SEM VI

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

The student will be able to:

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

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

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

TEXTBOOKS

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

REFERENCES

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

The student will be able to:

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

The student will be able to:

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with:

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

Course Outcomes:

The student after undergoing this course will be able to:

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

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

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

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

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

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

Course Objectives:

This course will enable students to

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

Course Outcomes:

The student will be able to:

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

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

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

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with:

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

Course Outcomes:

The student will be able to:

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with:

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

Course Outcomes:

The student will be able to:

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

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

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

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

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

Course Objectives:

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

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

Course Outcomes:

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

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

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

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

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

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

Course Objectives:

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

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

Course Outcomes:

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

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

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

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

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

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

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

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

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

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

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

TEXTBOOKS

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

REFERENCES

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

TECHNICAL WRITING AND PROFESSIONAL ETHICS					
Course Code	**HM 200**		**Credits**	**3**	
Scheme of Instruction Hours/ Week	**L**	**T**	**P**	**TOTAL**	
	3	**0**	**0**	**42 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	Comprehensive understanding of the importance of professional ethics.
2	Knowledge of Engineering ethics and ethics in research.
3	Knowledge of the rules in technical writing.
4	Skills required for writing research papers and technical documents.

Course Outcomes:

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

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

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

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

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

SEM VII

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

Course Objectives

The subject aims to provide the student with:

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

Course Outcomes

The Student will be able to:

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

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

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

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

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

Course Objectives

The subject aims to provide the student with:

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

Course Outcomes

The Student will be able to:

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

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

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

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

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

Course Objectives

The subject aims to provide the student with:

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

Course Outcomes

The Student will be able to:

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

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

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

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

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

Course Objectives

The subject aims to provide the student with:

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

Course Outcomes

The Student will be able to:

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

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

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

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

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

Course Objectives

The subject aims to provide the student with:

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

Course Outcomes

The Student will be able to:

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

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

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

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

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

Course Objectives

The subject aims to provide the student with:

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

Course Outcomes

The Student will be able to:

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

List of Experiments

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

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

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

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

SEM VIII

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

Course Objectives:
The subject aims to provide the student with

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

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

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

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

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

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

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

Course Objectives:
The subject aims to provide the student with

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

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

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

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

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

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

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

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

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

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

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

Course Objectives:

The subject aims to provide the student with

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

Course Outcomes:

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

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

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

TEXTBOOKS	
1.	"**Software Engineering a Practitioners Approach**", Roger S. Pressman, 8th Edition – 2014, McGraw-Hill,
2.	"**Software Engineering**", Ian Sommerville, 9th Edition, 2010, Addison-Wesley.
REFERENCES	
1.	"**Software Engineering**",Stephen R. Schach, TMH, Seventh Edition.
2.	"**Design Patterns**", Erich Gamma, Ralph Johnson, Richard Helm, John Vlissides, Pearson Education, 2015.
3.	"**Software Engineering for Embedded Systems: Methods, Practical Techniques, and Applications**", Robert Oshana, Mark Kraeling, Newnes, Publisher (2013*).*