanding of the underlying principles, techniques and approaches in operating systems.
2	An understanding of operating system mechanisms like process management, threads, CPU scheduling and synchronization.
3	Knowledge on operating system mechanisms like memory management, file system, storage subsystem and input/output management.
4	Necessary skills required for Shell Programming.

Course Outcomes:

At the end of the course the student will be able to:

CE520.1	Illustrate the fundamental concepts of process and thread management and describe and analyze the performance of CPU scheduling algorithms.
CE520.2	Identify process synchronization mechanisms and deadlock detection techniques.
CE520.3	Discuss memory management techniques, secondary storage structures, file systems and I/O systems.
CE520.4	Apply various UNIX commands and write shell scripts for simple applications on a standard UNIX/LINUX operating system.

UNIT -1	
Introduction to Operating Systems: Abstract view of a Computer System, What Operating Systems do, Computer System Architecture, Operating System Structure, Operating System Services, System calls, Types of System calls. **Process management**: Processes concept, Process scheduling, Operations on processes, Inter-process communication. **Threads:** Overview, Multithreading models, Threading issues. **CPU Scheduling**: Basic Concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF / SRTN, Priority Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling, Multiprocessor Scheduling, Real Time Scheduling: RM, EDF	(10 Hours)
UNIT -2	
Process Synchronization: Critical Section Problem, Petersons solution, Synchronization hardware support, Mutex locks, Semaphores, Classical problems of synchronization using semaphores (Producer – Consumer problem, Readers – Writers problem, Dining philosophers Problem), Monitors (Dining philosophers Problem). **Deadlocks:** System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.	(10 Hours)
UNIT -3	
Memory Management: Background, Swapping, Contiguous allocation, Segmentation, Paging, Structure of the page table **Virtual Memory:** Demand Paging, Page replacement algorithms (FIFO, Optimal page replacement, Least Recently used), Allocation of frames, Thrashing. **File System Interface:** File Concept, Access methods, Directory and Disk Structure. **File system implementation:** File system structure, Implementation, Directory implementation, Allocation methods	(10 Hours)
UNIT -4	
I/O Systems: I/O Hardware, Application I/O Interface, Kernel I/O subsystem. **Secondary Storage structure:** Disk structure and attachment, Disk scheduling, Disk management **Linux Commands:** Basic Linux commands, Essential Shell Programming.	(10 Hours)

TEXTBOOKS	
1	Operating System Concepts; Abraham Silberschatz, Peter Baer Galvin, Greg Gagne; 9th Edition; Wiley; 2018.
2	UNIX – Concepts and applications; Sumitabha Das; 4th edition; McGraw Hill Education; 2017.
REFERENCES	
1	Operating systems- Internals and design principles; William Stallings; 9th edition; Pearson, 2018
2	Operating systems- Design and implementation; A.S Tanenbaum, Albert Woodhull; 3rd edition; Pearson; 2015
3	Operating Systems, Milan Milenkovic; 2nd edition, Tata McGraw Hill; 2001
4	The Linux Command Line: A Complete Introduction; William E. Shotts, Jr; 2nd edition; No Starch Press; 2019

GRAPH THEORY					
Course Code	**CE531**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	Understanding of the structure of graphs.
2	Understanding and knowledge of application of the fundamental concepts in graph theory.
3	Use of graph theory-based tools in solving practical problems.
4	Ability to understand the specific proof techniques to prove results in graph theory.

Course Outcomes:

At the end of the course the student will be able to:

CE531.1	Identify induced subgraphs, cliques, matchings, covers in graphs and determine whether graphs are Hamiltonian and /or Eulerian.
CE531.2	To formulate and prove central theorems about trees, matching, connectivity, coloring and planar graphs.
CE531.3	To Describe and apply some basic algorithms for graphs.
CE531.4	To justify graph theory as a modeling tool.

UNIT -1	
Basic graph theory Concepts: Graphs, isomorphism, subgraphs, matrix representation, degree sequence. Bipartite graphs, line graphs, chordal graphs. **Trees**: Characterization, number of trees, Minimum spanning trees.	(10 Hours)
UNIT -2	
Connected Graphs and Shortest Paths: Walks, trails, paths, connected graphs, distance, Eulerian and Hamiltonian graphs, cut vertices, cut edges, blocks, weighted graphs, shortest paths algorithms, Dijkstra's and Floyd Warshall algorithms	(10 Hours)
UNIT -3	
Independent sets, coverings and matchings: Basic equations, matching in bipartite graphs, perfect matching, greedy and approximation algorithms. **Vertex Colouring:** Chromatic number and cliques, Greedy colouring algorithms.	(10 Hours)

UNIT -4	
Directed Graphs: Directed Graphs, underlying Graphs, out degree, in degree, connectivity, orientation, Eulerian directed graphs, Hamiltonian directed graphs, tournaments	(10 Hours)

TEXTBOOKS	
1	Graph theory with applications, J.A. Bondy and U.S.R.Murthy, Edition 2, 1977
2	Introduction to graph theory, D.B.West, Cambridge University Press, Edition 2.
REFERENCES	
1	Graph theory, R.Diestel, Springer, Elsevier Science Publishing.

NEURAL NETWORKS					
Course Code	**CE532**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	The basic concepts and techniques of Neural Network and different types of learning.
2	An ability to understand the function of Single layer and Multilayer Perceptron.
3	An ability to understand the working and limitation of Back Propagation.
4	Understanding of Self-Organization Maps (SOM) in Artificial Neural Network

Course Outcomes:

At the end of the course the student will be able to:

CE532.1	Discuss the basic concept and techniques of Neural Networks.
CE532.2	Demonstrate working of single layer and multilayer perceptron.
CE532.3	Illustrate working of Back Propagation and Supervised Learning.
CE532.4	Identify the feature mapping models, SOM.

UNIT -1	
Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks **Learning Process:** Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process.	(10 Hours)
UNIT -2	
Single Layer Perceptron: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment **Multilayer Perceptron:** Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection.	(10 Hours)

UNIT -3	
Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning.	(10 Hours)
UNIT -4	
Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification.	(10 Hours)

TEXTBOOKS	
1	Neural Networks A Comprehensive Foundations, Simon Haykin,2nd Edition,PHI,1997.
REFERENCES	
1	Neural Networks, Fuzzy system and Evolutionary Algorithms Synthesis and applications S.Rajasekaran, G.A.Vijayalaxshmi Pai,2nd Edition,PHI,2017.
2	Neural Networks: Satish Kumar A classroom approach ,2nd Edition,MGH,2004
3	Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed., 2006.
4	Artificial Neural Networks - B. Yegnanarayana, 12th edition,Prentice Hall of India P Ltd,2005

OBJECT ORIENTED PROGRAMMING USING JAVA					
Course Code	**CE533**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	An understanding of the basic features of Java language like data types, operators, control statements and classes.
2	An ability to apply Java programming paradigms like interfaces, packages, file handling, exception handling and multi-threaded programming.
3	An understanding of the use of Event driven Graphics programming in Java.
4	An understanding of JDBC and Networking concepts.

Course Outcomes:

At the end of the course the student will be able to:

CE533.1	Explain, develop and test programs using basic features of Java like classes, inheritance,arrays, strings and vectors.
CE533.2	Illustrate Java concepts like packages, interfaces, file handling, multithreading and Illustrate the use of exception handling for run-time error management.
CE533.3	Develop GUI based Java applications.
CE533.4	Demonstrate database connectivity and networking in Java.

UNIT -1	
Introduction to Java: Java Buzzwords, Bytecode, Java environment, Overview of Java Language, Constants, Variables and Data Types, Operators and Expressions, Decision Making and Branching, Decision Making and Looping, Classes, Objects, Methods, Inheritance, Arrays, Strings, Vectors.	(10 Hours)
UNIT -2	
Interfaces: Introduction, Defining, extending and implementing Interfaces, Accessing interface variables. **Packages:** Introduction, Java API packages, using system packages, naming conventions, creating, accessing and using a package, adding a class to a package, hiding classes, static import. **Multithreaded Programming:** Introduction, Creating Threads, Extending the Thread class, Stopping and Blocking Threads, Life Cycle, Thread methods, Thread Exceptions, Priority and Synchronization, Implementing the runnable interface, inter-thread communication.	(10 Hours)
Managing Errors and Exceptions: Introduction, Types of Errors and Exceptions, Exception handling, Multiple catch statements, finally, Throwing our own Exceptions, Improved exception handling, Using exceptions for debugging. **Managing Input/ Output Files in Java:** Introduction, Streams, Stream classes, Byte Stream and Character Stream classes, Using Streams, other useful I/O Classes, File Class, Input/Output Exceptions, Creation of Files, Reading/Writing Characters, Bytes and Primitive Types, Concatenating and Buffering Files, Random Access Files, Interactive I/O.	
UNIT -3	
Java Collections: Introduction, Overview of Interfaces, Classes and Algorithms. **Applet Programming:** Introduction, how applets differ from applications, building applet code, applet life cycle, creating an executable applet, Applet tag, adding an applet to a HTML file, running applets, passing parameters, aligning the display, displaying numerical values, getting input form the user. **AWT:**AWT classes, Windows fundamentals, Working with Frame Windows,Introducing Graphics, Working with Color, Setting the Paint mode, Working with Fonts, Managing text output using FontMetrics, AWT Controls, Layout Managers. **Event Handling:** Two event handling mechanisms, The delegation event model, Event classes, Sources of events, Event listener interfaces, Using the delegation event model, Adapter classes, Inner classes.	(10 Hours)

UNIT -4	
JavaFX: JavaFX Basic Concepts, A JavaFX Application Skeleton, Compiling and Running a JavaFX Program, The Application Thread, A Simple JavaFX Control: Label, Using Buttons and Events, Drawing Directly on a Canvas, Using Image and ImageView, ToggleButton, RadioButton, CheckBox, ListView, ComboBox, TextField, ScrollPane, TreeView, Introducing Effects and Transforms, Adding Tooltips, Disabling a Control. **JDBC:** Introduction, Setting up, Connecting to and Querying a database, RowSet Interface,PreparedStatements,Stored Procedures,Transaction Processing. **Networking:** Networking Basics, The Networking Classes and Interfaces, InetAddress, Inet4Address and Inet6Address, TCP/IP Client Sockets, URL, URLConnection, HttpURLConnection, The URI Class, Cookies, TCP/IP Server Sockets, Datagrams.	(10 Hours)

TEXTBOOKS	
1	Programming with Java, E.Balagurusamy, 6th edition, McGraw Hill, 2019.
2	Java -The Complete Reference, Herbert Schildt,10th edition, Tata McGraw Hill, 2017.
3	Java-How to Program (Early Objects), Paul J. Deitel and Harvey Deitel, 11th Edition, Pearson Education, 2018.
REFERENCES	
1	Introduction to Java Programming (Comprehensive version),Y. Daniel Liang, 10th edition, Pearson Education, 2015.
2	Core Java: Volume II–Advanced Features,Cay S. Horstmann and Gary Cornell, 9th edition,Pearson, 2013.

DISTRIBUTED OPERATING SYSTEMS					
Course Code	**CE534**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	An introduction to the basic concepts upon which distributed systems at large and distributed operating systems in particular rely.
2	An understanding of the design issues, design problems, solutions and performance issues.
3	An understanding of the principles underlying the functioning of distributed systems
4	An ability to implement typical algorithms used in distributed systems

Course Outcomes:

At the end of the course the student will be able to:

CE534.1	Illustrate and explain the core concepts of process management, communication, synchronization, and file management in distributed systems.
CE534.2	Assess the desired properties and design issues of a distributed system and the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
CE534.3	List the principles underlying the functioning of distributed systems.
CE534.4	Describe the problems and challenges associated with these principles, and evaluate the effectiveness and shortcomings of their solutions.

UNIT -1	
Introduction to distributed operating systems: What is a distributed system? Goals, Hardware Concepts, Software Concepts, Design Issues **Communication in distributed systems:** Layered Protocols, The Client-Server Model, Remote Procedure Call, Group Communication	(10 Hours)
UNIT -2	
Synchronization in Distributed Systems: Clock Synchronization, Mutual Exclusion, Election Algorithms, Atomic Transactions, Deadlocks in Distributed Systems **Processes and Processors in Distributed Systems:** Threads, System Models	(10 Hours)

UNIT -3	
Processes and Processors in Distributed Systems: Processor Allocation, Scheduling in Distributed Systems, Fault Tolerance **Distributed File Systems:** Distributed File System Design, Distributed File System Implementation	(10 Hours)
UNIT -4	
AMOEBA: Introduction to Amoeba, Objects and capabilities, Process management, Memory management, Communication **MACH**: Introduction to Mach, Process management **Distributed Computing Environment:** Introduction, Threads, RPC, Time Service	(10 Hours)

TEXTBOOKS	
1	Distributed Operating Systems; A.S. Tanenbaum; Edition 1; Pearson Education; 2002
REFERENCES	
1	Distributed Systems: Concepts and Design; G. Coulouris, J. Dollimore and T. Kingberg , G. Blair; 5th Edition; Pearson; 2012
2	Advanced Concepts in Operating Systems; M. Singhal and N. G. Shivaratri; TMH; 2017
3	Distributed Systems: Principles and Paradigms; S. Tanenbaum, Maarten Van Steen; 2nd Edition; PHI; 2006
4	Distributed Systems and Networks; William Buchanan; TMH; 2004

MODERN COMPUTER GRAPHICS					
Course Code	**CE541**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	Knowledge about computer graphic hardware and software used.
2	Understanding of 2D and 3D graphics, and their transformations.
3	Ability to appreciate the use of colour models.
4	Understanding of the methodsused in modelling the motion in the virtual world.

Course Outcomes:

At the end of the course the student will be able to:

CE541.1	Identify and Apply various graphics primitives to generate computer graphics.
CE541.2	Illustrate and apply techniques of 2D transformations and clipping used in various graphic applications.
CE541.3	Explain the basics of 3D Graphics, 3D transformations and represent curves along with their properties.
CE541.4	Discuss the techniques of surface detection, color models and design of an animation sequence.

UNIT -1	
Overview of graphic systems: Raster scans systems, Random scan systems. **Output Primitives**: Points and lines, Line drawing algorithms, DDA, Bresenham's line algorithm, Circle generating algorithms, Properties of circles, Midpoint circle algorithm, Ellipse generating algorithm, Properties of Ellipses, Midpoint ellipse algorithm. **Filled area primitives**: Scan line polygon Fill algorithm, Inside – outside tests, Scan line fill of curved boundary, Boundary fill algorithm, Flood fill algorithm, Fill area functions.	(10 Hours)
UNIT -2	
Two Dimensional Geometric Transformations: Basic Transformations, Translation, Rotation, Scaling, Composite transformation, Translations, Rotations, Scaling, Other transformations- Reflection, Shear. **Two-Dimensional Viewing**: The viewing pipeline, Viewing coordinate reference frame, Window to viewport coordinate transformation, 2-D viewing functions. **Clipping operations**: Point Clipping, Line clipping, Cohen- Sutherland Line Clipping, Polygon Clipping, Sutherland Hodgeman Polygon clipping, Weiler-Atherton Polygon Clipping, Curve clipping, Text clipping.	(10 Hours)

UNIT -3	
Three Dimensional Concepts: 3-Dimensional display methods, Parallel projections Perspective projection, Depth cueing, Surface rendering, Exploded and cutaway views. Three-Dimensional Object representations- Polygon surfaces, Polygon tables. **Three Dimensional Geometric and Modeling transformations:** Translation Rotation, Coordinate Axes, rotations, Scaling, Reflections, Shears Three-Dimensional Viewing, **Curves and Surfaces**: Shape Description Requirements, Parametric Functions, Bezier Methods. B-Spline Methods.	(10 Hours)
UNIT -4	
Visible – surface detection algorithms: Back – Face detection, Depth buffer method, A – Buffer method, Scan – Line method, Depth Sorting method, BSP- Tree method, Area Sub-division method. **Color Models and Color Applications**: Properties of light, Standard primaries and the, Chromaticity Diagram, XYZ Color model, CIE Chromaticity Diagram, RGB color model, YIQ Color Model, CMY Color Model, HSV Color Model, HLS Color Model. **Computer Animation**: Design of animation sequences, General computer animation functions, Raster Animations, Computer animation languages, Motion specification, Direct motion specification, Goal directed systems Kinematics and dynamics.	(10 Hours)

TEXTBOOKS	
1	Computer Graphics; Donald Hearn and M. P. Baker; Second Edition; Prentice Hall of India Pvt. Ltd. 1999
2	Principles of Interactive Graphics; William Newman and Robert Sproull; Second Edition; Tata McGraw hill Publishing company Ltd.1979
REFERENCES	
1	Introduction to Computer Graphics; N. Krishnamurthy; Tata McGraw Hill.
2	Computer Graphics; Steven Harrington; Second Edition; Tata McGraw Hill.
3	Computer Graphics: Principles and Practice.Foley, Van Dam, Feiner and Hughe; Second Edition;Addison- Wesley Publishing Company 1997

WEB-TECHNOLOGIES					
Course Code	**CE542**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	An insight of how the world wide web works.
2	Illustration of the implementation of various client-side technologies like html,html5, JavaScript and CSS.
3	Design of data using XML and JSON.
4	The implementation aspects of server-side technologies like PHP and MySQL.

Course Outcomes:

At the end of the course the student will be able to:

CE542.1	Discuss the basics of the internet and the related underlying protocols involved in web development.
CE542.2	Explain, design and transform data using XML and JSON.
CE542.3	Design static web pages using HTML and Cascading Style Sheet
CE542.4	Test dynamic websites using JavaScript, PHP and MySQL.

UNIT -1	
Introduction to Web Technologies: History of the Web, Understanding Web System Architecture, understanding 3-Tier Web Architecture, Web browsers, Overview of HTTP, Using Cookies to Remember User Information, Exploring Web Technologies. **HTML**: HTML, Introducing HTML Document structure, Creating Headings on a web page, Working with Links, creating a paragraph, working with images, working with tables, Introduction to Forms and HTML Controls. **Overview of HTML5:**Exploring new features of HTML5: new elements, attributes, support, CSS enhancements **Cascading Style Sheets:** Coding CSS, Properties of Tags, Property Values, In-Line Style Properties, Embedded Style Sheets, External Style Sheets, Grouping, Class as Selector, ID as Selector, ContextualSelectors, Positioning, Backgrounds, Element Dimensions.	(10 Hours)

UNIT -2	
Extensible Mark-Up Language (XML): Introduction, HTML vs XML, Syntax of XML Document, XML Attributes **JSON:** Basics of JSON, JSON syntax, JSON data types,JSON schemas,The JavaScript XmlHttpRequest and Web APIs: Web APIs,The JavaScript XMLHttpRequest. **JSON, Client-side frameworks, JSON on the server side:** Serializing, Deserializing and Requesting JSON:PHP.	(10 Hours)
UNIT -3	
Overview of JavaScript: Exploring features of Javascript, Using Javascript in HTML document, exploring programming fundamentals of JavaScript, using: an external javascript file, variables, operators, if statement, if…else statement, switch statement, while loop, do while loop, for loop, break statement, continue statement, alert box, confirm box, prompt box. **Javascript Functions,events**: Working with functions, working with events: onclick, onload, mouse,onreset, onsubmit. **Javascript objects**: Working with the String object, working with the Number object, working with the Array object, Working with the Math object. **Validation &Errors:** Introducing Form validation,Exploring errors in javascript,Validating forms.	(10 Hours)
UNIT -4	
Introducing PHP: Versions of PHP, Features of PHP, Advantages of PHP over other scripting languages, creating a PHP Script, running a PHP Script, Handling Errors in a PHP Script. **Working with variables and constants:** Using variables, using constants, exploring data types in PHP, Exploring operators in PHP. **Controlling Program Flow**: Conditional Statements, Looping Statement, Break, Continue and Exit Statements. **Working with Functions,Arrays,Files** : User-Defined Functions in PHP, Built-in functions in PHP, Recursive, Variable and call-back Functions, Introducing Arrays, Types of Arrays, Traversing Arrays using Loops and Array Iterators, Built-in Array Functions, Working with Files. **Working with Forms and databases**: working with the Form Tag and Form Elements, processing a Web Form, validating a Form, Using Php and Mysql. **Exploring sessions in PHP:** Working with Sessions.	(10 Hours)

TEXTBOOKS	
1	N. P. Gopalan and J. Akhilandeswari; Web Technology: A Developer's Perspective; PHI; ISBN: 978-81-203-5006-9
2	DT Editorial Services; Web Technologies Black Book;dreamtechpress; ISBN: 9788177229974
3	Kogent Learning Solutions; HTML5 Black Book; dreamtechpress; ISBN: 978-93-5004-095-9
4	Lindsay Bassett; Introduction to JavaScript Object Notation;O'Reilly Media; ISBN: 978-1-491-92948-3
REFERENCES	
1	Smith, Ben;Beginning JSON;Apress; ISBN 978-1-4842-0202-9

TESTING AND QUALITY ASSURANCE					
Course Code	**CE543**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	An understanding of the importance for software systems to meet people's expectations for quality and reliability.
2	An understanding that software testing is the primary means to ensure software quality.
3	The ability to plan and prepare other alternatives for quality assurance, including defect prevention, process improvement, inspection, fault tolerance, safety assurance, and damage control.
4	The ability to measure and analyze to close the feedback loop for quality assessment and quantifiable improvement.

Course Outcomes:

At the end of the course the student will be able to:

CE543.1	Explain quantitative, technical, and practical methods to assure software quality.
CE543.2	Apply different testing approaches to all stages of software development.
CE543.3	Illustrate quality assurance techniques other than testing.
CE543.4	Describe the different types of testing tools available and identify the appropriate types of tools for their needs.

UNIT -1	
Software Quality: Quality perspective and expectations, Quality framework and ISO 9126, Correctness and defects. **Quality Assurance:** Classification, Defect prevention, Defect reduction, Defect containment. **Quality Assurance in context:** Handling discovered defects during QA activities, QA activities in software processes, Verification and validation perspective. **Software Quality Assurance – an overview:** Quality Management Systems: ISO 9000 series standards, Capability Maturity Model Integration for software engineering.	(10 hours)

UNIT -2	
Quality Engineering: Activities & Process, Quality planning, Quality assessment & improvement. **Testing:** Purposes, activities, process and context; questions about testing, Functional v/s structural testing, Coverage based vs. usage-based testing. **Test Activities, Management, and Automation:** Test planning and preparation; Test execution, result checking and measurement; Analysis and follow up; Activities, people, and management. **Coverage and usage testing based on checklists and partitions:** Checklist based testing and limitations. Testing for partition coverage, Usage-based statistical testing with Musa's operational profiles.	(10 hours)
UNIT - 3	
Input domain partitioning and Boundary testing: Input domain partitioning and testing, simple domain analysis and extreme point combination strategies, testing strategies based on boundary analysis. **Control Flow, Data dependency, and Interaction Testing:** Basic Control flow testing, Data Dependency and data flow testing. **Defect prevention and process improvement:** Basic concepts and generic approaches, Root cause analysis for defect prevention, Education and Training for defect prevention, Defect prevention techniques. **Software Inspection:** Basic Concepts and Generic Process; Fagan Inspection; Other Inspections and related activities; Defect detection techniques, Tool/Process Support, and Effectiveness.	(10 hours)
UNIT - 4	
Fault tolerance and Failure Containment: Basic ideas and concepts, fault tolerance with recovery blocks, fault tolerance with N-Version Programming, Failure Containment. **Comparing Quality Assurance techniques and activities:** General questions: Cost, Benefit, and Environment; Applicability to different environments; Effectiveness comparison; Cost Comparison. **Risk Identification for quantifiable quality improvement:** Basic ideas and concepts, traditional statistical analysis techniques. **Software testing tools - an overview:** Need for automated testing tools, Taxonomy of testing tools, Functional/Regression testing tools, Performance testing tools, Testing management tools, Source code testing tools, Selection of testing tools.	(10 hours)

TEXTBOOKS	
1	Software Quality Engineering – Testing, Quality Assurance and Quantifiable Improvement, Jeff Tian, Wiley, 2006.
2	Software Testing Tools, Dr. K.V.K.K Prasad, Dreamtech Press, 2007.
REFERENCES	
1	Software Testing - Principles and Practices, Naresh Chauhan, 2nd Edition, Oxford University Press, 2018.
2	Introduction to Software Testing, Paul Ammann and Jeff Offutt, 2nd Edition, Cambridge University Press, 2016.

REAL TIME SYSTEMS					
Course Code	**CE544**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	An introduction to the concepts and approaches in real-time systems.
2	An understanding of issues related to the design and analysis of systems with real-time constraints.
3	An ability to analyze the commonly used approaches to real time scheduling.
4	Anunderstanding of resource access control in real time systems.

Course Outcomes:

At the end of the course the student will be able to:

CE544.1	Understand the fundamental principles of real time systems with time and resource limitations.
CE544.2	Demonstrate the reference model of real time systems.
CE544.3	Formulate real time scheduling and compare the schedulability analysis on uniprocessor systems.
CE544.4	Illustrate the real time system model on multiprocessor and distributed systems.

UNIT - 1	
Introduction: Issues in Real Time Computing, Structure of a Real Time system, Task Classes **Hard Versus Soft Real-Time Systems:** Jobs and Processors, Release Times, Deadlines and Timing Constraints, Hard and Soft Timing Constraints, Hard Real Time systems, Soft Real Time Systems **A Reference Model of Real Time Systems:** Processors and Resources, Temporal Parameters of Real –Time Workload, Period Task Model, Precedence Constraints and Data Dependency, Other Types of Dependencies, Functional Parameters, Resource Parameters of Jobs and Parameters of Resources, Scheduling Hierarchy **Characterizing Real- Time systems and Task:** Introduction, Performance Measures for Real-Time Systems, Estimating Program Run Times.	(10 hours)
UNIT - 2	
Clock Driven Scheduling: Notation and Assumptions, Static Timer-Driven Scheduler, General Structure of Cyclic Schedules, Cyclic Executives,	(10 hours)

Improving the Average Response time of Aperiodic Jobs: Slack Stealing, Scheduling Sporadic jobs, Practical considerations and Generalizations, Pros and Cons of Clock Driven Scheduling **Priority Driven Scheduling of Periodic Tasks:** Static Assumptions, Fixed priority versus Dynamic Priority Algorithms, Maximum Schedulable Utilizations: Schedulability Test for the EDF Algorithm, Optimality of RM and DM algorithms, A schedulability test for Fixed Priority Tasks with Short Response times, Schedulability test for Fixed Priority Tasks with Arbitrary Response times: Busy Interval, General Schedulability Test, Sufficient Schedulability conditions for the RM and DM algorithms : Schedulability utilization of RM Algorithm for tasks with Di=Pi.	
UNIT - 3	
Scheduling Aperiodic and Sporadic Jobs in Priority Driven Systems: Assumptions and Approaches, Deferrable Servers, Sporadic servers, Constant Utilization, Total Bandwidth and Weighted Fair Queuing Servers, Scheduling of Sporadic jobs. **Resource and Resource Access Control**: Assumptions on Resources and their usage, Effects of Resource Contention and Resource Access Control, Non-preemtive Critical Sections, Basic Priority Inheritance Protocol, Basic Priority Ceiling protocol	(10 hours)
UNIT - 4	
Task Assignment and Scheduling: Task Assignment, Mode Changes **Multiprocessor Scheduling, Resource Access control and Synchronization:** Model of Multiprocessor and Distributed systems, Task assignment, Multiprocessor priority ceiling protocol, Elements of Scheduling Algorithms for End to End Periodic tasks, End to End tasks in heterogeneous systems.	(10 hours)

TEXTBOOKS	
1	Real-Time Systems; Jane W. S. Liu; 1st Edition; Pearson Education; 2002
2	Real-Time Systems; C. M. Krishna and K. G. Shin; 1st Edition; TMH; 2017
REFERENCES	
1	Real Time Systems Development; Rob Williams; 1st Edition; Butterworth-Heinemann; 2005
2	Real-Time Systems and Programming Languages; Alan Burns, Andy Wellings; 4th Edition; Addison Wesley; 2009
3	Real-Time Systems Design and Analysis; P. A. Laplante, S. J. Ovaska; 4th Edition; Wiley; 2011

DATABASE MANAGEMENT AND QUERY PROCESSING LAB					
Course Code	**CE550**		**Credits**	**2**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**0**	**0**	**2**	**20 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**0**	**25**	**0**	**50**	**0**

Course Objectives:

The subject aims to provide the student with

1	Understanding of fundamental database concepts and the underlying concepts of database Technology.
2	Strong practice in SQL programming through a variety of database problems.
3	Ability to declare and enforce integrity constraints on a database
4	Ability to develop database applications using front-end tools and back-end DBMS.

Course Outcomes:

At the end of the course the student will be able to:

CE550.1	Apply the basics of SQL and construct queries using SQL in database creation and interaction.
CE550.2	Formulate nested queries and subqueries.
CE550.3	Implement the various types of joins.
CE550.4	Design and test GUI application.

List of Experiments

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Study of various Data Definition Language Statements.
2. Study of various Data Manipulation language Statements.
3. Study of various SELECT command with different clauses.
4. Study of various Set, GROUP BY functions(avg,count,max,min,sum)
5. Study of various nested Queries and Subqueries.
6. Study of various type of SET OPERATORS (Union, Intersect, Minus).
7. Study of SQL queries using logical operations and operators.
8. Study and implement various types of Joins
9. Study and implement queries to create VIEWS and TRIGGERS.
10. Mini project: Develop application with front end and backend connection.

TEXTBOOKS

1	Fundamental of Database systems RamezElmasri, ShamkantB.Navathe ,7th Edition Pearson,2018.
2	Database System ConceptsAbrahamSilberschatz, Henry F. Korth, S. Sudarshan ,6th

3	Edition,MC Graw HillI,2013 NOSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pramod J.Sadalage, Martin Fowler.,4th Edition,Pearson,2014
REFERENCES	
1	Database Management Systems, Raghu Ramkrishnan, Johannes Gehrke ,3rd Edition McGraw-Hill,2002.

OPERATING SYSTEMS LAB					
Course Code	**CE560**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**0**	**0**	**2**	**20 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**0**	**25**	**0**	**50**	**0**

Course Objectives:

The subject aims to provide the student with

1	A comprehensive understanding of the underlying principles, techniques and approaches which constitute a coherent body of knowledge in operating systems.
2	An understanding of operating system mechanisms like process management, threads, CPU scheduling and synchronization.
3	Knowledge of operating system mechanisms like memory management, file system, storage subsystem and input/output management.
4	Necessary skills required for Shell Programming.

Course Outcomes:

At the end of the course the student will be able to:

CE560.1	Explain, devise and test/Write programs for process and thread management using system calls.
CE560.2	Demonstrate/Implement CPU scheduling algorithms.
CE560.3	Illustrate and assess/ Implement process synchronization mechanisms, deadlock avoidance techniques and memory management techniques.
CE560.4	Explain, devise and test/Write shell scripts for simple applications and execute various UNIX commands on a standard UNIX/LINUX operating system.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Process creation using system calls
2. Non preemptive CPU scheduling algorithms
3. Preemptive CPU scheduling algorithms
4. Implementation of threads
5. Process synchronization using semaphores
6. Implementation of deadlock avoidance scheme
7. Paging/ Segmentation
8. Page replacement methods
9. Disk scheduling algorithms
10. Linux commands
11. Shell scripting

TEXTBOOKS	
1	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne; Operating System Concepts; 9th Edition.
2	Sumitabha Das; UNIX – Concepts and applications;4th edition
REFERENCES	
1	William Stallings; Operating systems internals and design principles;7th edition
2	A.S Tanenbaum; Operating systems, Design and implementation;3rd edition
3	Milenkovic; Operating Systems,2nd edition
4	William E. Shotts, Jr; The Linux Command Line: A Complete Introduction;3rd edition

CYBER LAW AND IPR					
Course Code	**HM300**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**TH**	**IA**	**TW**	**P**	**O**
	100	**25**	**0**	**0**	**0**

Course Objectives:

The subject aims to provide the student with**:**

1.	To introduce emerging Cyberlaws, Cybercrime & Cyber security trends and jurisprudence impacting cyberspace in today's scenario.
2.	To understand the concept of Copyright Protection and Digital Certificates.
3.	To provide fundamental aspects of Intellectual Property Rights.
4.	To disseminate knowledge on Patents, Copyrights and Trademarks.

Course Outcomes:

At the end of the course the student will be able to:

HM300.1	Describe Cyber Crime and understand jurisdictional aspects of cyber law.
HM300.2	Classify the types of contract law, digital signature and related legal issues.
HM300.3	Explain the need for various Intellectual Property Rights.
HM300.4	Identify Intellectual Property Rights for the concepts developed

UNIT -1	
Power of Arrest without Warrant under the IT Act, 2000: A Critique: Section 80 of the IT Act 2000, Forgetting the line between Cognizable and Non-Cognizable Offences, Necessity of Arrest without warrant from any place, public or otherwise. **Cyber Crime and Criminal Justice**: Concept of Cyber Crime and the IT Act 2000, Hacking, Teenage web vandals, Cyber fraud and cyber cheating, Virus on the Internet. Defamation, harassment and E-mail abuse, Monetary penalties, adjudication and appeals under IT Act 2000, Nature of cyber criminality, strategies to tackle Cyber Crime and trends, Criminal justice in India and Implications on Cyber Crime. **Contracts in the InfoTech World**: Contracts in the InfoTech world, Click-wrap and Shrink-wrap contracts, Contract formation under the Indian Contract Act 1872, Contract formation on the Internet, Terms and Conditions of Contracts, Software product license. **Jurisdiction in the Cyber World**: Civil law of Jurisdiction in India, Cause of action, Jurisdiction and the Information Technology Act 2000.	**10hrs**

UNIT -2	
Battling Cyber Squatters and Copyright Protection in the Cyber World: Concept of Domain name and reply to Cyber Squatters, Battle between freedom and control on the internet, Works in which copyright subsists and meaning of copyright, Downloading for	**10hrs**
Viewing Content on the Internet, Hyper-linking and Framing, Liability of ISPs for Copyright violation in Cyber World: Legal Developments in the US, Napster and its Cousins, Computer Software Piracy. **Digital signatures, Certifying Authorities and E-Governance:** Digital signatures, Digital Signature Certificate, Certifying Authorities and Liability in the Event of Digital Signature Compromise, E-Governance in India. **The Indian Evidence Act of 1872 v/s Information Technology Act, 2000:** Status of Electronic Records as Evidence, Proof and Management of Electronic Records, Proving Digital Signature, Proof of Electronic Agreements, Proving Electronic Messages, Other Amendments in the Indian Evidence Act by the IT Act.	
UNIT – 3	
Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention1952, the WIPO Convention1967,the Patent Co-operation Treaty 1970, the TRIPS Agreement, 1994. **Patents - Elements of Patentability:** Novelty, Non-Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board.	**10hrs**
UNIT – 4	
Copyright: Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights. **Trademarks: Concept of Trademarks -** Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non-Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board.	**10hrs**

TEXTBOOKS	
1	Cyber Law Simplified, VivekSood, Tata McGraw-Hill, ISBN 0-07-043506-5.
2	Intellectual Property Rights: Protection and Management. India, Nithyananda K V., Cengage Learning India Private Limited (2019)
3	Intellectual Property Rights. India, Neeraj P. &Khusdeep,D. PHI learning Private Limited (2014)

REFERENCES	
1	Law relating to Intellectual Property Rights. India, Ahuja V K., Lexis Nexis. (2017)
2	Intellectual property right - Unleashing the knowledge economy, PrabuddhaGanguli, Tata McGraw Hill publishing Company Ltd(2001)
3	Law Relating to Intellectual Property, B.LWadhera, Fifth Edition (2011, Reprint)

SEM VI

MODERN COMPUTER NETWORKING					
Course Code	**CE610**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40hrs/Sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TH**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	To provide an introduction to basic concepts of communication and Networks.
2	To provide detailed knowledge on the principles of Data Communications andNetwork Architectures.
3	To give good understanding of the internetworking concepts.
4	To provide detailed understanding of the techniques used to communicatebetween independent host computers.

Course Outcomes:

The student will be able to:

CE610.1	Understand the fundamental concepts of computer networks
CE610.2	Explain the layered approach in computer networks.
CE610.3	Compare the OSI and TCP/IP Reference models
CE610.4	Assess detailed understanding of data link, network, transport and application layer protocols.

UNIT -1	
Introduction: Reference Models : The OSI Reference Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models. **The Physical Layer:** The Theoretical Basis for Data Communication, Fourier Analysis, Bandwidth-Limited Signals, The Maximum Data Rate of aChannel. **The Data Link Layer:** Data Link Layer Design Issues: Services Provided to the Network Layer, Framing, Error Control, FlowControl **Error Detection And Correction**: Error-Correcting Codes, Error –Detecting Codes **Elementary Data Link Protocols** : An Unrestricted Simplex Protocol, A Simplex Stop-and-Wait Protocol, A Simplex Protocol for a NoisyChannel. **Sliding Window Protocols:**A One-Bit Sliding Window Protocol, A Protocol Using Go Back N, A Protocol Using Selective Repeat	10hrs

UNIT -2	
The Medium Access Sublayer : Multiple access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wavelength Division Multiple Access Protocols, Wireless LAN Protocols **Ethernet**: Ethernet Cabling, Manchester Encoding, The Ethernet MAC Sublayer Protocol. **The Network Layer**: Network Layer Design Issues: Store-and-Forward PacketSwitching, Services Provided to the Transport, Implementation ofConnectionless Service, Implementation of Connection-Oriented Service, Comparison of Virtual-Circuit and DatagramSubnets. **Routing Algorithms**: The Optimality Principle, Shortest Path Routing,Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing.	10hrs
UNIT-3	
Congestion Control Algorithms: General Principles of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Load Shedding. **The Network Layer In The Internet**: The IP Protocol, IP Addresses, Internet Control Protocols **The Transport Layer**: The Transport Service: Services Provided to the Upper Layers, Transport Service Primitive, An Example of Socket Programming Elements of Transport Protocols : Addressing, Establishing a Connection, Releasing aConnection The Internet Transport Protocols: UDP: Introduction to UDP, Remote Procedure Call	10hrs
UNIT -4	
The Internet Transport Protocols: Tcp: Introduction to TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release **The Application Layer:** The World Wide Web, Architectural Overview, The Client Side, The Server Side, URLs, Statelessness and Cookies **DNS--Domain Name System**: The DNS Name Space, Resource Records, Name Servers **Electronic Mail**: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery	10 hrs

TEXTBOOKS

1	"Computer Networks",Andrew S. Tanenbaum,FourthEdition,Prentice Hall,2003

REFERENCES

1	"Data Communications and Networking",Behrouz A. Forouzan,FourthEdition,Tata McGraw-Hill,2006
2	"Data and Computer Communications",WilliamStallings,EighthEdition,Prentice Hall,2006
3	"Computer Networking", James Kurose & Keith Ross, 7th Edition,Pearson Publications,2016
4	"Computer Networks",BhushanTrivedi,Reprintedition,Oxford University Press,2011

ARTIFICIAL INTELLIGENCE					
Course Code	**CE620**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	To understand the concept of Artificial Intelligence (AI).
2	To learn various important search strategies, Planning &knowledge representation in AI.
3	To acquaint with the fundamentals of Learning, Computer Vision & Expert Systems.
4	To develop a mind to solve real world problems in AI.

Course Outcomes:

The student will be able to:

CE620.1	Discuss the structure of an A.I. Problem and requirement, representation and application of the knowledge to solve an AI problem, planning of heuristic based search algorithms and need of machine learning algorithms.
CE620.2	Develop a heuristic based state space search techniques, knowledge and planning models for AI applications.
CE620.3	Design a solution strategy and an expert system in any domain to transfer human expertise into machine.
CE620.4	Analyze the suitability of knowledge models, search algorithms and the machine learning algorithms to solve any AI application.

UNIT -1	
Introduction, State Space Search and Heuristic Search **Artificial Intelligence**: Introduction, **State Space Search**: Breadth First Search, Depth First Search, Depth Bounded DFS (DBDFS), Depth First Iterative Deepening (DFID). **Heuristic Search**: Heuristic Functions, Best First Search, Hill Climbing, Variable Neighbourhood Descent. **Optimal Search**: A* algorithm, Iterative Deepening A*, Recursive Best First Search.	**10hrs**

UNIT -2	
Problem Decomposition and Planning and Constraint Satisfaction **Problem Decomposition**: Goal Trees, Rule Based Systems, Rule Based Expert Systems. **Planning**: STRIPS, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning. **Constraint Satisfaction**: N-Queens, Constraint Propagation. **Game Playing**: Alpha-Beta Pruning.	**10hrs**
UNIT -3	
Logic and Reasoning and Knowledge Representation **Knowledge Based Reasoning**: Agents, Facets of Knowledge. **Logic and Inferences**: Formal Logic, Propositional Logic, Resolution method in Propositional Logic, and First Order Logic, Resolution Refutation in FOL, Forward & Backward Chaining. **Knowledge Representation**: Frames, Semantic nets.	**10hrs**
UNIT -4	
Applications of AI **Learning**: Introduction, Types of Learning: Rote Learning, Learning by taking advice, Learning by Induction **Computer Vision**: Human Vision Processing, Edge detection, The Waltz algorithm. **Expert System:** Architecture of Expert System, Role of Expert system in Knowledge acquisition.	**10 hrs**

TEXTBOOKS	
1	"A First Course in Artificial Intelligence", Deepak Khemani, ISBN: 978-1-25-902998-1, McGraw Hill Education (India) 2013.
2	"Artificial Intelligence", Ela Kumar, I.K. International Publishing House Pvt. Ltd. 2008.
REFERENCES	
1	"Artificial Intelligence: A Modern Approach", Stuart Russell and Peter Norvig, Third edition, ISBN :10: 0136042597, Pearson, 2003
2	"Artificial Intelligence", Elaine Rich, Kevin Knight and Nair, ISBN-978-0-07-008770-5,TMH
3	"Artificial Intelligence: A new Synthesis, Nilsson Nils J , Morgan Kaufmann Publishers Inc. San

COMPUTATIONAL NUMBER THEORY					
Course Code	**CE631**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**125**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	The course provides an introduction to basic number theory, where the focus is on computational aspects with applications in cryptography.
2	To make students familiar with basic properties and techniques of finite fields and their application to cryptography and coding theory.
3	To learn the various methods for source coding and derive their performance
4	To familiarize students essential information theoretic tools like entropy and mutual information

Course Outcomes:

The student will be able to:

CE631.1	Explain the foundations of number theory and its applications in building crypto systems
CE631.2	Demonstrate the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms
CE631.3	Analyze which error-correction coding scheme is most appropriate for a given demand.
CE631.4	Explain the relations existing among different areas of mathematics, especially algebra, coding theory and the theory of self -correcting codes.

UNIT -1	
Basic Number Theory: Divisibility, Prime numbers, Greatest Common Divisor, Euclidean algorithm, Extended Euclidean Algorithm, Congruence, Division, Chinese Remainder Theorem, Modular Exponentiation, Fermat's Little Theorem, Euler's Theorem, Primitive Roots, Inverting Matrices Mod n, Square Roots Mod n, Legendre and Jacobi Symbols, Finite Fields.	**10hrs**
UNIT -2	
Pseudo-random Bit Generation, LFSR Sequences, Enigma. **Primality Testing**: Fermat's Primality Test, Miller-Rabin Primality Test, Solovay-StrassenPrimality Test. **Factoring**: p-1 Factoring Algorithm, Quadratic Sieve **Discrete Logarithms**: Discrete logarithms, Computing Discrete Logs, The Pohlig-Hellman Algorithm	**10hrs**

UNIT -3	
Source Coding :Introduction to Information Theory, Uncertainty and Information, Average Mutual Information and Entropy, Information Measures for Continuous Random Variables, Source Coding Theorem, Huffman Coding, Shannon-Fano-Elias Coding, Arithmetic Coding, Run Length Encoding. **Channel Capacity and Coding**: Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, The Shannon Limit, Channel Capacity	**10hrs**
UNIT -4	
Linear Block Codes for Error Correction: Introduction to Error Correcting Codes, Basic Definition, Matrix Description of Linear Block Codes, Equivalent Codes, Parity Check Matrix, Decoding of a Linear Block Code, Syndrome Decoding, Error Probability after Coding Perfect codes, Hamming Codes **Cyclic Codes:** Introduction to Cyclic Codes, Polynomials, The Division Algorithm For Polynomials, A Method for Generating Cyclic Codes, Burst Error Correction, Cyclic Redundancy Check (CRC)codes, Circuit Implementation of CRC Codes	**10 hrs**

TEXTBOOKS	
1	Introduction to Cryptography with Coding Theory, 2nd edition, Wade Trappe and Lawrence C. Washington, Pearson Education, 2011
2	Information Theory, Coding and Cryptography, Second Edition, RanjanBose,Tata McGraw-Hills
REFERENCES	
1	Neal Koblitz, "Course on Number Theory and Cryptography", Springer-Verlag, 1986.
2	Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, "Handbook of Applied Cryptography", CRC Press, 1996

ADVANCED COMPUTER ORGANIZATION AND ARCHITECTURE					
Course Code	**CE632**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**125**	**0**	**0**

Course Objectives:

The subject aims to provide the student with:

1	Identify & study different parallel computer models.
2	Demonstrate concepts of parallelism in hardware/software
3	Study & implement multiple pipelining techniques.
4	Elaborate different memory systems and buses for parallel computing.

Course Outcomes:

The student after undergoing this course will be able to:

CE632.1	Compare and contrast classes of computers, and new trends and developments in computer architecture.
CE632.2	Demonstrate the Concept of Parallel Processing and its applications.
CE632.3	Analyze the performance and efficiency in advanced multi processors.
CE632.4	Discuss the virtual memory and multithreading issues and solutions.

UNIT -1	
Theory of Parallelism-Parallel Computer Models: The State of Computing, Multiprocessors and Multicomputer, Multi vector and SIMD Computers, PRAM and VLSI Models **Program and Network Properties**: Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures (For all Algorithm or mechanism any one example is sufficient).	**10 Hrs**
UNIT -2	
Principles of Scalable Performance: Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws. **Processors and Memory Hierarchy:** Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology.	**10 Hrs**
UNIT -3	
Bus Systems, Cache Memory Organizations: Shared Memory Organizations, Sequential and Weak Consistency Models **Pipelining and Superscalar Techniques**: Linear Pipeline Processors, Nonlinear Pipeline Processors.	**10 Hrs**

UNIT – 4	
Parallel and Scalable Architectures-Multiprocessors and Multi computers: Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Message- Passing Mechanisms **Multi vector and SIMD Computers:** Vector Processing Principles, Multi vector Multiprocessors, Compound Vector Processing. **Scalable, Multithreaded, and Dataflow Architectures:** Latency-Hiding Techniques, Principles of Multithreading, Fine- Grain Multi computers.	**10 Hrs**

TEXT BOOKS	
1	Advanced Computer Architecture: Parallelism, Scalability, Programmability,2nd Edition, Kai Hwang, Tata Mc Grow Hill
2	Computer Architecture: A quantitative approach, 5th Edition, John Hennessy and David A. Patterson, Morgan Kaufmann Publishers.

REFERENCE BOOKS	
1	Computer Systems Design and Architecture, 2nd Edition, Vincent P. Heuring, 2008, Pearson Prentice Hall
2	Computer Organization and Architecture, 6th Edition, William Stallings, 2006, Pearson Prentice Hall
3	Advanced Computer Architectures-A Design Space Approach, Dezsosima, Terence Fountain, Peter Kacsuk.,1997, PearsonPrentice Hall

SPEECH AND NATURAL LANGUAGE PROCESSING					
Course Code	**CE633**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**TH**	**IA**	**TW**	**P**	**O**
	100	**25**	**0**	**0**	**0**

Course Objectives:

This course will enable students to

1	Gain knowledge on the fundamental concepts and techniques of natural language processing (NLP).
2	Gain in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
3	Understand semantics and pragmatics of English language for processing.
4	Understand the principles of automatic speech recognition and synthesis.

Course Outcomes:

The student will be able to:

CE633.1	Justify the need of Natural Language Processing & various approaches to Text preprocessing
CE633.2	Identify the approaches to syntax and semantics & need and ways of morphological analysis in NLP.
CE633.3	Categorize the machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars.
CE633.4	Understand the techniques & ways of Information extraction & named entities recognition within NLP.

UNIT -1	
Introduction & Basic Text Processing Introduction, Regular Expressions, Text Normalization, Edit Distance: Regular Expressions , Words, Corpora , Text Normalization , Minimum Edit Distance **N-gram Language Models:** N-Grams, Evaluating Language Models, Generalization and Zeros, Kneser-Ney Smoothing, The Web and Stupid Backoff.	10hrs

UNIT -2	
Morphology & Syntax **Part-of-Speech Tagging:** English Word Classes , The Penn Treebank Part-of-Speech Tagset, Part-of-Speech Tagging ,HMM Part-of-Speech Tagging , Maximum Entropy Markov Models, Part-of-Speech Tagging for Morphological Rich Languages **Constituency Grammars :** Constituency ,Context-Free Grammars, Some Grammar Rules for English, Treebanks ,Grammar Equivalence and Normal Form , Lexicalized Grammars **Constituency Parsing :**Ambiguity, CKY Parsing: A Dynamic Programming Approach, Partial Parsing **Statistical Constituency Parsing:** Probabilistic Context-Free Grammars ,Probabilistic CKY Parsing of PCFGs	10hrs
UNIT -3	
Semantics **Vector Semantics and Embeddings:** Lexical Semantics , Vector Semantics ,Words and Vectors ,Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Applications of the tf-idf vector model. **Word Senses and WordNet:** Word Senses, Relations Between Senses ,WordNet: A Database of Lexical Relations ,Word Sense Disambiguation **Information Extraction:** Named Entity Recognition ,Relation Extraction , Extracting Times ,Extracting Events and their Times , Template Filling	10hrs
UNIT -4	
Speech Processing **Phonetics:** Speech Sounds and Phonetic Transcription, Articulatory Phonetics, Prosodic Prominence: Accent, Stress and Schwa, Prosodic Structure and Tune, Acoustic Phonetics and Signals. **Speech Synthesis :** Introduction **Speech Recognition:** Speech Recognition ,Basic Architecture	10 hrs

TEXTBOOKS	
1	"Speech and Language Processing: An Introduction to Natural Language Processing ,Computational Linguistics, and Speech Recognition ",Daniel Jurafsky and James H. Martin(Third Edition draft), Prentice Hall
2	"Foundations of Statistical Natural Language Processing", Chris Manning and HinrichSchuetze, MIT Press
REFERENCES	
1	"Natural Language Processing" ,Ela Kumar ,IK International,2011.

DATA MINING AND DATA WAREHOUSING					
Course Code	**CE634**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**TH**	**IA**	**TW**	**P**	**O**
	100	**25**	**0**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	Understand the need for data mining and different mining tasks.
2	Understand fundamental concepts and algorithms of data mining.
3	Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
4	Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes:

At the end of the course the student will be able to:

CE634.1	Apply suitable pre-processing and visualization techniques for data analysis
CE634.2	Discuss the data warehouse concepts.
CE634.3	Apply principles of various classification and association mining techniques.
CE634.4	Illustrate the various clustering algorithms.

UNIT -1	
Introduction –Challenges, Origin of Data Mining, Data Mining Tasks, Architecture of data mining system. Types of Data: Attributes and Measurement, Types of Data Sets, Data Mining- Different kinds of data– Relational Databases, Data warehouses, Transactional Databases, Advanced database systems and Advanced Database Applications, Data Pre-processing: Importance of data Pre-processing, Data Cleaning, Data Integration and transformation, Data reduction, Discretization and Concept Hierarchy Generation.	**10 Hrs**

UNIT -2	
Measures of Similarity and Dissimilarity Similarity and Dissimilarity between Simple Attributes, Dissimilarities between Data Objects. Similarities between Data Objects Examples of Proximity Measures ISSUES in Proximity Calculation Selecting the Right Proximity Measures. **Summary Statistics:**Frequencies and the Mode, Percentiles, Measures of Location: Mean and Median, Measures of Spread: Range and Variance, Multivariate Summary Statistics. **Data Warehouse and OLAP Technology for Data Mining:** Introduction to Data Warehousing, Difference between Operational database Systems and Data Warehouses, A Multidimensional data Model, and Schemas for Multidimensional data model, Measures: Categorization and Computation, Concept Hierarchies, OLAP Operations. **Data Warehouse Architecture:** Steps for the design and construction of data warehouse.	**10 Hrs**
UNIT -3	
Classification: Introduction to Classification and Prediction. **Issues Regarding Classification and Prediction:** Preparing the data for Classification and Prediction, Comparing Classification Methods. **Decision Tree Induction:** Basic strategy, Algorithm, Attribute Selection Measure, Tree Pruning, Extracting Classification rules from Decision Trees, Enhancements to basic Decision Tree Induction, Scalability & decision tree Induction. **Bayesian Classification:** Bayes theorem, Naïve Bayesian Classification **Other Classification Methods:** k-Nearest Neighbor Classifier Concept, Algorithm and examples.	**10 Hrs**
UNIT – 4	
Association Analysis Frequent Itemset Generation, The Apriori Principle, Frequent Itemset Generation in the Apriori Algorithm, Candidate Generation and Pruning, Support Counting, Computational Complexity, Rule Generation: Confidence-Based Pruning, Rule Generation in Apriori Algorithm, Maximal Frequent Itemsets, Closed Frequent Itemsets. FP Growth Algorithm: Construction, Frequent Itemset Generation. **Cluster Analysis**: Importance of cluster analysis, K-means: The Basic K-means Algorithm, K-means: Additional Issues, K-means and Different Types of Clusters, Strengths and Weaknesses. **Agglomerating Hierarchical Clustering:** Basic Agglomerative Hierarchical Clustering Algorithm, Key Issues in Hierarchical Clustering, Strengths and Weaknesses. **Outlier Analysis:** Statistical Based, Distance-Based and Deviation-Based Outlier Detection. Data Mining Applications.	**10 Hrs**

TEXT BOOK	
1	Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education, ISBN:81-317-1472-1
2	Data Mining - Concepts and Techniques by Jiawei Han and MichelineKamber, Elsevier, Second Edition, Original ISBN: 978-1-55860-901-3, Indian Reprint ISBN: 978-81-3120535-8

REFERENCES	
1	Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
2	Data Warehousing, Data Mining and OLAP, Alex Berson and Stephen J.Smith, Tata McGraw – Hill Edition, 35th Reprint 2016.

HIGH PERFORMANCE COMPUTING					
Course Code	**CE641**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**TH**	**IA**	**TW**	**P**	**O**
	100	**25**	**0**	**0**	**0**

Course Objectives:

The subject aims to provide the student with:

1	Introduce the fundamentals of high performance computing with the graphics processing units and many integrated cores using their architectures and corresponding programming environments
2	Provide systematic and comprehensive treatment of the components in the pipeline that extract instruction level parallelism.
3	Illustrate the cache coherence and consistency problems in multiprocessors, and their existing Solutions
4	Introduce the learner to fundamental and advanced parallel algorithms through the GPU

Course Outcomes:

The student will be able to:

CE641.1	Assess the Key Features of the modern processors responsible for the improvement in the performance
CE641.2	Discuss various optimization techniques used in sequential code to improve the execution speed
CE641.3	Explain different parallel computing paradigms, parallel architectures and parallel programming models
CE641.4	Design and Implement various interconnection networks
CE641.5	Develop an efficient parallel algorithm to solve given problem

UNIT -1	
Modern Processors: Stored Program Computer Architecture General purpose cache- based microprocessor-Performance based metrics and benchmarks- Moore's Law- Pipelining- Superscalarity SIMD- Memory Hierarchies Cache- mapping- prefetch- Multicore processors- Multithreaded processors- Vector Processors- Design Principles- Maximum performance estimates- Programming for vector architecture.	**10hrs**

UNIT -2	
Basic optimization techniques for serial code : scalar profiling function and line based runtime profiling- hardware performance counters- common sense optimizations- simple measures, large impact- elimination of common subexpressions- avoiding branches using simd instruction sets- the role of compilers - general optimization options- inlining - aliasing- computational accuracy register optimizations- using compiler logs- c++ optimizations - temporaries- dynamicmemory management- loop kernels and iterators data access optimization: balance analysis and light speed estimates- storage order- case study: Jacobi algorithm and dense matrix transpose.	**10hrs**
UNIT -3	
Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.	**10hrs**
UNIT -4	
Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.	**10 hrs**

TEXTBOOKS	
1	Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series, 2011.
2	AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
REFERENCES	
1	Charles Severance, Kevin Dowd, High Performance Computing, O'Reilly Media, 2nd Edition, 1998
2	Kai Hwang, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984

INFORMATION RETRIEVAL					
Course Code	**CE642**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**39 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with:

1	To Learn different Information Retrieval model.
2	To understand how to evaluate information retrieval model.
3	To learn how human computer interface can be used for information retrieval.
4	To learn applications of IR models.

Course Outcomes:

The student will be able to:

CE642.1	Discuss the different Information retrieval models.
CE642.2	Illustrate the evaluation methods of the information retrieval model.
CE642.3	Demonstrate the text processing techniques in IR.
CE642.4	Explain the human computer interface and some applications of IR.

UNIT -1	
Introduction to Information retrieval: Motivation, Basic Concepts, Past, Present, and Future, The Retrieval Process **Modelling:** Introduction, A Taxonomy of Information Retrieval Models, Retrieval: Ad hoc and Filtering, A Formal Characterization of IR Models, Classic Information Retrieval, Alternative Set Theoretic Models, Alternative Algebraic Models, Alternative Probabilistic Models, Structured Text Retrieval Models, Models for Browsing, Trends and Research Issues.	10hrs
UNIT -2	
Retrieval Evaluation: Introduction, Retrieval Performance Evaluation, Reference Collections, Trends and Research Issues. **Query Languages**: Introduction, Keyword-Based Querying, Pattern Matching, Structural Queries, Query Protocols, Trends and Research Issues. **Query Operations:** Introduction, User Relevance Feedback, Automatic Local Analysis, Automatic Global Analysis, Trends and Research Issues.	10hrs

UNIT -3	
Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Mark-up Languages, Multimedia, Trends and Research Issues **Text Operations:** Introduction, Document Pre-processing, Document Clustering, Text Compression, Comparing Text Compression Techniques, Trends and Research Issues. **Indexing and Searching:** Introduction, Inverted Files, Other Indices for Text, Boolean Queries, Sequential Searching, Pattern Matching, Structural Queries, Compression, Trends and Research Issues.	10hrs
UNIT -4	
User Interfaces and Visualization: Introduction, Human-Computer Interaction, The Information Access Process, Starting Points, Query Specification, Context, Using Relevance Judgements, Interface Support for the Search Process, Trends and Research Issues. **Searching the Web:** Introduction, Challenges, Characterizing the Web, Search Engines, Browsing, Meta searchers, Finding the Needle in the Haystack, Searching using Hyperlinks, Trends and Research Issues.	10 hrs

TEXTBOOKS	
1	Modern Information Retrieval. Baeza-Yates Ricardo and BerthierRibeiro-Neto. 2nd edition, Addison-Wesley, 2011.
2	Introduction to Information Retrieval by Manning, C.D., Raghavan, P. and Schütze, H. Cambridge University Press, 2008, ISBN-13: 978-1-107-66639-9.
REFERENCES	
1	Information Storage and Retrieval by R. R. Korfhage, published by John Wiley & Sons in 1997. ISBN 0-471-14338-3

IMAGE PROCESSING AND VISION					
Course Code	**CE643**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**TH**	**IA**	**TW**	**P**	**O**
	100	**25**	**0**	**0**	**0**

Course Objectives:

The subject aims to provide the student with**:**

1	To introduce the fundamental concepts and methodologies in digital image processing.
2	To study the image enhancement techniques.
3	To study the image restoration and compression techniques.
4	To develop a foundation that can be used as the basis for further research in image processing.

Course Outcomes:

At the end of the course the student will be able to:

CE643.1	Identify the digital image processing techniques, including image enhancement, restoration, compression and segmentation.
CE643.2	Apply various image processing techniques i.e. enhancement, restoration, compression and segmentation to the given image
CE643.3	Differentiate between various image processing techniques i.e. enhancement, restoration, compression and segmentation
CE643.4	Demonstrate the various image processing algorithms.

UNIT -1	
Introduction Introduction to Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System **Digital Image Fundamentals** Image Storage Formats – BMP, RAW, JPEG, GIF, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels **Image Enhancement in the spatial domain** Background, Some Basic Intensity Transformation Functions, Histogram Processing, Histogram Equalization, Histogram Matching (Specification), Enhancement using arithmetic/logic operations, Basics of Spatial filtering, Smoothing Spatial Filters, Sharpening Spatial Filters	**10hrs**

UNIT -2	
Filtering in the Frequency Domain Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform (DFT) of One Variable, Extension to Functions of Two Variables, Some Properties of the 2-D Discrete Fourier Transform, The Basics of Filtering in the, Frequency Domain, Image Smoothing Using Frequency DomainFilters, Image Sharpening Using Frequency Domain Filters, Selective Filtering, Implementation **Image Restoration** A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise, Mean Filters, Order-Statistics Filters, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.	**10hrs**
UNIT -3	
Color Image Processing Color Fundamentals, Color Models – The RGB color model, Basics of Full-Color Image Processing **Image Compression** Fundamentals - Image Compression Models, Some Basic Compression Methods - Huffman Coding, JPEG Coding **Morphological Image Processing** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms	**10hrs**
UNIT -4	
Image Segmentation Point, Line, and Edge Detection - Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, Thresholding - Foundation, Basic Global Thresholding using Otsu's method, Using Image Smoothing to improve Global Thresholding, Using Edges to improve Global Thresholding,Region-Based Segmentation – Region growing **Representation and DescriptionRepresentation –** Boundary following, Boundary Descriptors - Some Simple Descriptors, Regional Descriptors - Some Simple Descriptors, Topological Descriptors	**10hrs**

TEXTBOOKS	
1	Digital Image Processing by R.C. Gonzalez and R.E. Woods, Third Edition, Addison Wesley, 2008.
2	A Concise Introduction to Image Processing Using C++ by Meiqing Wang, Choi-Hong Lai, First Edition, CRC Press, 2008.
REFERENCES	
1	Fundamentals of Digital Image Processing by Anil K. Jain, First Edition, Pearson Education, 2015.
2	Digital Image Processing - An Algorithmic Approach by Madhuri A. Joshi, Second Edition, PHI, 2018.
3	Digital Image Processing by William K.Pratt, Fourth Edition,John-Wiley & Sons, 2006.
4	Digital Image Processing and Computer Vision by Milan Sonka, Roger Boyle&VaclavHlavac, First Edition, Cengage Learning India, 2008.

CLOUD COMPUTING AND APPLICATIONS					
Course Code	**CE644**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**TH**	**IA**	**TW**	**P**	**O**
	100	**25**	**0**	**0**	**0**

Course Objectives:

The subject aims to provide the student with **:**

1	To introduce the fundamentals and essentials of Cloud Computing to the students.
2	To provide a foundation of Cloud Computing to the students so that they can use and adopt Cloud Computing services and tools.
3	To motivate the students to explore some important cloud computing driven commercial systems and applications.
4	To provide sufficient foundations to the students to enable further study and research.

Course Outcomes:

At the end of the course the student will be able to:

CE644.1	Compare the advantages and disadvantages of various cloud computing platforms.
CE644.2	Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
CE644.3	Solve a real-world problem using cloud computing through group collaboration.
CE644.4	Summarize the different cloud service providers.

UNIT -1	
Cloud Computing Fundamental Motivation for Cloud Computing, Defining Cloud Computing, 5-4-3 Principles of Cloud computing, Cloud Ecosystem, Requirements for Cloud Services, Cloud Application, Benefits and Drawbacks. **Cloud Computing Architecture and Management** Introduction, Cloud Architecture, Network Connectivity in Cloud Computing, Anatomy of the Cloud, Applications on the Cloud, Managing the Cloud, Migrating Application to Cloud	**10hrs**

UNIT -2	
Cloud Deployment Models Introduction, Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud. **Cloud Service Models** Introduction, Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models. **Virtualization** Introduction, Virtualization Opportunities, Approaches to Virtualization, Hypervisors, Types of Hypervisors, Security Issues and Recommendations, From Virtualization to Cloud Computing	**10hrs**
UNIT -3	
Technological Drivers for Cloud Computing Introduction, SOA and Cloud, Services architectural model of SOA, Benefits of SOA. **Open Source Support for Cloud** Open Source in Cloud Computing: An Overview, Open Source Tools for IaaS, Open Source Tools for PaaS, Open Source Tools for SaaS, Reliability, availability and security of services deployed from the cloud. **Cloud Computing Economics** Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)	10hrs
UNIT -4	
Cloud Service Providers Introduction, Google cloud platform, Amazon Web Services, Microsoft. **Application Development** Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App, How to decide if the cloud is right for your requirements, the total cost of ownership (TCO)	10hrs

TEXTBOOKS	
1	Essentials of Cloud Computing, K. Chandrasekaran, First Edition, Chapman and Hall/CRC, 2014.
2	Enterprise Cloud Computing Technology Architecture Applications, Gautam Shroff, First Edition,Cambridge University Press, 2010.
REFERENCES	
1	Cloud Computing - A Practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, First Edition, McGraw-Hill Education, 2009.

2	Cloud Computing: Implementation, Management and Security, John W. Rittinghouse, James F Ransome, First Edition, CRC Press, 2009.
3	Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, First Edition, O'Reilly Media, 2009.
4	Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, First Edition, O'Reilly Media, 2009.

COMPUTER NETWORKS LAB				
Course Code	**CE 650**		**Credits**	**02**
Scheme of Instruction Hours/ Week	**L**	**T**	**P#**	**TOTAL**
	0	**0**	**2(04Hrs/Week)**	**32 hrs/Sem**
Scheme of Examination TOTAL = 75 marks	**IA**	**TW**	**P/O**	**P/O**
	0	**25**	**50**	**75**

Course Objectives:

The subject aims to provide the student with

1	To provide practical knowledge on network devices and Computer Networking.
2	To provide hands on basic IP commands
3	To evaluate the network performance using simulators.
4	To provide understanding of computer programming in network communication.

Course Outcomes:

At the end of the course the student will be able to:

CE 650.1	Discuss the network devices and communication in computer network.
CE 650.2	Formulate in real test-bed networking environment using IP commands
CE 650.3	Design the networking model and perform simulation to evaluate the network.
CE 650.4	Implement communication at application layer using computer programming.

(Minimum 08 experiments to be performed from the following list)

Sr. No.	Experiment
1	Study of the following network devices.(Repeater, Hub, Switch, Bridge, router and Gateway)
2	Study of network IP. (Classification of IP, sub netting and Super netting).
3	Study of basic IP Commands using command prompt.(Ping, Traceroute, Nslookup, Pathping,etc)
4	Connect the computers in local area network.(Host Computer - Share Internet connection and Client computer- Connect to the internet by using the shared connect ion.)
5	Implement CRC error detection method.
6	Configure a Network Topology using Packet Tracer Software and ping from any one machine to another machine in the network.
7	Create simple network and understand the configurations of DHCP, TELNET, VLAN using Packet Tracer software
8	Configure a network using Distance Vector Routing protocol with the help of Packet Tracer Software.
9	Configure a network using Link State Routing protocol with the help of Packet Tracer Software.
10	Create a simple client and server chat application using socket programming

11	Develop a simple Web server in Python/Java/C++/C# that is capable of processing only one request. Specifically, Web server will (i) create a connection socket when contacted by a client (browser); (ii) receive the HTTP request from this connection; (iii) parse the request to determine the specific file being requested; (iv) get the requested file from the server's file system; (v) create an HTTP response message consisting of the requested file preceded by header lines; and (vi) send the response over the TCP connection to the requesting browser. If a browser requests a file that is not present in your server, web servershould return a "404 Not Found" error message.
12	Develop a Web proxy for the HTTP requests. When the proxy receives an HTTP request for an object from a browser, it generates a new HTTP request for the same object and sends it to the origin server. When the proxy receives the corresponding HTTP response with the object from the origin server, it creates a new HTTP response, including the object, and sends it to the client. This proxy will be multi-threaded, so that it will be able to handle multiple requests at thesame time.

TEXTBOOKS
1. "Data Communications and Networking",Behrouz A. Forouzan,FourthEdition,Tata McGraw-Hill,2006
2. "Data and Computer Communications",WilliamStallings,EighthEdition,Prentice Hall,2006
3. "Computer Networking", James Kurose & Keith Ross, 7th Edition,Pearson Publications,2016
4. "Computer Networks",BhushanTrivedi,Reprintedition,Oxford University Press,2011
REFERENCES
1.Cisco Packet Tracer for Beginners by Kalyanchinta
2.CCNA Study Guide Seventh Edition ToddLammle

ARTIFICIAL INTELLIGENCE LAB				
Course Code	**CE660**		**Credits**	**2**
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**
	0	**0**	**2(04Hrs/Week)**	**32 hrs/Sem**
Scheme of Examination TOTAL = 75 marks	**IA**	**TW**	**P/O**	**P/O**
	0	**25**	**50**	**75**

Course Objectives:

The subject aims to provide the student with

1	Gain the fundamental knowledge in the AI Concepts.
2	Implement different AI techniques in AI problems.
3	Gain good programming expertise in the implementation of various AI techniques using Java or Python.
4	Gain practical knowledge in the implementation of Expert system using Prolog.

Course Outcomes:

At the end of the course the student will be able to:

CE 660.1	Understand the basics and general frameworks of the common AI approaches such as Search, problem decomposition etc. for problem solving.
CE 660.2	Apply AI techniques and considerations properly in solving different AI problems (Water Jug, N-Queens, Traveling Salesman, Tic- tac-toe etc.)
CE 660.3	Apply basic principles of AI in solutions that require problem solving, knowledge representation, and learning.
CE 660.4	Discuss Programming languages such as Python or java & the related constructs through the implementation of variety of AI problems.

(Minimum 08 Experiments to be performed from the following list in Java/Python.)

SNo.	**Experiment**
1	Program to implement depth first search algorithm.
2	Program to implement breadth first search algorithm.
3	Program to implement Best First Search algorithm.
4	Program to simulate 4-Queen / N-Queen problem.
5	Program to implement alpha beta search.
6	Program for implementation Hill climbing problem.
7	Program to implement A* search algorithm.
8	Program to solve water jug problem.
9	Program to simulate tic – tac – toe game using min-max algorithm.
10	Program to implement Constraint satisfaction problem
11	Program to solve Missionaries and Cannibals problem.
12	Program to implement Traveling salesman problem.

13	Program to implement Expert System using prolog.
14	Program for simulation of Logical functions using Neural networks.

TEXTBOOKS

1. "A First Course in Artificial Intelligence", Deepak Khemani, ISBN: 978-1-25-902998-1, McGraw Hill Education (India) 2013.
2. "Artificial Intelligence", ElaKumar,I.K. International Publishing House Pvt. Ltd. 2008

REFERENCES

1. "Artificial Intelligence: A Modern Approach", Stuart Russell and Peter Norvig, Third edition,ISBN :10: 0136042597, Pearson, 2003.
2. https://www.tutorialspoint.com/artificial_intelligence_with_python/artificial_intelligence_with_python_tutorial.pdf

TECHNICAL WRITING AND PROFESSIONAL ETHICS					
Course Code	**HM 200**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**42 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	Comprehensive understanding of the importance of professional ethics.
2	Knowledge of Engineering ethics and ethics in research.
3	Knowledge of the rules in technical writing.
4	Skills required for writing research papers and technical documents.

Course Outcomes:

At the end of the course the student will be able to:

HM200.1	Explain/Understand the concept of Professional ethics
HM200.2	Apply engineering ethics in real-life implications
HM200.3	Comprehend the rules of technical writing and Technical Communication
HM200.4	Apply the rules of technical writing in research papers, reports and othertechnical documents.

UNIT – 1	
PROFESSIONAL ETHICS: Introduction and Code of Ethics and Importance of Professional Ethics, Trust, Responsibility, Character, Human values, IEEE Guidelines, Professional responsibilities of engineers, Professional rights of engineers, Crucial role of project managers, Risk Benefit Analysis, Whistleblowing, Intellectual Property Rights, Corporate Social Responsibility	(10 Hours)
UNIT – 2	
PROFESSIONAL ETHICS: Ethics in Research and Experimentation, Environmental Ethics, Computer Ethics, Ethics as Design, Engineering Ethics, Case Studies: i) The Challenger ii) Chernobyl iii) Citicorp Centre Case iv) Johnson and Johnson	(10 Hours)
UNIT – 3	
TECHNICAL WRITING: What is Technical Writing, audience, purpose, and measures of excellence in technical documents, use visuals, types of technical documentation, practical tools and effective strategies for increasing your academic vocabulary and grammar, Scholarly Communication, Proposal Writing, Market Research, Research Proposal, Qualitative Research and Quantitative Research Writing, Research Report,Case Studies, Plagiarism, Research paper: format, editing, proofreading, summarizing Technical Writing using LaTeX software'.	(10 Hours)

UNIT - 4	
TECHNICAL WRITING: Grammar Basics, Oxford Style Guide, Google Style Guide, Microsoft Style Guide, Research Papers, Editing and Proofreading, Summarizing, Stages of Writing.	(10 Hours)

TEXTBOOKS	
1	Professional Ethics (values and ethics of profession) – Jayshree Suresh and B.S. Raghavan – S. Chand
2	Engineering Ethics (2nd edition) – Charles B Fleddermann – Pearson Education
REFERENCES	
1	Technical Communication (Principles and Practice) – Meenakshi Raman and Sangeeta Sharma – Oxford University Press

SEM VII

COMPILER DESIGN					
Course Code	**CE710**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives

The subject aims to provide the student with:

1	To understand the basic principles of compiler design
2	To know the major steps involved in translating a high-level programming language down to a low-level target machine language
3	To understand the relationship between machine and assembly language, compilers, interpreters, linkers, loaders, assemblers and macro preprocessors
4	To construct efficient algorithms for compilers

Course Outcomes

The Student will be able to:

CE710.1	Understanding the basic structure and working principles of various components and phases of compiler.
CE710.2	Illustrate automation compiler construction process using tools
CE710.3	Justify the role of parser in compiler design.
CE710.4	Demonstrate the code generation and code optimization techniques.

UNIT-1	
Evolution of Programming Languages: The move to higher level languages, Impacts on Compilers, Applications of compiler Technology. **Assemblers**: Design of a Two Pass Assembler. **Introduction to Compiler**, Phases of compilation, Bootstrapping and Porting, Compiler writing tools, Input Buffering. **Lexical Analysis**: The role of a lexical analyzer, Specification and Recognition of Tokens, Role of Finite Automata in lexical analysis, Study of the features and applications of LEX/FLEX tool. Implementation of lexical analysis using Lex/Flex tool.	10hrs
UNIT-2	
Syntax Analysis: Overview of Context free grammars, Defining Context Free Grammar for If, Nested IF, For, While, Switch, Nested For, Nested While. Derivations and Parse trees, Ambiguity, Elimination of Left recursion, Left factoring. **Top down parsing**: Recursive descent parsing and Predictive parsers. **Parser Generator YACC**: Syntax Phase implementation for If, Nested If, For, While, Switch, and Assignment Statement using YACC tool.	10hrs

UNIT-3	
Bottom up parsing: Shift-reduce parser, Operator precedence parser, LR parsers. **Intermediate Code Generation**: Intermediate Language, Declarations, Assignment statements, Boolean expressions, Case statement, Backpatching , Procedure call. **Error detection and recovery**: Lexical phase errors, Syntactic phase errors, Semantic errors.	10hrs
UNIT-4	
Code generation: Issues in the design of a code Generator, Basic blocks and flow graphs, Next-use information, A simple Code generator, DAG representation of Basic blocks, Peephole Optimization, Generating code from DAGS. **Code optimization**: The principle sources of optimization, Optimization of basic blocks, Implementation for Common Sub expression technique using DAG. **Symbol table**: The contents of a symbol table, Data structures for Symbol Table, Representing scope information.	10hrs

TEXTBOOKS	
1	Compilers – Principles, Techniques, and Tools; Alfred Aho, Monica Lam, Ravi Sethi and Jeffrey Ullman ; 2009; 2nd Edition, Pearson, ISBN: 978-81-317-2101-8,
2	Compiler design with FLEX and YACC; Vinu V. Das ; 2007; PHI publication, ISBN:978- 81-203-3251-5
3	Systems Programming; D M Dhamdere, 2011 Tata McGraw Hill Education Private Limited
REFERENCES	
1	Louden; Compiler Construction, Principles and Practice; 2006, Galgotia Publication, ISBN:0-534-93972-4
2	Compiler design in C; Holub A I , 1992, Prentice-Hall, ISBN:0-87692-778-9
3	System Programming and Compiler Construction; R.K. Maurya, Anand A. Godbole; 2014; Dreamtech Press,ISBN 13:9789351197195
4	Compiler Design; A.A.Putambekar; First Edition 2009,Technical Publications Pune

EMBEDDED SYSTEMS AND DESIGN					
Course Code	**CE721**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives

The subject aims to provide the student with:

1	To understand the basics of Embedded Systems
2	To understand the basics of organization and architectural issues of a microcontroller
3	To learn programming techniques used in a microcontroller
4	To understand fundamentals of Real Time Operating Systems

Course Outcomes

The Student will be able to:

CE721.1	Describe the differences between the general computing system and the embedded system; also recognize the classification of embedded systems and Embedded system development tools.
CE721.2	Explain the concept of real time embedded systems using the concepts of RTOS.
CE721.3	Develop the programs for a microcontroller and its interfacing.
CE721.4	Describe the role of embedded systems in industry.

UNIT-1	
Overview of Embedded System Architecture, Application areas, Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC (System on Chip). **Real Time Operating Systems:** Real Time Tasks, Real Time Systems, Types of Real Time Tasks, Real Time Operating Systems, Real Time Scheduling Algorithms. **The Embedded System Development Environment:** The Integrated Development Ebnvironment (IDE), Simulators, Emulators and Debugging	10hrs
UNIT-2	
Introduction to 8051: Architecture and Pin Diagram. 8051 Assembly Language Programming. Jump, Loop and Call Instructions. I/O Port Programming. 8051 Addressing Modes. Arithmetic, Logic Instructions and Programs.	10hrs

UNIT-3	
8051 Timer Programming in Assembly and C. **8051 Serial Port** Programming in Assembly and C. **Interrupts** Programming in Assembly and C. **8051 Interfacing** To External RAM / ROM.	10hrs
UNIT-4	
8051 LCD and Keyboard Interfacing **Hardware Software Co-Design and Program Modeling:** Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design. **Embedded System Case Studies**: Battery operated smart card reader, Washing Machine, Microwave Owen, Automotive Embedded Systems.	10hrs

TEXTBOOKS	
1	The 8051 microcontroller & Embedded systems; M. A. Mazidi, J. G. Mazidi, R. D. McKinlay; 2nd Edition; Pearson
2	The 8051 microcontroller; Kenneth J. Ayala, 3rd Edition; CengageLearning.
3	Embedded / real – time systems: concepts, design & programming, Black Book; Dr. K. V. K. K. Prasad; Reprint edition2013/2018; Dreamtech press,
REFERENCES	
1	Introduction to Embedded Systems; Shibu K.V, 2nd Edition; McGrawHill
2	Embedded systems an integratedapproach;Lyla B. Das, Reprint Edition 2016, Pearson;
3	Embedded system design A Unified hardware/softwareIntroduction; Frank Vahid&Tony Givargis;Wiley Student Edition Reprint 2014, Wiley

MACHINE LEARNING					
Course Code	**CE722**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives

The subject aims to provide the student with:

1	To introduce basic concepts and techniques of Machine Learning
2	To understand the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
3	To study the design and implementation of various machine learning algorithms in a range of real-world applications.

Course Outcomes

The Student will be able to:

CE722.1	Identify the characteristics of machine learning that make it useful to real-world problems; characterize machine learning algorithms as supervised, semi-supervised, and unsupervised.
CE722.2	Explain fundamental issues and challenges of machine learning: data model selection, generalization and model complexity.
CE722.3	Demonstrate the concept of support vector machines, regression algorithms
CE722.4	Illustrate and apply algorithms for dimensionality reduction and clustering;

UNIT-1	
Introduction to Machine Learning: Machine Learning; Examples of Machine Learning Applications **Supervised Learning:** Learning a Class from Examples, Vapnik-Chervonenkis (VC) Dimension, Probably Approximately Correct (PAC) Learning, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm. **Bayesian Decision Theory:** Classification, Losses and Risks, Discriminant Functions, Utility Theory, Association Rules	10hrs
UNIT-2	
Parametric Methods AND Non-Parametric Methods: **Parametric Methods:** Introduction Maximum Likelihood Estimation, evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Regression, Tuning Model Complexity: Bias/Variance Dilemma, Model Selection Procedures, Over fitting and Under fitting. **Multivariate Methods:** Multivariate Data, Multivariate Normal Distribution, Multivariate Classification, Discrete Features, Multivariate Regression **Nonparametric Methods:** Introduction, Nonparametric Density Estimation, Generalization to Multivariate Data, Nonparametric Classification.	10hrs

UNIT-3	
Dimensionality Reduction and Clustering **Dimensionality Reduction:** Introduction, Subset Selection, Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis, Isomap. **Clustering:** Introduction, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Choosing the number of clusters. **Kernel Machines:** Introduction, Optimal Separating Hyperplane, The Non-Separable Case: Soft Margin Hyperplane, νSVM, Kernel Trick, Vectorial Kernels, Defining Kernels, Multiple Kernel Learning, Multiclass Kernel Machines.	10hrs
UNIT-4	
Fundamentals of Deep Learning: **The Neural Network:** Building Intelligent Machines, The Limits of Traditional Computer Programs, The Mechanics of Machine Learning, The Neuron, Expressing Linear Perceptron as Neurons, Feed-forward Neural Networks, Linear Neurons and their Limitations, Sigmoid Tanh and ReLU Networks, Softmax Output Layers. **Training Feed-Forward Neural Networks**: The Cafeteria Problem, Gradient Descent, The Delta Rule and Learning Rates, Gradient Descent with Sigmoidal Neurons.	10hrs

TEXTBOOKS	
1	Introduction to Machine Learning; EthemAlpaydın, Third Edition, PHI ISBN No. 978-81-203- 5078-6.
2	Fundamentals of Deep Learning, Nikhil Buduma, First Edition, O'Reilly, ISBN No. 978-14-919- 2561-4.
REFERENCES	
1	Understanding Machine Learning(From Theory to Algorithms), Shaishalev-Shwartz and Shai Ben-David, First Edition, Cambridge University Press, , ISBN No. 978-1-107-51282-5.
2	Pattern Recognition and Machine Learning, Christopher M. Bishop, Mcgraw-Hill, ISBN No. 0- 07-115467-1. Paperback – 23 August 2016
3	Machine Learning,Tom Mitchell, First Edition,Mcgraw-Hill, ISBN No. 0-07-115467-1.
4	Deep Learning (Adaptive Computation and machine Learning Series), Ian Goodfellow and YoshuaBengio, Illustrated, 3 January 2017, MIT Press, Massachusetts London, England, ISBN No. 9780262035613.

DATA ANALYTICS					
Course Code	**CE723**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40 hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125 marks	**25**	**0**	**100**	**0**	**0**

Course Objectives

The subject aims to provide the student with:

1	To learn, understand and practice Big Data Analytics
2	To introduce and learn about the tools required to manage and analyze Big Data like Hadoop, NoSQL, MapReduce
3	To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
4	To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes

The Student will be able to:

CE723.1	Explain the fundamental concepts of database management and to demonstrate basic data analysis techniques.
CE723.2	Demonstrate the Data Analytics Lifecycle to address big data analytics projects
CE723.3	Apply appropriate analytic techniques and tools to analyze big data, create statistical models, and identify insights that can lead to actionable results
CE723.4	Illustrate the appropriate data visualizations to clearly communicate analytic insights to business sponsors and analytic audiences

UNIT-1	
Basic Data Analysis Techniques: **Introduction** to Data Analytics, Data pre-processing, concepts of supervised and unsupervised learning. Sampling, sampling methods and re-sampling **Basic statistics**: Mean median, standard deviation, variance, correlation and covariance. **Linear regression:** Simple linear regression, introduction to multiple linear regressions.	10hrs
UNIT-2	
Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance and covariance **Classification:** logistic regression, decision trees, SVM., Naïve Bayesian	10hrs

classifiers, text analysis. **Ensemble methods**: bagging, random forests, boosting. **Clustering:** K-means, K-medoids, Hierarchical clustering. **Association Rules**, Apriori algorithm.	
UNIT-3	
DBMS, NoSQL and Basic Data Analytics Lifecycle : **DBMS:** Introduction to Database Management Systems, Purpose of Database Systems, Database System Applications, View of Data, Database Languages, Database System Structure. **Introduction to NoSQL Database:** Types and examples of NoSQL Database-Key value store, document store, graph, Performance, Structured verses unstructured data, Comparative study of SQL and NoSQL **Basic Data Analytics:** Need of Data analytic lifecycle, Key roles for successful analytic projects. **Phases of Data analytic lifecycle:** Discovery, Data Preparation, Model Planning, Model Building, Communicating Results, Operationalization.	10hrs
UNIT-4	
Data Analytics using R - Theory, Methods & Case Studies: **Introduction to R:** GUI of R, R nuts and Bolts, Getting data into & out of R, Data types in R, Basic operations, Basic statistics, Generic functions, Data visualization using R, Data exploration & presentation, Statistics for model building & evaluation. **Case study using R:** Call Data Record analytics, Medical Data Analysis	10hrs

TEXTBOOKS	
1	"Data Science & Big Data Analytics", David Dietrich, Barry Hiller, EMC education services, Wiley publications, 2012
2	"The Elements of Statistical Learning", Trevor Hastie, Robert Tibshirani, Jerome Friedman,Second Edition, 2011, Springer,
3	"Database System Concepts", Silberschatz A., Korth H., Sudarshan S., 6th edition, McGraw Hill Publishers, ISBN 0-07-120413-X,
4	Mark gardner, "Beginning R: The Statistical Programming Language", Wrox Press (WILEY), 2012
REFERENCES	
1	C J Date, "An Introduction to Database Systems", 8th Edition, Addison-Wesley, ISBN: 0201144719,Addison-Wesley Pub.Co.
2	Adam Fowler, "NoSQL For Dummies", 2015, John Wiley & Sons, ISBN-1118905628.

MOBILE COMPUTING AND ANDROID PROGRAMMING					
Course Code	**CE724**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives

The subject aims to provide the student with:

1	To understand the basic concepts of mobile computing.
2	To be familiar with the MAC, IP and Transport layer protocols and Ad-Hoc networks.
3	To learn the basics of GSM.
4	To understand the basics of android programming.

Course Outcomes

The Student will be able to:

CE724.1	Explain the basics of mobile telecommunication system
CE724.2	Identify issues and the solution for at each layer of the mobile network protocol stack
CE724.3	Discuss/Study GSM and services
CE724.4	Explain and apply/Study the basics of Android Programming.

UNIT-1	
Introduction: Mobile computing characteristics Mobile Computing vs wireless Networking Simplified Reference model **Wireless Transmission:** Frequencies for Radio Transmission Signals **Medium Access Control:** Motivation for a specialized MAC – Hidden and exposed terminals, near and far terminals SDMA FDMA TDMA – fixed TDM, classical aloha, slotted aloha, CSMA, Multiple access with collision avoidance (MACA) CDMA Comparison of S/T/F/CDMA	10hrs

UNIT-2	
Mobile Internet Protocol: Mobile IP Packet Delivery Overview of mobile IP Desirable features of Mobile IP Key mechanism used in Mobile IP **Mobile Transport Layer:** Traditional TCP - Congestion control, Slow start, fast retransmit/fast recovery, Implications on mobility Classical TCP improvements – Indirect TCP, Snooping TCP, Mobile TCP	10hrs
UNIT-3	
GSM: Services System Architecture **Mobile AD-HOC Networks :** Ad-Hoc Basic Concepts – setup without infrastructure support, routing in MANET complex task Characteristics of MANETs Applications of MANETs Popular MANET routing protocols – DSDV, DSR Security Issues in MANETs	10hrs
UNIT-4	
An Overview of the Android Architecture: Android Software Stack ,Linux Kernel, Android Runtime – ART, Android Libraries - C/C++ Libraries, Application Framework, Applications. **The Anatomy of an Android Application:** Android Activities, Android Intents, Broadcast Intents, Broadcast Receivers, Android Services, Content Providers, The Application Manifest, Application Resources, Application Context. **Understanding Android Application and Activity Lifecycles:** Android Applications and Resource Management, Android Process States, Foreground Process, Visible Process, Service Process, Background Process, Empty Process , Inter-Process Dependencies, The Activity Lifecycle , The Activity Stack, Activity States.	10hrs

TEXTBOOKS	
1	Mobile Communications; Jochen H. Schiller; Second Edition; Pearson Education, New Delhi; 2007.
2	Fundamentals of Mobile Computing; Prasant Kumar Pattnaik, Rajib Mall; Second Edition; PHI Learning Pvt. Ltd, New Delhi; 2012.
3	Android Studio 2 Development Essentials;Neil Smyth; CreateSpace Independent Publishing Platform; 2016
REFERENCES	
1	UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober; Principles of Mobile Computing; Springer; 2003
2	John Horton; Android Programming for Beginners; Second Edition; Packt Publishing; 2015

COMPILER DESIGN LAB					
Course Code	**CE730**		**Credits**	**2**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	0	**0**	**2**		
Scheme of Examination TOTAL = 75 marks	**IA**	**TW**	**TM**	**P**	**O**
	0	**25**	**0**	**0**	**50**

Course Objectives

The subject aims to provide the student with:

1	To understand the basic principles of compiler design
2	To know the major steps involved in translating a high-level programming language down to a low-level target machine language
3	To understand the relationship between machine and assembly language, compilers, interpreters, linkers, loaders, assemblers and macro preprocessors
4	To construct efficient algorithms for compilers

Course Outcomes

The Student will be able to:

CE730.1	Understanding different phases of compilation process.
CE730.2	Demonstrate modern tools and techniques used in compilers.

List of Experiments

(Experiments are not limited to the list but a minimum of 8 experiments is to be completed)

Sr No	Title
1	To eliminate left recursion from grammar
2	A program to detect tokens from user defined expression.
3	A LEX program to find if the input is integer, real number or word
4	A LEX program to convert decimal numbers to hexadecimal numbers.
5	A Lex program to include line numbers in a given source program
6	A LEX program to compute average of given set of numbers.
7	A YACC program to parse an expression for a given grammar.
8	A program to compute First and Follow for a user specified grammar.
9	A program to compute Leading and Trailing for a user specified grammar.
10	To implement code generation algorithm.
11	Intermediate code for simple assignment statement using YACC tool.
12	Implementation of Common Sub expression technique using DAG
13	A program to simulate a Predictive Parser.
14	Syntax Phase implementation for If , Nested If using YACC

TEXTBOOKS	
1	Compilers – Principles, Techniques, and Tools, Alfred Aho, Monica Lam, Ravi Sethi and Jeffrey Ullman, 2nd Edition, Pearson, ISBN: 978-81-317-2101-8, 2009.
2	Compiler design with FLEX and YACC; Vinu V. Das, 2007, PHI publication, ISBN:978- 81-203-3251-5
3	Systems Programming by D M Dhamdere, 2011, Tata McGraw Hill Education Private Limited

REFERENCES	
1	Louden; Compiler Construction, Principles and Practice; 2006, Galgotia Publication, ISBN:0-534-93972-4
2	Compiler design in C; Holub A I , 1992, Prentice-Hall, ISBN:0-87692-778-9
3	System Programming and Compiler Construction; R.K. Maurya, Anand A. Godbole; 2014; Dreamtech Press,ISBN 13:9789351197195
4	Compiler Design; A.A.Putambekar; First Edition 2009,Technical Publications Pune

SEM VIII

CRYPTOGRAPHY TECHNIQUES FOR NETWORK SECURITY					
Course Code	**CE810**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 Hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:
The subject aims to provide the student with

1	Familiarize with Cryptography and very essential algorithms.
2	Understand Symmetric-key cryptosystem and Asymmetric-key cryptosystem.
3	Understand Authentication and Key management.
4	Understand concepts of Network security.

Course Outcomes:
At the end of the course the student will be able to:

CE810.1	Demonstrate the concepts of Symmetric-key cryptography.
CE810.2	Illustrate the concepts of Asymmetric-key cryptography.
CE810.3	Discuss the Hash functions, Digital signatures and Key management.
CE810.4	Identify the security aspects at application layer, transport layer and network layer.

UNIT -1	
Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography. **Block Ciphers and The Data Encryption Standard**: Traditional Block Cipher Structure, Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design principles. **Advanced Encryption Standard**: AES Structure.	10 hours
UNIT -2	
Block Cipher Operation: Multiple Encryption and Triple DES, Electronic Code Book, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode. **Stream Cipher,** RC4.	10 hours

Public Key Cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm. **Other Public key CryptoSystems:** Diffie-Hellman Key Exchange, Elgamal Cryptographic System.	
UNIT -3	
Cryptographic Hash Functions: Applications of CHF, Two Simple Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA-512). **Message Authentication Code**s: Message Authentication Requirements, Message Authentication Functions, Requirements for MACs, Security of MACs, MACs based on Hash Functions (HMAC). **Digital Signatures**: Digital Signatures, Elgamal Digital Signature Scheme, NIST Digital Signature Algorithm.	10 hours
UNIT -4	
Key Management and Distribution: Symmetric Key Distribution using Symmetric Encryption, Symmetric Key Distribution using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public key infrastructure, Kerberos. **Transport Level Security**: Web Security Considerations, Secure Socket layer, HTTPS, Secure Shell (SSH). **Electronic Mail Security**: Pretty Good Privacy, S/MIME. **Wireless Network Security**: Wireless Security, IEEE 802.11 wireless LAN overview, IEEE 802.11i Wireless LAN Security.	10 hours

TEXTBOOKS	
1	**Cryptography and Network - Security Principles and Practice**, William Stallings, Pearson, 6th Edition, 2014.
2	**Cryptography and Network Security**, Behrouz A. Forouzan, DebdeepMukhopadyay, McGraw Hill Education, 2nd Edition, 2010.
REFERENCES	
1	**Cryptography and Network Security**,Atul Kahate,McGraw Hill Education, 3rd Edition, 2011

INTERNET OF THINGS					
Course Code	**CE821**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 Hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:
The subject aims to provide the student with

1	Assess the genesis and impact of IoT applications, architectures in the real world.
2	Illustrate diverse methods of deploying smart objects and connect them to the network.
3	Compare different Application protocols for IoT.
4	Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Course Outcomes:
At the end of the course the student will be able to:

CE821.1	List the impact and challenges posed by IoT networks leading to new architectural models.
CE821.2	Compare and contrast the deployment of smart objects and the IoT protocols used technologies to connect them to the network efficiently.
CE821.3	Identity the management models in IoT.
CE821.4	Formulate the different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

UNIT -1	
Introduction to IoT: Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges. **IoT Network Architecture and Design:** Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	10 hours

UNIT -2	
Smart Objects The "Things" in IoT: Sensors, Actuators, and Smart Objects, Sensor Networks. **Connecting Smart Objects**: Communications Criteria, IoT Access Technologies. **IP as the IoT Network Layer**: The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.	10 hours
UNIT -3	
Identity Management Models: Different Identity Management Models,User Centric, Device Centric and Hybrid Trust management Life Cycle. **Identity and Trus**t: Web of Trust Model. **Access control:** Access control in IoT context, Different access control schemes, Capability-based access control, Concept of capability, Identity-based capability structure, Identity-driven capability-based access control.	10 hours
UNIT -4	
IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. **IoT Physical Devices and Endpoints - RaspberryPi**: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Demonstration of Wireless Temperature Monitoring System Using Pi & DS18B20 Temperature Sensor, Demonstration on Connecting Raspberry Pi via SSH for Remoteaccess. **Smart and Connected Cities**: An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.	10 hours

TEXTBOOKS	
1.	**"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",** David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry**,** 1st Edition, Pearson Education (Cisco Press Indian Reprint), 2017. (ISBN: 978-9386873743),
2.	**"Internet of Things",** Srinivasa K G, 1st Edition, CENGAGE Learning India, 2018.
3.	"**Identity management for internet of things"**, Parikshit N. Mahalle and Poonam N. Railkar. Vol. 39. River Publishers, 2015.
REFERENCES	
1	**"Internet of Things (A Hands-on-Approach)",** Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014. (**ISBN:** 978-8173719547).
2	**"Internet of Things: Architecture and Design Principles",** Raj Kamal, 1st Edition, McGraw Hill Education, 2017. (**ISBN:** 978-9352605224).

PATTERN RECOGNITION					
Course Code	**CE822**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 Hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.
2	To introduce students to a variety of pattern recognition algorithms.
3	To be able to identify applications of pattern recognition.
4	To develop a foundation that can used as the basis for further study and research in pattern recognition

Course Outcomes:

At the end of the course the student will be able to:

CE822.1	Explain the pattern recognition concepts and representative structures.
CE822.2	Understand the concepts of kNN and Bayes classifiers and their variants.
CE822.3	Asses the concepts of HMM, SVM and Neural Networks.
CE822.4	Justify the use of PCA in applications of pattern recognition.

UNIT -1	
Introduction- Introduction to Pattern Recognition, Different paradigms for Pattern Recognition. **Representation**- Data Structures for Pattern Representation: Patterns as Vectors, Patterns as Strings, Logical Descriptions, Fuzzy and Rough Pattern Sets, Patterns as Trees and Graphs. Representation of Clusters. Proximity Measures: Distance Measure, Weighted Distance measure, Non-Metric Similarity function, Edit Distance, Mutual Neighbourhood Distance, Conceptual Cohesiveness, Kernel Functions. Size of Patterns: Normalization of Data, Use of appropriate similarity measures. Abstraction of Data Set. Feature Extraction: Fisher's Linear Discriminant, Principal Component Analysis. Feature Selection: Exhaustive Search, Branch and Bound Search, Selection of Best Individual Features, Sequential Selection, Sequential floating search, Max-Min approach to feature selection, Stochastic Search Techniques, Artificial NeuralNetworks. Evaluation of Classifiers.Evaluation ofClustering.	10 hours
UNIT -2	
Nearest Neighbour Based Classifiers- Nearest Neighbour Algorithm. Variants of Nearest Neighbour Algorithm: k-Nearest Neighbour (kNN)algorithm, Modified k-Nearest neighbour(MkNN) algorithm, Fuzzy kNN algorithm, r Near Neighbours. Use of Nearest Neighbour Algorithm for Transaction Databases. Efficient Algorithms: The Branch & Bound algorithm, The Cube algorithm, Searching for Nearest Neighbour by Projection, Ordered Partitions, Incremental Nearest Neighbour Search. Data Reduction. Prototype Selection: Minimal Distance Classifier, Condensation Algorithms, Editing Algorithms, Clustering Methods, Other Methods. **Bayes Classifier**- Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with Nearest Neighbour Classifier. Naïve Bayes Classifier: Classification using Naïve Bayes Classifier, The Naïve Bayes Probabilistic Model, Parameter Estimation, Constructing a classifier from the Probability Model. Bayesian Belief Network.	10 hours

UNIT -3	
Hidden Markov Models- Markov Models for Classification. Hidden Markov Models: HMM parameters, Learning HMMs. Classification using HMMs: Classification of Test Patterns. **Support Vector Machines-** Introduction: Linear Discriminant Functions. Learning the Linear Discriminant Function: Learning the weight vector, Multi-class problems, Generality of Linear Discriminants. Neural Networks: Artificial Neuron, Feed-forward Network, Multilayer perceptron. SVM for Classification: Linearly Separable Case, Non-linearly separable case.	10 hours
UNIT -4	
Continuous Latent Variables- Principal Component Analysis: Maximum variance formulation, Minimum-error formulation, Applications of PCA, PCA for high dimensional data. Probabilistic PCA: Maximum likelihood PCA, EM algorithm for PCA, Bayesian PCA, Factor Analysis. Kernel PCA.	10 hours

TEXTBOOKS	
1.	**Pattern Recognition An Algorithmic Approach,**M. Narasimha Murty, Dr. V SusheelaDevi ,Springer - ISBN 978-0-85729-494-4 (2011)
2.	**Pattern Recognition and Machine Learning,**Christopher M. Bishop,Springer -ISBN-10: 0-387-31073-8 (2006)
REFERENCES	
1.	**Pattern recognition From Classical to Modern Approaches**, Sankar K. Pal, Amita Pal, World Scientific Publishing Company - ISBN 981-02-4684-6 (2002)
2.	**Pattern Recognition and Image Preprocessing**,Sing-Tze Bow, Marcel Dekker - 2nd Edition - 2002

MULTIMEDIA SYSTEMS AND APPLICATIONS					
Course Code	**CE823**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 Hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	Students will acquire an understanding of the fundamental principles of multimedia systems.
2	Students will gain an intuitive understanding of multimedia applications.
3	Tounderstand thestandards availablefor different audio,video and text applications.
4	Students will be introduced to principles and current technologies of multimedia systems

Course Outcomes:

At the end of the course the student will be able to:

CE823.1	Define the fundamental principles of multimedia system.
CE823.2	Categorize the different ways of representing multimedia data.
CE823.3	Discuss the core multimedia processes and technologies.
CE823.4	Illustrate the use of multimedia for the web and mobile platform.

UNIT -1	
Multimedia: Definitions, Where to Use Multimedia, Multimedia in Business, Multimedia in Schools, Multimedia at Home, Multimedia in Public Places, Virtual Reality, Delivering Multimedia, CD-ROM, DVD, Flash Drives, Broadband Internet. **Making Multimedia:**Stages of a Multimedia Project, The Intangibles, Hardware, Software, Authoring Systems. **Images:** Making Still Images, Bitmaps, Vector Drawing, Vector Drawn Objects vs. Bitmaps,3-D Drawing and Rendering, Color, File Formats.	10 hours

UNIT -2	
Sound: Digital Audio, MIDI Audio, MIDI vs. Digital Audio, Multimedia System Sounds, Audio File Formats, Vaughan's Law of Multimedia Minimums, Adding Sound to Project. **Animation**: The Power of Motion, Principles of Animation, Animation by Computer, Making Animations that Work. **Video:** Analog Video, Digital Video, Displays, Digital Video Containers, Obtaining Video Clips, Shooting and Editing Video.	10 hours
UNIT -3	
Planning and Costing: The Process of Making Multimedia, Scheduling, Estimating, RFPs and Bid Proposals. **Designing and Producing:** Designing, Producing. **Content and Talent**: Acquiring Content, Acquiring Talent.	10 hours
UNIT -4	
The Internet and Multimedia: Internet History, Internetworking, Multimedia on the Web, Developing for the Web, Text for the Web, Images for the Web, Sound for the Web, Animation for the Web, Video for the Web. **Mobile Multimedia:** Digital Revolution Worldwide, Mobile Hardware, Connection, Mobile Operating Systems.	10 hours

TEXTBOOKS	
1.	**Multimedia: Making it Work**, Tay Vaughan, Ninth Edition, McGraw Hill Education ISBN-13:978-93-5260-157-8, ISBN-10:93-5260-157-2.
REFERENCES	
1	**A - Multimedia Technologies and Application**, Walterworth John, Ellis Horwood Ltd.- London - 1991.
2	**Multimedia Systems**, John F Koegel Buford - Addison Wesley - First Indian Reprint- 2000.

SOFTWARE DEVELOPMENT FRAMEWORK					
Course Code	**CE824**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**40 hrs/sem**	
Scheme of Examination TOTAL = 125 marks	**IA**	**TW**	**TM**	**P**	**O**
	25	**0**	**100**	**0**	**0**

Course Objectives:

The subject aims to provide the student with

1	Describe their unique features relative to traditional software practices.
2	Study the functionality and behaviors of a software component into a reusable and self-deployable binary unit.
3	Study Agile Software Development, Extreme Programming and Software Development Rhythms.
4	Examine the applications in the real world and addresses their impacts on developing software.

Course Outcomes:

At the end of the course the student will be able to:

CE824.1	Design and construct the software systems using reusable software components based on domain engineering and component-based development.
CE824.2	Assess the conventional principles, concepts and methods in software engineering with the elements of object oriented and CBSE to create client/server systems.
CE824.3	Apply Agile approaches within an overall Project Management Lifecycle framework.
CE824.4	Propose the extreme programming to small applications / projects.

UNIT -1	
Introduction to Software Process: Process models, Generic process models, prescriptive process models and spiral model. **Pattern-based Software design**: Design patterns – kind of patterns, frameworks, describing a pattern, Pattern languages and repositories, Pattern based design in context, Thinking in pattern, Design tasks, Pattern-organizing tables, Common design mistakes. **Cleanroom Software Engineering**: Approach, functional specification, design and testing. **Component-Based Software Engineering**: CBSE process, domain engineering, component-based development, classifying and retrieving components and economics of CBSE.	10 hours
UNIT -2	
Client-Server Software Engineering: Structure of client-server systems, software engineering for Client-Server systems, analysis modelling issues, design and testing issues. **Web Engineering**: Attributes of web-based applications, the WebE process, a framework for WebE, formulating, analyzing web-based systems, design and testing for web-based applications, Management issues. **Reengineering**: Business process reengineering, software reengineering, reverse reengineering, restructuring, forward reengineering, Economics of reengineering.	10 hours
UNIT -3	
Computer-Aided Software Engineering: Building blocks and taxonomy for CASE, integrated CASE environments, integration architecture, CASE repository, case study of tools like TCS Robot. **Agile Programming**: Introduction, Flavors of Agile Development, Agile Manifesto, Refactoring Techniques, Limitations of The Agile Process.	10 hours
UNIT -4	
Extreme Programming (XP): Introduction, XP Equation, XP Values, Assuming Sufficiency- Sufficient time and resources, Constant change of cost, Developer effectiveness, Freedom to experiment. **Extreme Programming Practices & Events:** Introduction, Coding Practices, Developer Practices, Business Practices. **Events**: Introduction - Iteration Planning- Stories and tasks, Estimates and schedules, first iteration, Iteration, Releasing.	10 hours

TEXTBOOKS	
1.	"**Software Engineering a Practitioners Approach**", Roger S. Pressman, 8th Edition – 2014, McGraw-Hill,
2.	"**Software Engineering**", Ian Sommerville, 9th Edition, 2010, Addison-Wesley.
REFERENCES	
1.	"**Software Engineering**",Stephen R. Schach, TMH, Seventh Edition.
2.	"**Design Patterns**", Erich Gamma, Ralph Johnson, Richard Helm, John Vlissides, Pearson Education, 2015.
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