ANNEXURE A

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	3	0	0	**3**	100	25	0	0	125	3
CE532	Neural Networks										
CE533	Object Oriented Programming using JAVA										
CE534	Distributed Operating System										
CE541	Modern Computer Graphics	3	0	0	**3**	100	25	0	0	125	3
CE542	Web-Technologies										
CE543	Testing & Quality Assurance										
CE544	Real Time Systems										
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 AND EXAMINATION 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 & Data Warehousing										
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

ANNEXURE B

SYLLABUS

DATABASE MANAGEMENT AND QUERY PROCESSING					
Course Code	**CE510**		**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 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	**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	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 2	Graph theory with applications, J.A. Bondy and U.S.R.Murthy, Edition 2, 1977 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	**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 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. Computer Graphics; Steven Harrington; Second Edition; Tata McGraw Hill.
2	
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	**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 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 Edition,MC Graw Hilll,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 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)

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	**10 Hrs**
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.	
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