Kerala Technological University

Cluster 4: Kottayam

M. Tech Program in Computer Science & Engineering (Computer & Information Science)

Scheme of Instruction and Syllabus: 2015 Admissions

Cluster Centre

Rajiv Gandhi Institute of Technology, Kottayam

July 2015

Kerala Technological University

(Kottayam Cluster)

M. Tech Program in Computer and Information Science

Scheme of Instruction

Credit requirements **:** 67 (22+19+14+12)
Normal Duration : Regular: 4 semesters; External Registration: 6 semesters
Maximum duration : Regular: 6 semesters; External Registration: 7 semesters
Courses: Core Courses: Either 4 or 3 credit courses; Elective courses: All of 3 credits
Allotment of credits and examination scheme:-

Semester 1 (Credits: 22)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	04 CS 6201	Mathematical Concepts of Computer Science	4-0-0	40	60	3	4
B	04 CS 6203	Modern Information Retrieval	4-0-0	40	60	3	4
C	04 CS 6205	Advanced Digital Image processing	3-0-0	40	60	3	3
D	04 CS 6207	Advanced Computer Networks	3-0-0	40	60	3	3
E	04 CS 6XXX*	Elective - I	3-0-0	40	60	3	3
	04 GN 6001	Research Methodology	0-2-0	100	0	0	2
	04 CS 6291	Seminar - I	0-0-2	100	0	0	2
	04 CS 6293	Image Processing Lab	0-0-2	100	0	0	1
		Total	23				22

**See List of Electives-I for slot E*

List of Elective - I Courses

Exam Slot	Course No.	Course Name
E	04 CS 6204	Machine Learning
E	04 CS 6211	Intelligent Systems
E	04 CS 6213	Algorithms & Complexity
E	04 CS 6215	Virtualized Systems

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Semester 2 (Credits: 19)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	04 CS 6202	Advanced Data Mining	4-0-0	40	60	3	4
B	04 CS 6204	Natural Language Processing	3-0-0	40	60	3	3
C	04 CS 6206	Mathematics of Cryptography	3-0-0	40	60	3	3
D	04 EE 6XXX*	Elective - II	3-0-0	40	60	3	3
E	04 EE 6XXX^	Elective - III	3-0-0	40	60	3	3
	04 CS 6292	Mini Project	0-0-4	100	0	0	2
	04 CS 6294	Network Simulation Lab	0-0-2	100	0	0	1
		Total	22				19

**See List of Electives -II for slot D* *^See List of Electives -III for slot E*

List of Elective - II Courses

Exam Slot	Course Code	Course Name
D	04 CS 6208	Image Analysis and Recognition
D	04 CS 6212	Adhoc Networks
D	04 CS 6214	Cloud Computing
D	04 CS 6216	Parallel Computer Architecture

List of Elective - III Courses

Exam Slot	Course Code	Course Name
E	04 CS 6218	Bioinformatics
E	04 CS 6222	Distributed Operating Systems
E	04 CS 6224	Pattern Recognition
E	04 CS 6226	Agent based Computing

Summer Break

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
NA	04 CS 7290	Industrial Training	0-0-4	NA	NA	NA	Pass /Fail
		Total	4				0

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Semester 3 (Credits: 14)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	04 CS 7XXX*	Elective - IV	3-0-0	40	60	3	3
B	04 CS 7XXX^	Elective - V	3-0-0	40	60	3	3
	04 CS 7291	Seminar - II	0-0-2	100	0	0	2
	04 CS 7293	Project (Phase - I)	0-0-12	50	0	0	6
		Total	20				14

**See List of Electives-IV for slot A* *^See List of Electives-V for slot B*

List of Elective - IV Courses

Exam Slot	Course Code	Course Name
A	04 CS 7201	Computational Linguistics
A	04 CS 7203	Advanced Compiler Design
A	04 CS 7205	Human Computer Interaction
A	04 CS 7207	Advanced Database Management System

List of Elective - V Courses

Exam Slot	Course Code	Course Name
B	04 CS 7204	Big Data Analytics
B	04 CS 7211	Semantic Web
B	04 CS 7213	Object Oriented Software Engineering
B	04 CS 7215	Mobile Communication Networks

Semester 4 (Credits: 12)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	External Evaluation Marks		Credits
NA	04 CS 7294	Project (Phase -II)	0-0-21	70	30	NA	12
		Total	21				12

Total: 67

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6201	Mathematical Concepts of Computer Science	4-0-0: 4	2015

Pre-requisites:

Course Objectives:

- To understand vectors and matrices
- To study mathematical logic and detailed models of computability
- To study graph theory and its applications
- To understand application of probability

Syllabus

It introduces linear algebra, optimization problem, logic, computability, graph theory and probability. The course is intended to cover the main aspects which are useful in studying, describing and modelling of objects and problems in the context of computer algorithms and programming languages.

Course Outcome:

The students will be able to understand the concept of linear algebra, logic, computability, graph theory and probability.

Text Books:

1. Discrete Mathematical Structures for Computer Science (1st Ed): Bernard Kolman, Robert Busby, PHI (1984)

2. Linear Algebra and Probability for Computer Science Applications (1st Ed): Ernest Davis, CRC Press (2012)

References:

1. Graph Theory and Its Applications (2nd Ed): Jonathan L. Gross and Jay Yellen, CRC (2005)

2. Schaum's Outline of Probability, Random Variables, and Random Processes (2nd Ed): Hwei Hsu, McGraw-Hill (2010)

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6201	MATHEMATICAL CONCEPTS FOR COMPUTER SCIENCE	4-0-0:4	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Linear Algebra: Vector spaces—Definition and examples, subspaces, linear independence, basis, dimension, Orthogonality, Eigen-values and vectors, Singular Value Decomposition, Vector and matrix norms.		10	15
MODULE 2: Unconstrained and constrained optimization problem solving methods		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Logic: Propositional logic, Truth tables, Tautologies, Resolution proof system, Predicate logic, Temporal logic.		8	15
MODULE 4: Turing Machines, Recursive and Recursively Enumerable languages, Decidability, Resource bounded computation, Elements of Complexity classes and Complexity measures, Relationships among complexity measures, Polynomial time and space, Theory of NP-completeness		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Basic definitions of Graphs, connectivity of a graph, cut points, cycles – Hamiltonian graphs – sub graphs – s panning sub graphs - isomorphic graphs - matrix representation of graphs, Bipartite graphs, Tree, different characterization of trees - Algorithms on graphs – BFS, DFS Dijkstra's algorithm for shortest path, Floyd's algorithm for all pairs of shortest paths, Kruskal's and Prim's algorithm for minimum spanning tree		12	20
MODULE 6: Random Variables and Stochastic Processes: Random variables, Probability-Random Variables and Expectations, Moments and Deviations, distributions, conditional probability, Bayes Theorem-Functions of random variables, Sequences of random variables, Stochastic processes,Markov chains, Markov processes and basic queuing theory .		12	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6203	MODERN INFORMATION RETRIEVAL	4-0-0:4	2015

Pre-requisites:

Course Objectives:

- Gain practical experience building simple, but true-to-practice retrieval software.
- Appreciate topics in the broad area of information retrieval, including evaluation, classification, cross-language retrieval, and computational linguistics.

Syllabus

To understand the underlying theories and algorithms of advanced information retrieval systems and to introduce the methodology for the design and evaluation of information retrieval systems. Also covers the major types of information retrieval systems models, the different theoretical foundations underlying these systems, and the methods and measures that can be used to evaluate them.

Course Outcome:

The students will learn the underlying concepts of information retrieval and computer based web search tools.

Text Books:

1. Ricardo Baexa-Yates and BerthierRibeiro-Neto, “Modern Information Retrieval”, Addison Wesley Longman, 1999

2. Bing Liu, Web DataMining: Exploring Hyperlinks, Contents, and Usage Data, © Springer-Verlag Berlin Heidelberg 2007.

References:

1. Gerald J. Kowalski, Mark T. Maybury.”Information storage and retrieval systems:Theoryand Implementation” Second Edition , Kluwer Academic Publishers, New York, 2002

2. Zdravko Markov and Daniel T. Larose, Data Mining The Web: Uncovering Patterns InWeb Content, Structure, and Usage, Wiley-Interscience: A John Wiley & Sons, Inc., Publication, 2007)

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6203	MODERN INFORMATION RETRIEVAL	4-0-0:4	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Information retrieval and web search: Web Challenges-Web Search Engines, Topic Directories, Semantic Web, Crawling the Web-Web Basics, Web Crawlers.		6	15
MODULE 2:Indexing and Keyword Search-Document Representation, Implementation Considerations, Relevance Ranking, Advanced Text Search, Using the HTML Structure in Keyword Search. User Search Technique: Search Statements and Binding, Similarity Measures and Ranking, Evaluating Search Quality.		12	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Similarity Search-Cosine Similarity, Jaccard Similarity, Document Resemblance.Information Retrieval Models & Pre-processing: Information Retrieval Models- Boolean Model, Vector Space Model, Statistical Language Model,		8	15
MODULE 4:Inverted Index and Its Compression: Inverted Index-Search Using an Inverted Index, Index Construction, Index Compression		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Relevance Feedback, Evaluation Measures, Text and Web Page Pre-processing, Stop word Removal, Stemming, Other Pre-Processing Tasks, Duplicate Detection		10	20
MODULE 6:Latent Semantic Indexing, Singular Value Decomposition, Query and Retrieval. Searching Algorithms – PageRank, Timed PageRank , HITS, Strengths and Weaknesses of HITS.		12	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6205	ADVANCED DIGITAL IMAGE PROCESSING	3-0-0:3	2015

Pre-requisites: Concepts of Digital Image Processing

Course Objectives:

- To understand processing of digital images
- To familiarize different mathematical structures
- To study detailed image transforms
- To study image segmentation
- To understand wavelets and morphological applications.

Syllabus

Fundamentals of Image Processing:- Image Acquisition, Image Model, Sampling, Quantization. Histogram: Definition, decision of contrast based on histogram, operations based on histograms like image stretching, image sliding. Basic intensity transformation functions, Spatial filtering, smoothing and sharpening filters. Image Transforms:- Fourier Transform of sampled functions, DFT of one and two variables. WALSH and, HADAMARD Transforms. Filtering in the frequency domain: smoothing and sharpening filters. Image Segmentation:- Definition, characteristics of segmentation. Detection of Discontinuities, Thresholding, Pixel based segmentation method. Wavelets:- Image pyramids, subband coding, The Haar transform, wavelet transform in one and two dimensions, wavelet packets.

Course Outcome:

Students will be able to perform Image enhancement and Transforms.

Text Books:

1. Digital Image Processing , Rafael C. Gonzalez and Richard E. Woods 3rd edition, PHI Learning, 2008

References:

1. Fundamentals of Electronic Image Processing by Arthyr –R – Weeks, Jr. (PHI)
2. Image processing, Analysis, and Machine vision by Milan SonkavaclanHalavac Roger Boyle, Vikas Publishing House.
3. Sonka M, Vaclav Hlavac, and Roger Boyle, Image Processing, Analysis and Machine Vision, Brooks Cole, 3rd ed, 2008
4. Jain A K, Fundamentals of Digital Image Processing, Prentice-Hall India, 2007.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6205	Advanced Digital Image Processing	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1:Fundamentals of Image Processing:- Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels, distance measures, connectivity, Image Geometry		6	15
MODULE 2:Histogram: Definition, decision of contrast based on histogram, operations based on histograms like image stretching, image sliding. Basic intensity transformation functions, Spatial filtering, smoothing and sharpening filters.		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:Image Transforms:- Fourier Transform of sampled functions, DFT of one and two variables. WALSH and, HADAMARD Transforms. Filtering in the frequency domain: smoothing and sharpening filters		8	15
MODULE 4:Image restoration: noise models, restoration in the presence of noise only, periodic noise reduction.		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5:Image Segmentation:- Definition, characteristics of segmentation. Detection of Discontinuities, Thresholding, Pixel based segmentation method. Region based segmentation methods – segmentation by pixel aggregation, segmentation by sub region aggregation, histogram based segmentation, spilt and merge technique.		8	20
MODULE 6:Wavelets:- Image pyramids, subband coding, The Haar transform, wavelet transform in one and two dimensions, wavelet packets. Morphology:- Dilation, Erosion, Opening, closing, Hit-and-Miss transform, Connected components, thinning, Thickening, skeletons, Application of Morphology in image processing.		6	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6207	Advanced Computer Networks	3-0-0:3	2015

Pre-requisites: Concepts of computer networks

Course Objectives:

- To understand analog and digital transmission.
- To understand TCP/IP Protocol architecture
- To understand TCP features and applications
- To understand HTTP architecture

Syllabus

Description on transmission media, Analog and digital transmission, Introduction to TCP/IP protocol suite, Protocols, detailed description of different layers of TCP/IP Protocol architecture and associated protocols.

Course Outcome:

The students will learn the underlying mechanisms used for analog& digital data transmission & protocols associated with the computer networks.

Text Books:

1. William Stallings, “Data and Computer Communications” , Pearson Education.

2. Kurose and Ross, “Computer Networks A systems approach” , Pearson Education.

References:

1.Behrouz A Forouzan, ”TCP/IP Protocol Suite”, Tata McGraw-Hill.

2.Peterson and Davie, “Computer Networks A systems approach” , Elsevier.

3. Behurouz A Forouzan, “Data Communications & Networking”,4th edition, McGraw-Hill.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6207	Advanced Computer Networks	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Physical Layer: Data Transmission- Analog and Digital Transmission, Transmission Impairments, Channel Capacity. Transmission Media- Wired Transmission, Wireless Transmission, Wireless Propagation, Line-of Sight Transmission, Signal Encoding Techniques.		7	15
MODULE 2: Data link layer: TCP/IP Protocol Architecture, Framing, Reliable Transmission, Ethernet (802.3) and Token Ring (802.5)		5	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Network Layer: Connecting Devices. ARP, RARP. IP Address - Sub netting / Super netting, Packet Forwarding with Classful / Classless Addressing, Datagram Fragmentation, Components in IP software, Private IP and NAT, ICMP.		6	15
MODULE 4: Routing Protocols -Distance Vector Routing-RIP, Link-State Routing-OSPF		4	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Transport Layer: UDP- Port Addressing, UDP datagram, UDP operation. TCP- TCP services and features, TCP segment, TCP connection, TCP state transitions, TCP module's algorithm, Flow and Error control, Congestion control, TCP Timers. SCTP- SCTP services and features, Packet format, SCTP connection, State Transitions, Flow and Error control.		10	20
MODULE 6: Application Layer: DNS- Distribution of Name Space, Name Resolution, DNS messages, HTTP-Architecture, HTTP Transaction,DHCP - Address allocation, Packet format. SNMP- SMI, MIB, SNMP PDUs, Real Time Data Transfer- RTP, RTCP, Voice over IP-Session Initiation Protocol.		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6204	MACHINE LEARNING	3-0-0: 3	2015

Pre-requisites: Concepts of Artificial Neural Networks

Course Objectives:

- To illustrate the design of a learning system.
- To impart a basic knowledge about the learning algorithms and theory that form the foundation of machine learning

Syllabus

Introduction: Well defined learning problems, Designing a Learning System, Issues in Machine Learning. The Concept Learning Task. General-to-specific ordering of Hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias. ARTIFICIAL NEURAL NETWORKS: Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Backpropagation Algorithm, Convergence, Generalization. BAYESIAN LEARNING: Bayes theorem, Concept learning, Bayes Optimal Classifier. Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces,Sample Complexity for Infinite Hypothesis spaces

Course outcome:

Student will be able to learn Computational Learning Theory and classification

Text Books:

1. Machine Learning, Tom.M.Mitchell, McGraw Hill International Edition 1 edition 1997.

References:

1. Introduction to Machine Learning, EthernAlpaydin, Eastern Economy Edition, Prentice Hall of India, 2005.
2. Pattern Recognition and Machine Lerning -Christopher M Bishop - Springer
3. A probabilistic perspective - Kevin P Murphy - Machine Learning- MIT Press
4. Neural Networks and Learning Machines –Simon S Haykin Prentice Hall of India

COURSE PLAN

COURSE CODE:	COURSE TITLE:	CREDITS	
04 CS 6204	Machine Learning	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE: 1 – Introduction: Well defined learning problems, Designing a Learning System, Issues in Machine Learning. The Concept Learning Task. General-to-specific ordering of Hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias.		6	15
MODULE: 2 - Decision Tree Learning: Decision tree learning algorithm,Inductive bias, Issues in Decision tree learning		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 - Artificial Neural Networks: Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Backpropagation Algorithm, Convergence, Generalization.		8	15
MODULE: 4 - Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms. BAYESIAN LEARNING: Bayes theorem, Concept learning		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 -Bayes Optimal Classifier. Naïve Bayes classifier, Bayesian belief networks, EM algorithm. Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces,Sample Complexity for Infinite Hypothesis spaces.		7	20
MODULE: 6 -The Mistake Bound Model of Learning; Instance-Based Learning, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial basis function networks, Case based learning		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6211	INTELLIGENT SYSTEMS	3-0-0: 3	2015

Pre-requisites: Concepts of Artificial Intelligence

Course Objectives:

- Learn the concepts of Agents
- Explain the basic knowledge representation, problem solving, and learning methods of Artificial Intelligence
- Assess the applicability, strengths, and weaknesses of the basic knowledge representation,
- problem solving, and learning methods in solving particular engineering problems
- Develop intelligent systems by assembling solutions to concrete computational problems
- Understand the role of knowledge representation, problem solving, and learning in intelligent-system engineering

Syllabus

Introduction to Agents, uninformed and informed search strategies, Knowledge representations and reasoning, Learning techniques, Introduction to Neural Networks.

Course outcome:

The students will learn general and specialized knowledge representations and reasoning mechanisms, problem solving and search algorithms, and machine learning techniques.

Text Books:

5. Artificial Intelligence: A Modern Approach (3rd Ed): Stuart Russell and Peter Norvig, PHI (2004).

References:

1. Artificial Intelligence: A Systems Approach (1st Ed): M. Tim Jones, Jones and Bartlett Publishers(2008)
2. Software Agents: Jeffrey M.Bradshaw, AAAI Press (1997)

COURSE PLAN

COURSE CODE:	COURSE TITLE:	CREDITS	
04 CS 6211	Intelligent Systems	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 – Artificial Intelligence – Introduction -Intelligent agents - Agents and Environments - Structure of agents - Agent types - Problem solving agents		5	15
MODULE: 2 - Uninformed Search strategies – DFS, BFS, Depth limited search, Iterative deepening depth first search, Bidirectional Search		4	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 - Informed Search and Exploration – Informed search strategies – Heuristics Function - Local Search Algorithms and Optimization Problems - Online Search Agents		6	15
MODULE: 4 - Constraint Satisfaction Problems - Adversarial Search - The minimax algorithm - Alpha-Beta Pruning		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 -Knowledge and reasoning - Knowledge Based Agents - First order logic – Reasoning - Backward chaining – Resolution - Knowledge representation - Handling uncertain knowledge - Reasoning under uncertainty – Statistical Reasoning		11	20
MODULE: 6 -Learning - forms of learning - Inductive learning - Learning decision trees- Explanation based learning - Statistical learning - Instance based learning - Reinforcement learning.Neural networks – Learning with Backpropogation		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6213	ALGORITHMS & COMPLEXITY	3-0-0: 3	2015

Pre-requisites: Basic concepts of algorithms and data structures

Course Objectives:

- To know problem solving techniques
- To understand techniques of randomized algorithms
- To understand NP completeness and approximation algorithms

Syllabus

The syllabus covers the asymptotic notations, a brief overview of advanced data structures, graph and randomized algorithms. Also covers complexity classes and approximation algorithms.

Course outcome:

The students will learn the techniques for Analysis of algorithms and advanced datastructures giving emphasis on methods useful in practice.

Text Books:

6. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, Introduction to Algorithms, 3rd Edition, Prentice Hall India, 1990.

7. S. Basse, Computer Algorithms: Introduction to Design and Analysis, Addison Wesley, 1998.

References:

1. Dexter Kozen, The Design and Analysis of Algorithms, Springer, 1992.

2. U. Manber, Introduction to Algorithms: A creative approach, Addison W1989.

3. V. Aho, J. E. Hopcraft, J. D. Ullman, The design and Analysis of Computer Algorithms, Addison Wesley, 1974.

COURSE PLAN

COURSE CODE:	COURSE TITLE:	CREDITS	
04 CS 6213	Algorithms & Complexity	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE: 1 – Analysis: RAM model – Notations, Recurrence analysis - Master's theorem and its proof		8	15
MODULE: 2 - Amortized analysis - Advanced Data Structures: B-Trees, Binomial Heaps - Fibonacci Heaps, Disjoint Sets, Union by Rank and Path Compression.		5	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 - Graph Algorithms and complexity: Matroid Theory - All-Pairs Shortest Paths - Maximum Flow and Bipartite Matching.		5	15
MODULE: 4 - Randomized Algorithms : Finger Printing - Pattern Matching - Graph Problems, Algebraic Methods - Probabilistic Primality Testing, De-Randomization		4	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 -Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions. Approximation algorithms		10	20
MODULE: 6 -Polynomial Time and Fully Polynomial time Approximation Schemes. Probabilistic Complexity Classes, Probabilistic Proof Theory and Certificates.		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6215	VIRTUALIZED SYSTEMS	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- The course introduces the concepts and principles of virtualization, the mechanisms and techniques of building virtualized systems, as well as the various virtualization-enabled computing paradigms.

Syllabus

Introduces the concepts of Virtualization and its history, general structures and architectures. The syllabus also covers virtualization in memory management, OS level and I/O level. Concepts of Virtual networking, virtual storage and virtual computing is also covered.

Course outcome:

The student will be able to do Virtualized computing and networking.

Text Books:

8. Virtual Machines: Versatile Platforms for Systems and Processes (1st Ed): Jim Smith, Ravi Nair; Morgan Kaufmann (2005).

References:

4. Applied Virtualization Technology - Usage models for IT professionals and Software Developers (1st Ed): Sean Campbell Intel Press (2006).

COURSE PLAN

COURSE CODE:	COURSE TITLE:	CREDITS	
04 CS 6215	Virtualized Systems	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 – Overview: Why server virtualization History and re-emergence - General structures. Architectures comparison. Commercial solutions –VMWare, Xen.		8	15
MODULE: 2 - Virtual machines: CPU virtualization -Privileged instructions handling -Hypervisor -Paravirtualization. Hardware-assisted virtualization. Booting up. Time keeping. CPU scheduling. Commercial examples.		5	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 - Memory management in virtualization: partitioning – reclamation –ballooning. Memory sharing OS-level virtualization –VMWare –Red Hat Enterprise Virtualization.		5	15
MODULE: 4 - I/O virtualization: Virtualizing I/O devices -monolithic model -virtual I/O server.		4	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 -Virtual networking –tunneling –overlay networks. Commercial examples. Virtual storage: Granularity -file system level – blocks level.		10	20
MODULE: 6 -Virtualized computing: Virtual machine based distributed computing, elastic cloud computing, clustering, cold and hot migration. Commercial examples - Challenges and future trends.		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
04 GN 6001	RESEARCH METHODOLOGY	0-2-0:2	2015

Pre-requisites:

Course Objectives:

To enable the students:

- To get introduced to research philosophy and processes in general.
- To formulate the research problem and prepare research plan
- To apply various numerical /quantitative techniques for data analysis
- To communicate the research findings effectively

Syllabus

Introduction to the Concepts of Research Methodology, Research Proposals, Research Design, Data Collection and Analysis, Quantitative Techniques and Mathematical Modeling, Report Writing.

Course Outcome:

Students who successfully complete this course would learn the fundamental concepts of Research Methodology, apply the basic aspects of the Research methodology to formulate a research problem and its plan. They would also be able to deploy numerical/quantitative techniques for data analysis. They would be equipped with good technical writing and presentation skills.

Text Books:

1. Research Methodology: Methods and Techniques', by Dr. C. R. Kothari, New Age International Publisher, 2004
2. Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar, SAGE Publications Ltd; Third Edition

References:

1. Research Methodology: An Introduction for Science & Engineering Students', by Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004
2. Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville, Juta and Company Ltd, 2004
3. Research Methodology, G.C. Ramamurthy, Dream Tech Press, New Delhi
4. Management Research Methodology' by K. N. Krishnaswamy et al, Pearson Education

COURSE CODE:	COURSE TITLE	CREDITS	
04 GN 6001	RESEARCH METHODOLOGY	0-2-0: 2	
MODULES		Contact Hours	
MODULE : 1 Introduction to Research Methodology: Concepts of Research, Meaning and 2 Objectives of Research, Research Process, Types of Research, Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical		5	
MODULE :2 Criteria of Good Research, Research Problem, Selection of a problem, Techniques involved in definition of a problem, Research Proposals – Types, contents, Ethical aspects, IPR issues like patenting, copyrights.		4	
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 **Research Design :** Meaning, Need and Types of research design, Literature Survey and Review, Identifying gap areas from literature review, Research Design Process, Sampling fundamentals, Measurement and scaling techniques, Data Collection – concept, types and methods, Design of Experiments.		5	
MODULE 4: **Quantitative Techniques:** Probability distributions, Fundamentals of Statistical analysis, Data Analysis with Statistical Packages, Multivariate methods, Concepts of correlation and regression - Fundamentals of time series analysis and spectral analysis.		5	
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 **Report Writing:** Principles of Thesis Writing, Guidelines for writing reports & papers, Methods of giving references and appendices, Reproduction of published material, Plagiarism, Citation and acknowledgement.		5	
MODULE: 6 Documentation and presentation tools – LaTeX, Office with basic presentations skills, Use of Internet and advanced search techniques.		4	

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 6202	ADVANCED DATA MINING	4-0-0:4	2015

Pre-requisites:

Concepts of Data mining

Course Objectives:

- Introduce the fundamental concepts of data and data analysis.
- Case based study of specific data mining tasks like Clustering, Classification, regression, Pattern Discovery and Retrieval by Content.
- Introduce algorithms for temporal data mining and spatial data mining.

Syllabus

Fundamentals of data mining, Data Mining Functionalities, Data Mining Task Primitives.Classification and prediction :Decision tree induction-bayesian classification-rule-based classification- neural networks-support vector machines. Cluster Analysis:portioning methods-hierarchical methods- density based methods-grid based-model based-constraint based-clustering high dimensional data-outlier analysis. Mining Streams, Time Series and Sequence Data: Mining Data Streams, Mining Time-Series Data. Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining.

Course Outcome:

The student will demonstrate the ability to understand the basic concepts of data mining

Text Books:

1. Data mining concepts and techniques- Jiawei Han & Micheline Kamber , Elsevier (2008)

References:

1. Data mining methods and Techniques: A B M Showkat Ali, Saleh A Wasimi, Cengage Learning (2004)
2. Introduction to Data mining with case studies: G.K Gupta PHI (2008).
3. Temporal Data mining –Theophano Mitsa, CRC Press (2010)
4. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education., 1/E (2005)

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 6202	ADVANCED DATA MINING	4-0-0:4	
MODULES		**Contact hours**	**Sem. Exam Marks;%**
MODULE : 1 Fundamentals of data mining, Data Mining Functionalities, Data Mining Task Primitives, Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation. Mining Frequent Patterns		10	15
MODULE : 2 Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Mining various kinds of Association Rules. Classification and prediction:Decision tree induction-bayesian classification-rule-based classification- neural networks-support vector machines.		10	15
FIRST INTERNAL TEST			
MODULE : 3 Lazy learners-genetic algorithms- prediction-accuracy and error measures-ensemble methods- model selection. Cluster Analysis: portioning methods-hierarchical methods- density based methods-grid based-model based-constraint based-clustering high dimensional data-outlier analysis		8	15
MODULE : 4 Mining Streams, Time Series and Sequence Data: Mining Data Streams, Mining Time-Series Data. Mining Sequence Patterns in Transactional Databases, Mining Sequence Patterns in Biological Data		8	15
SECOND INTERNAL TEST			
MODULE : 5 Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining		10	20

MODULE : 6 Multimedia Data Mining, Description-based retrieval systemsContent-based retrieval systems,Visual datamining,Text Mining, Mining the World Wide Web	10	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 6204	NATURAL LANGUAGE PROCESSING	3-0-0:3	2015

Pre-requisites:

Course Objectives:

- To familiarize the fundamentals of speech and written language processing
- To study the applications of these techniques in real world problems like spell-checking, Parts-of Speech Tagging, Corpus development, Wordnet, speech recognition, pronunciation modelling, dialogue agents, document retrieval etc
- To gather information about widely used language processing resources.

Syllabus

Introduction to Natural Language Understanding: Linguistic Background-Applications An Outline of English Syntax-Grammars and Parsing-Features and Augmented Grammars.Grammars for Natural Language: Toward Efficient Parsing, Ambiguity Resolution: Statistical Methods - Basic Probability Theory. POS tagging – Probabilistic CFG's. Knowledge Representation and Reasoning-Local Discourse Context and Reference-Using World Knowledge - Discourse Structure-Defining a Conversational Agent.

Course Outcome:

The student will demonstrate the ability to understand the basic concepts of natural language processing

Text Books:

1. Allen, James. Natural Language Understanding. The Benjamin/Cummings Publishing Company, Inc., Redwood City, CA. 1995.
2. Christopher Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. The MIT Press.

References:

1. Bates, M. (1995). Models of Natural language understanding. Proceedings of the National Academy of Sciences of the United States of America, Vol. 92, No. 22 (Oct. 24, 1995)
2. Speech and Language Processing (2nd Ed): Daniel Jurafsky and James Martin, PH (2008)
3. Bird, S., Klein, E., Loper, E. (2004). Natural Language Processing with Python. Sebastopol, CA: O'Reilly Media.
4. Dan Jurafsky and James Martin. 2000. Speech and LanguageProcessing. Prentice Hall.

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 6204	NATURAL LANGUAGE PROCESSING	3-0-0:3	
MODULES		**Contact hours**	**Sem. Exam Marks;%**
MODULE : 1 Introduction to Natural Language Understanding: Linguistic Background-Applications An Outline of English Syntax-Grammars and Parsing-Features and Augmented Grammars.		7	15
MODULE : 2 Grammars for Natural Language: Toward Efficient Parsing, Ambiguity Resolution: Statistical Methods- Basic Probability Theory		7	15
FIRST INTERNAL TEST			
MODULE : 3 POS tagging – Rule based POS tagging , Stochastic HMM POS tagging , Transformation based tagging, Probabilistic CFG's		8	15
MODULE : 4 Semantics and Logical Form: Linking Syntax and Semantics-Ambiguity Resolution		6	15
SECOND INTERNAL TEST			
MODULE : 5 Strategies for Semantic Interpretation-Scoping and the Interpretation of Noun Phrases		6	20
MODULE : 6 Knowledge Representation and Reasoning-Local Discourse Context and Reference-Using World Knowledge - Discourse Structure-Defining a Conversational Agent		8	20
END SEMESTER EXAM			

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 6206	MATHEMATICS OF CRYPTOGRAPHY	3-0-0:3	2015

Pre-requisites:

Basic concepts of Cryptography

Course Objectives:

- To understand the number theoretic foundations of modern cryptography
- To implement and analyze cryptographic and number theoretic algorithms
- To understand public key cryptosystems
- To understand modern cryptographic techniques

Syllabus

Divisibility, Division Algorithm, Euclidean Algorithm, Congruence, Complete Residue systems, Reduced Residue systems. Fermat's little theorem, Euler's Generalization, Wilson's Theorem, Euler Phi-function, multiplicative property. Discrete Logarithm problem, Introduction to Modern symmetric key ciphers- MODERN BLOCK CIPHERS-Substitution - transposition , Block ciphers as Permutation groups-Components of a Modern block cipher. Asymmetric Key Encipherment : Mathematics of Cryptography: Primes-Definition- Cardinality of primes -checking for primeness ,Generating primes, PRIMALITY TESTING-Deterministic algorithms , Probabilistic algorithms ,FACTORIZATION, Fundamental Theorem of Arithmetic.

Course Outcome:

The student will demonstrate the ability to understand the basic concepts of modern cryptography

Text Books:

1. Cryptography and Network security",Beharoz a Forouzan, Tata McGraw Hill, Special Indian Edition, 2007

References:

1. Introduction to Cryptography with coding theory", Wade Trappe, Lawrence C. Washington ,pearson ,2nd edition
2. A Course in Number Theory and Cryptography, Â Neal Koblitz, (Springer 2006).
3. An Introduction to Mathematical Cryptography, Jill Pipher, Jeffrey Hoffstein, Joseph H. Silverman (Springer, 2008)
4. William Stallings, "Cryptography and network security- principles and practice", Pearson Prentice Hall, 3rd Edition.
5. An Introduction to theory of numbers, Niven, Zuckerman and Montgomery, (Wiley 2006)
6. Charlie Kaufman, Radia Perl man, Mike Speciner , "Network Security private communication in a practice", Pearson Prentice Hall, 2nd Edition.
7. Atul Kahate , "Cryptography and network security", TMGH.

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 6206	MATHEMATICS OF CRYPTOGRAPHY	3-0-0:3	
MODULES		**Contact hours**	**Sem. Exam Marks; %**
MODULE : 1 Divisibility, Division Algorithm, Euclidean Algorithm, Congruence, Complete Residue systems, Reduced Residue systems. Fermat's little theorem, Euler's Generalization, Wilson's Theorem, Euler Phi-function, multiplicative property.		7	15
MODULE : 2 Finite Fields, DLP-Primitive Roots, Quadratic Residues, Legendre Symbol, Jacobi Symbol, Quadratic Reciprocity Law. Symmetric Key Encipherment Mathematics of Cryptography- Algebraic structures Group-Ring-Field, GF(2^n)Fields-Polynomials-Using a Generator.		7	15
FIRST INTERNAL TEST			
MODULE : 3 Discrete Logarithm problem, Introduction to Modern symmetric key ciphers- MODERN BLOCK CIPHERS-Substitution - transposition , Block ciphers as Permutation groups-Components of a Modern block cipher- S-Boxes, Attacks on Block ciphers. MODERN STREAM CIPHERS- Synchronous Stream ciphers and Asynchronous Stream ciphers		6	15
MODULE : 4 Asymmetric Key Encipherment : Mathematics of Cryptography: Primes-Definition- Cardinality of primes -checking for primeness ,Generating primes, PRIMALITY TESTING-Deterministic algorithms , Probabilistic algorithms ,FACTORIZATION, Fundamental Theorem of Arithmetic-Factorization methods-Fermat method ,Pollard p-1 method , Pollard rho method- CHINEESE REMAINDER THEORM, Quadratic congruence, Exponentiation and Logarithm. Asymmetric key cryptography-RSA cryptosystem, RABIN cryptosystem		8	15
SECOND INTERNAL TEST			

MODULE : 5 ELGAMAL cryptosystem, ELLIPTIC CURVE cryptosystem-Elliptic Curves over reals, -Elliptic Curves over finite field, Discrete Log problem for Elliptic curves. Message Integrity and Message Authentication: Message integrity-Document and fingerprint-message and message digest, checking integrity, cryptographic hash function criteria.	8	20
MODULE : 6 RANDOM ORACLE MODEL-Pigeon hole principle Attacks on Random Oracle model. MESSAGE AUTHENTICATION-Modification detection code, Message authentication code.	6	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 6208	IMAGE ANALYSIS AND RECOGNITION	3-0-0:3	2015

Pre-requisites:

Concepts of Digital Image Processing

Course Objectives:

- To understand processing of digital images
- To familiarize different mathematical structures
- To study detailed models of image formation
- To study image feature detection, matching, segmentation and recognition
- To understand classification and recognition of objects

Syllabus

Course Outcome:

The student will demonstrate the ability to understand the processing of digital images

Text Books:

1. Computer vision: Algorithms and Applications (1st Ed): Richard Szeliski , Springer (2010)
2. Algorithms for Image Processing and Computer Vision (2nd Ed): J. R. Parker, Wiley (2010)

References:

1. Learning OpenCV: Computer Vision with the OpenCV Library (1st Ed): Gary Bradski, O'Reilly (2008)
2. Digital Image Processing, Rafael C., Gonzalez & Woods R.E. Addison Wesley, 1999.
3. Digital Image Processing , 1st Edition, T Veerakumar , S Jayaraman , S Esakkirajan.
4. Computer Vision, L. Shapiro, G. Stockman

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 6208	IMAGE ANALYSIS AND RECOGNITION	3-0-0:3	
MODULES		**Contact hours**	**Sem. Exam Marks; %**
MODULE : 1 Introduction - digital image representation - a simple image model - sampling and quantization.		8	15
MODULE : 2 Discrete Fourier Transform -Harr,Walsh and Hadamard transforms.		6	15
FIRST INTERNAL TEST			
MODULE : 3 Texture and Color-Texture and segmentation, Grey-Level Co-occurrence, Edges and Texture, Energy and Texture.		6	15
MODULE : 4 Color segmentation, Color textures. Object detection-face detection-Pedestrian detection		6	15
SECOND INTERNAL TEST			
MODULE : 5 Instance recognition-context and scene understanding . Classification – Objects, Patterns and Statistics, Minimum distance classifiers – Cross validation		8	20
MODULE : 6 SVM – Ensembles – Bagging and boosting, Content-based image retrieval, Features for query by example		8	20
END SEMESTER EXAM			

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 6212	ADHOC NETWORKS	3-0-0:3	2015

Pre-requisites:

Concepts of Networking

Course Objectives:

- To know the constraints of the wireless physical layer that affect the design and performance of ad hoc and sensor network, protocols, and applications;
- To understand MAC, Routing protocols that have been proposed for ad hoc and sensor network
- To understand the energy issues in sensor network and how they can be addressed using scheduling, media access control, and special hardware;
- To explain various security threats to ad hoc networks and describe protocol solutions

Syllabus

Overview of Wireless LAN, PAN - IEEE 802.11- Bluetooth - Wireless WANs and MANs.AD HOC Wireless Networks - Cellular and Ad hoc networks - Applications of Ad hoc networks . Issues in Ad hoc networks - MAC protocols for Ad hoc networks. Routing Protocols for Ad hoc Networks - Classification - Table driven, On demand, Hierarchical Routing Protocols . Energy Management in Ad hoc Networks. Wireless Sensor Networks - Architecture - Data Dissemination and Gathering - Location Discovery.

Course Outcome:

The student will get an understanding of wireless cellular, ad hoc and sensor networks

Text Books:

1. Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, (2nd Ed.), Pearson Education (2005)

References:

1. Wireless Networks: Anurag Kumar, D. Manjunath, Joy Kuri, Morgan Kaufman (1st Ed.), (2008)
2. Ad Hoc & Sensor Networks: Theory and Applications, Carlos de Morais Cordeiro and Dharma Prakash Agrawal, (1st Ed.), World Scientific (2007)

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 6212	ADHOC NETWORKS	3-0-0:3	
MODULES		**Contact hours**	**Sem. Exam Marks; %**
MODULE : 1 Overview of Wireless LAN, PAN - IEEE 802.11- Bluetooth - Wireless WANs and MANs		6	15
MODULE : 2 Cellular Architecture- WLL - IEEE 802.16 - Wireless Internet - IP and TCP in Wireless domain.		6	15
FIRST INTERNAL TEST			
MODULE : 3 AD HOC Wireless Networks - Cellular and Ad hoc networks - Applications of Ad hoc networks . Issues in Ad hoc networks - MAC protocols for Ad hoc networks.		8	15
MODULE : 4 Routing Protocols for Ad hoc Networks - Classification - Table driven, On demand, Hierarchical Routing Protocols . Energy Management in Ad hoc Networks.		8	15
SECOND INTERNAL TEST			
MODULE : 5 Wireless Sensor Networks - Architecture - Data Dissemination and Gathering - Location Discovery.		8	20
MODULE : 6 Applications of WSNs Environmental monitoring , Acoustic detection ,Seismic Detection ,Military surveillance ,Inventory tracking ,Medical monitoring ,Smart spaces Process Monitoring. Hybrid Wireless Networks- Ultra Wideband Systems		6	20

END SEMESTER EXAM			
COURSE NO.	**COURSE TITLE**	**CREDITS**	**YEAR**
04 CS 6214	**CLOUD COMPUTING**	**3-0-0:3**	**2015**

Pre-requisites:

Course Objectives:

- To know the Distributed Computing
- To understand Cloud Computing, Characteristics and Virtualization concepts
- To understand the Service models
- To explain various Parallel and Distributed Programming paradigms

Syllabus

Introduction to Cloud Computing- Cloud issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs . Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms . Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine – Emerging Cloud software Environment

Course Outcome:

The student will get an understanding of cloud computing and virtualization concepts.

Text Books:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, “Distributed and cloud computing from Parallel Processing to the Internet of Things”, Morgan Kaufmann, Elsevier – 2012
2. Barrie Sosinsky, “ Cloud Computing Bible” John Wiley & Sons, 2010

References:

1. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2004
2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 6214	CLOUD COMPUTING	3-0-0:3	
MODULES		**Contact hours**	**Sem. Exam Marks; %**
MODULE : 1 History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds.		7	15
MODULE : 2 Introduction to Cloud Computing- Cloud issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage.		7	15
FIRST INTERNAL TEST			
MODULE : 3 Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs.		7	15
MODULE : 4 Service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage.		7	15
SECOND INTERNAL TEST			
MODULE : 5 Case studies. Software as a Service (SaaS) - Web services - Web 2.0 - Web OS - Case studies – Anything as a service (XaaS).		7	20
MODULE : 6 Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms . Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine – Emerging Cloud software Environment.		7	20

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 6216	PARALLEL COMPUTER ARCHITECTURE	3-0-0:3	2015

Pre-requisites:

Course Objectives:

- Get a broad understanding of parallel computer architecture and different models for parallel computing
- To understand concepts related to memory consistency models, cache coherence, interconnection networks, and latency tolerating techniques.
- To learn about strategies for how algorithms that were originally developed for single-processor systems can be converted to run efficiently on parallel computers
- To know about current practical implementations of parallel architectures.

Syllabus

Introduction to parallel processing - Overview of pipelining – pipelined data paths and control – Data hazards – Control hazards. Instruction level parallelism – Instruction level parallelism (ILP)– Reducing branch costs – exploiting ILP using static and dynamic scheduling – Data level parallelism. Shared memory Multiprocessors – Clusters and message passing processors . Hardware multithreading – SISD, MIMD, SIMD, SPMD and Vector – Computing GPUs. Thread level parallelism – Centralised shared memory architectures – Distributed shared memory and directory based coherence

Course Outcome:

The student will get an understanding of parallel computer architecture and different models for parallel computing

Text Books:

1. Computer Organization and Design (4th Ed): David A Patterson and John L. Hennessy, Morgan Kaufmann (2011)
2. Computer Architecture-A Quantitative Approach (5th Ed): John L. Hennessy and David A Patterson, Morgan Kaufmann (2011)

References:

1. Programming massively parallel processors: A hands-on approach (1st Ed): David B. Kirk and Wen-mei W. Hwu, Morgan Kaufmann (2010)
2. David E. Culler and Jaswinder Pal Singh, with Anoop Gupta. Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann, 1998. ISBN: 1558603433.
3. Michael J. Quinn. Parallel Programming in C with MPI and OpenMP. McGraw Hill, 2003. ISBN: 0072822562.

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 6216	PARALLEL COMPUTER ARCHITECTURE	3-0-0:3	
MODULES		**Contact hours**	**Sem. Exam Marks; %**
MODULE : 1 Introduction to parallel processing - Overview of pipelining – pipelined data paths and control – Data hazards – Control hazards		7	15
MODULE : 2 Instruction level parallelism – Instruction level parallelism (ILP)– Reducing branch costs – exploiting ILP using static and dynamic scheduling – Data level parallelism		7	15
FIRST INTERNAL TEST			
MODULE : 3 Exploiting memory hierarchy – virtual machines – Cache coherence – Cache controllers . Parallelism and I/O		7	15
MODULE : 4 Shared memory Multiprocessors – Clusters and message passing processors . Hardware multithreading – SISD, MIMD, SIMD, SPMD and Vector – Computing GPUs.		7	15
SECOND INTERNAL TEST			
MODULE : 5 Thread level parallelism – Centralised shared memory architectures – Distributed shared memory and directory based coherence		7	20
MODULE : 6 Synchronisation – Models of memory Consistency – multicore processors and their performance.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6218	BIO INFORMATICS	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To familiarize computational problems in biology
- To understand models of DNA and DNA mapping
- To study structure prediction

Syllabus

Basic concepts of molecular Biology-Proteins-Nucleic acids– genes and genetic synthesis –translation-transcription protein Synthesis- Chromosomes- Maps and sequences- human genome project-sequence data bases . Strings-Graphs-Algorithms- Comparing 2 sequences- Global & Local comparison-General Gap Penalty Function-Affix gap penalty function. Fragment Assembly of DNA-Biological Background –Models-Algorithms-Heuristics-Physical Mapping of DNA Restriction site Mapping-site models-Internal Graph Models –Hybridization Mapping-Heuristics.

Course Outcome:

The student will demonstrate the ability to understand fundamental concepts from molecular biology, computational problems in molecular biology and some efficient algorithms that have been proposed to solve them.

Text Books:

1. Introduction to Computational Molecular Biology, Joao Meidanis, and Carlos Setubal , 2007 1st edition

References:

1. Computational Molecular Biology-An introduction (1st Ed): Peter Clote and Rolf Backofen, Wiley Series (2000)

2. An introduction to Bioinformatics Algorithms (1st Ed): Neil James and Pavel A Pevzner, MIT Press (2004)

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6218	BIO INFORMATICS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Basic concepts of molecular Biology-Proteins-Nucleic acids– genes and genetic synthesis –translation-transcription protein Synthesis- Chromosomes- Maps and sequences- human genome project- sequence data bases		8	15
MODULE 2: Strings-Graphs-Algorithms- Comparing 2 sequences- Global & Local comparison-General Gap Penalty Function-Affix gap penalty function		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: comparing multiple sequences-Star alignments-Tree alignments-Database Search-PAM matrices BLAST-FAST –Issues		8	15
MODULE 4: Fragment Assembly of DNA-Biological Background –Models-Algorithms-Heuristics-Physical Mapping of DNA Restriction site Mapping-site models-Internal Graph Models –Hybridization Mapping-Heuristics		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Phylogenic Trees –Binary Character States-Parsimony and Compatibility in Phylogenies-Algorithm for Distance Matrices-Additive Trees		8	20
MODULE 6: Genome rearrangements-Oriented Blocks-unoriented Blocks . RNA secondary structure prediction		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6222	DISTRIBUTED OPERATING SYSTEMS	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To familiarize Distributed computing environment.
- To understand Message Passing
- To understand Design and implementation Issues of DSM
- To understand Features of global scheduling algorithm.

Syllabus

Distributed computing systems fundamentals : Introduction to Distributed computing systems, Models, Popularity. Distributed Computing system . Design issues of Distributed operating system. Distributed computing environment. RPC Model,Transparency of RPC,RPC messages,Marshaling Arguments and Results. Server Management. Distributed Shared Memory: General architecture of DSM systems. Design and implementation Issues of DSM, Granularity, Structure of Shared Memory Space. Process Management: Introduction, Process Migration, Threads. Distributed File Systems: Features of good DFS, File models, File Accessing models.

Course Outcome:

The student will demonstrate the ability to understand the basic concepts of distributed computing systems.

Text Books:

1. Pradeep Sinha K., “Distributed Operating Systems concepts and design”, PHI pvt ltd

References:

1. Mukesh Singhal, Niranjan G Shivarathri, “Advanced Concepts in Operating systems”, Tata Mc Graw Hill Ltd. Tata Mcgraw Hill Education Pvt. Limited, 2011

2. Coulouris.G, Dollimore J & Kindberg T, “Distributed Systems concepts and design”, 4 th edition, Pearson Education.

3. Tanenbaum A S, “ Modern Operating System”, PHI learning private limited, 3 rd edition

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6222	DISTRIBUTED OPERATING SYSTEMS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Distributed computing systems fundamentals : Introduction to Distributed computing systems, Models, Popularity. Distributed Computing system . Design issues of Distributed operating system. Distributed computing environment		7	15
MODULE 2: Message Passing : Features of a good Message Passing System. Issues in IPC by Message Passing Synchronization ,Buffering, Multi datagram Messages, Encoding and Decoding Message data, Process Addressing ,Failure Handling, Group Communication		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: RPC Model ,Transparency of RPC,RPC messages, Marshaling Arguments and Results. Server Management ,Parameter Passing semantics, call semantics, Communication Protocols for RPCs, Client Server Building, Exception handling, Security ,RPC in Heterogeneous Environments, Lightweight RPC.		7	15
MODULE 4: Distributed Shared Memory: General architecture of DSM systems. Design and implementation Issues of DSM, Granularity, Structure of Shared Memory Space		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Consistency models, Replacement strategy, Thrashing. Synchronization: Clock Synchronization. Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms. Resource Management : Features of global scheduling algorithm. Task assignment approach, Load-Balancing and Load approach		7	20
MODULE 6: Process Management: Introduction, Process Migration, Threads. Distributed File Systems: Features of good DFS, File models, File Accessing models.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6224	PATTERN RECOGNITION	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To familiarize Pattern classification
- To understand Parameter estimation and supervised learning
- To understand Discriminant analysis
- To understand unsupervised learning

Syllabus

Pattern classification: Bayesian decision theory, minimum-error-rate classification, classifiers, discriminant functions. Parameter estimation and supervised learning:- Maximum likelihood estimation, the Bayes classifier, learning the mean of a normal density, general bayesian learning. Nonparametric technique- parzen windows, k-nearest Neighbor estimation, estimation of posterior probabilities, nearest- neighbor rule, k-nearest neighbor rule. Methods for dimensionality reduction: Fisher's discriminant analysis, Principal component analysis.

Discriminant analysis: Models for decision surfaces, linear discriminant analysis-perception model, minimum mean squared error based learning, support vector machines. Pattern clustering (unsupervised learning): Criterion functions for clustering, methods for clustering- hard and soft clustering.

Course Outcome:

The student will demonstrate the ability to understand the basic concepts of pattern recognition and analysis.

Text Books:

1. Richard O. Duda, Peter E. Hart and David G. Stork, Pattern Classification, 2nd Edition, John Wiley & Sons, 2012.

2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

References:

1. Sergios Theodoridis and Konstantinos Koutroumbas, Pattern Recognition,4th Edition, Academic Press-Elsevier, 2004 .

2. Earl Gose, Richard Johnsonbaugh, and Steve Jost; Pattern Recognition and Image Analysis, PHI Pvte. Ltd., NewDelhi-1, 1999.

3. Fu K.S., Syntactic Pattern recognition and applications, Prentice Hall, Eaglewood cliffs,N.J., 1982

4. Richard O. Duda and Hart P.E, and David G Stork, Pattern classification , 2nd Edn., John Wiley & Sons Inc., 2001.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6224	PATTERN RECOGNITION	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Pattern classification: Bayesian decision theory, minimum-error-rate classification, classifiers, discriminant functions, decision surfaces, normal (Gaussian) density, continuous and discrete values features Bayesian networks (graphical models)		7	15
MODULE 2: Parameter estimation and supervised learning:- Maximum likelihood estimation, the Bayes classifier, learning the mean of a normal density, general bayesian learning		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Nonparametric technique- parzen windows, k-nearest Neighbor estimation, estimation of posterior probabilities, nearest- neighbor rule, k-nearest neighbor rule. Methods for dimensionality reduction: Fisher's discriminant analysis, Principal component analysis.		7	15
MODULE 4: Discriminant analysis: Models for decision surfaces, linear discriminant analysis-perception model, minimum mean squared error based learning, support vector machines		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Regression: Linear models for regression, polynomial regression, Bayesian regression. Pattern clustering (unsupervised learning): Criterion functions for clustering, methods for clustering- hard and soft clustering		7	20
MODULE 6: K-means, GMM, hierarchical clustering methods, cluster validation methods.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6226	AGENT BASED COMPUTING	3-0-0: 3	2015

Pre-requisites: Concepts of Artificial Intelligence

Course Objectives:

- **Introduce the concepts of Artificial intelligence required by agents**
- **Study agent based programming languages**
- **Develop agent programs for various applications**

Syllabus

Artificial Intelligence - intelligent agents – Environment- Structure of agents - Agent types - Problem solving agents . Uninformed Search strategies - Informed Search and Exploration - Adversarial Search. Knowledge and reasoning - Knowledge Based Agents - First order logic – Reasoning - Backward chaining – Resolution . Knowledge representation - Handling uncertain knowledge - Reasoning under uncertainty - Statistical reasoning. Learning - forms of learning - Inductive learning - Learning decision trees- Explanation based learning - Statistical learning - Instance based learning - Neural networks - Reinforcement learning

Course Outcome:

The student will demonstrate the ability to understand the basic concepts of agent based computing.

Text Books:

1. Artificial intelligence. A modern approach by Stuart Russell & Peter Norvig.

2. Software Agents: Jeffrey M.Broadshaw, AAAI Press (1997)

References:

1. Software Agents: Jeffrey M.Broadshaw, AAAI Press (1997)

2. Multi agent System A modern approach to distributed artificial intelligence: Gerhard Weiss, MIT Press (2000)

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CS 6226	AGENT BASED COMPUTING	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Artificial Intelligence - intelligent agents – Environment- Structure of agents - Agent types - Problem solving agents . Uninformed Search strategies - Informed Search and Exploration - Adversarial Search		7	15
MODULE 2: Knowledge and reasoning - Knowledge Based Agents - First order logic – Reasoning - Backward chaining – Resolution . Knowledge representation - Handling uncertain knowledge - Reasoning under uncertainty - Statistical reasoning.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Planning - Components of planning systems - Planning with state space search - Partial order planning - Planning Graphs - Hierarchical planning - Multi agent planning		7	15
MODULE 4: Learning - forms of learning - Inductive learning - Learning decision trees- Explanation based learning - Statistical learning - Instance based learning - Neural networks - Reinforcement learning		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Agent oriented programming language - KQML as an agent communication language		7	20
MODULE 6: Java implementation of intelligent agents - Languages supporting mobility - Telescript.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6294	NETWORK SIMULATION LAB	0-0-2: 2	2015

Syllabus

1. A thorough study of packet capturing tool called WireShark.

2. Familiarizing Network Simulator – 3 (NS3) with suitable examples

3. Simulate a wired network consisting of TCP and UDP Traffic using NS3 and then calculate their respective throughput.

4. Performance evaluation of different routing protocols in wired network environment using NS3

5. Performance evaluation of different queues and effect of queues and buffers in wired network environment using NS3

6. Compare the behavior of different variants of TCP (Tahoe, Reno, Vegas….) in wired network using NS3. Comparison can be done on the congestion window behavior by plotting graph.

7. Simulation of wireless Ad hoc networks using NS3

8. Simulate a wireless network consisting of TCP and UDP

9. Performance evaluation of different ad-hoc wireless routing protocols using NS3

10. Create different Wired-cum-Wireless networks and MobileIP Simulations using NS3.

References:

1. An introduction to network simulator 3 Jack L. Burbank

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7201	COMPUTATIONAL LINGUISTICS	3-0-0: 3	2015

Pre-requisites:

Concepts of Natural Language Processing

Course Objectives:

To understand statistical and rule based modelling of natural languages from a computational point of view.

- To give a comprehensive coverage of language processing fundamentals like morphology, Syntax, Semantics and pragmatics.
- To study the applications of these techniques in real world problems like spell-checking, Parts-of Speech Tagging, Corpus development, Wordnet, speech recognition, pronunciation modelling, dialogue agents, document retrieval etc

Syllabus

Introduction – Words - Regular Expressions and Finite Automata – Regular Expressions. Finite state Automata. Morphology. Word Classes and Part-of-Speech Tagging- Rule-based POS tagging - HMM Taggers – Transformation Based Tagging. A Basic Top-down Parser - The Earley Algorithm - Features and Unification – Feature structures – Unification of Feature Structures.

Semantics - Representing Meaning - FOPC – Semantic Analysis. Relations Among Lexemes and Their Senses - WORDNET: A database of lexical relations Discourse – Reference Resolution -Text Coherence Discourse Structures - Dialog and Conversational Agents.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to Apply various computational models in application domains like Machine translation, information retrieval etc.

Text Books:

1. Speech and Language Processing (2nd Ed): Daniel Jurafsky and James Martin, PHI (2008)

References:

1. Foundations of statistical natural language processing (1st Ed): Christopher D. Manning and Hin Rich Schutze, MIT press (1999)
2. Natural Language Understanding (2nd Ed): James Allen, The Benajmins/Cummings Publishing Company Inc(1994)

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7201	COMPUTATIONAL LINGUISTICS	3-0-0: 3	
MODULES		**Contact hours**	**Sem. Exam Marks;%**
MODULE : 1 Introduction – Words - Regular Expressions and Finite Automata – Regular Expressions. Finite state Automata. Morphology and Finite State Transducers - Probabilistic Models of Pronunciation and Spelling – Probabilistic models		7	15
MODULE : 2 Minimum edit distance – weighted automata - N grams. Word Classes and Part-of-Speech Tagging- Rule-based POS tagging - HMM Taggers – Transformation Based Tagging		7	15
FIRST INTERNAL TEST			
MODULE : 3 Context-Free Grammars for English - Parsing with Context Free Grammars. A Basic Top-down Parser - The Earley Algorithm .		7	15
MODULE : 4 Features and Unification – Feature structures – Unification of Feature Structures .Semantics - Representing Meaning - FOPC – Semantic Analysis		7	15
SECOND INTERNAL TEST			
MODULE : 5 Syntax driven semantic analysis - Lexical Semantics. Relations Among Lexemes and Their Senses - WORDNET: A database of lexical relations.		7	20

MODULE : 6 Discourse – Reference Resolution -Text Coherence Discourse Structures - Dialog and Conversational Agents. Dialogue acts - dialogue structure.	7	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7203	ADVANCED COMPILER DESIGN	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To familiarize the fundamentals of Compiler structure
- To study the applications of Local and Global Symbol table management
- To gather information about widely used compilers

Syllabus

Principles of Compiler. Structure of Optimizing compilers. Introduction and Overview – Symbol table structure – Local and Global Symbol table management. Intermediate representation.

Run-time support – Register usage – local stack frame – run-time stack – Code sharing – position–independent code. Procedure optimization – in-line expansion – leaf routine optimization and shrink wrapping. Register allocation and assignment – graph coloring – control flow and low level optimizations - Inter-procedural analysis and optimization – call graph – data flow analysis. Case Studies – Sun Compilers for SPARC – IBM XL Compilers – Alpha compilers– PA –RISC assembly language – COOL.

Course Outcome:

The student will be able to demonstrate Run-time support, Register allocation and assignment of a compiler

Text Books:

1. Steven S Muchnik, “Advanced Compiler Design and Implementation”, Morgan Kaufmann publishers, Elsevier Science, India, Indian Reprint 2003.

References:

1. Keith D Cooper and Linda Torczon, “Engineering a Compiler”, Elsevier Science, India.
2. Sivarama P. Dandamudi, “Introduction to Assembly language programming: for Pentium and RISC processors”.
3. Allen Holub “Compiler Design in C”, Prentice Hall of India, 1990.
4. Alfred Aho, Ravi Sethi V., Jeffery Ullman D., “Compilers Principles, Techniques and Tools”,Addison Wesley, 1988.
5. Charles N. Fischer, Richard J. Leblanc, “Crafting a compiler with C”, Benjamin-Cummings Publishing Co., Inc. Redwood City, CA, USA.

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7203	ADVANCED COMPILER DESIGN	3-0-0: 3	
MODULES (42Hrs)		**Contact hours**	**Sem. Exam Marks;%**
MODULE 1 Principles of Compiler – Review of Compiler Structure – Optimization – Importance of Code optimization – Structure of Optimizing compilers – placement of optimizations in optimizing compilers – ICAN		7	15
MODULE 2 Introduction and Overview – Symbol table structure – Local and Global Symbol table management. Intermediate representation – Issues –High level, medium level, low level intermediate languages – MIR, HIR, LIR – ICAN for Intermediate code.		7	15
FIRST INTERNAL TEST			
MODULE 3 Run-time support – Register usage – local stack frame – run-time stack – Code sharing – position– independent code – Symbolic and polymorphic language support -Optimization – Early optimization – Constant folding		7	15
MODULE 4 Scalar replacement of aggregates Simplification – value numbering – constant propagation – redundancy elimination – loop optimization. Procedure optimization – in-line expansion – leaf routine optimization and shrink wrapping		7	15
SECOND INTERNAL TEST			
MODULE 5 Register allocation and assignment – graph coloring – control flow and low level optimizations - Inter-procedural analysis and optimization – call graph – data flow analysis –constant propagation – alias analysis – register allocation – global References: – Optimization for memory hierarchy. Code Scheduling – Instruction scheduling – Speculative scheduling –Software		7	20

pipelining – trace scheduling – percolation scheduling		
MODULE 6 Case Studies – Sun Compilers for SPARC – IBM XL Compilers – Alpha compilers– PA –RISC assembly language – COOL – (Classroom Object oriented language) – Compiler testing tools – SPIM	7	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7205	HUMAN COMPUTER INTERACTION	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- Introduces the concepts of HCI Cognitive architecture and Designing human computer interaction principles
- Describes Development process of Human Computer Interaction.

Syllabus

Overview of HCI - Mental models - Cognitive architecture - task loading and stress in HCI - Human error identification. Input technologies. - sensor and recognition based input visual displays Haptic interfaces Non speech auditory output network based interactions .Designing human computer interaction Visual design principles - HCI in healthcare games - older adults - kids - Physical disabilities - Perpetual Impairments - Deaf and Hard of Learning users. Developments process - requirement specification - User experiences and HCI - Usability Engineering life cycle - Task analysis - prototyping tools and techniques - scenario based design - Participatory design - Testing and evaluation - Usability testing - Inspection based evaluation - Model based evaluation

Course Outcome:

The student will be able to demonstrate Development process of Human Computer Interaction.

References:

1. The human computer interaction hand book: fundamentals, evolving technologies and emerging applications: Andrew sears, Julie A Jacko, Lawrence Erlbaum Associates (2008)
2. Designing the user interface strategies for effective human computer interaction (3rd Ed): Ben Shneiderman Pearson, New Delhi (2004)
3. Interaction Design : Beyond human Computer Interaction by Helen Sharp, Yvanno Rogers and Jenny preece, John Wiley (2007)
4. Human computer Interaction in the new millennium: John M. Carroll, ACM press (2001)

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7205	HUMAN COMPUTER INTERACTION	3-0-0: 3	
MODULES(42Hrs)		Contact hours	Sem. Exam Marks;%
MODULE 1 Overview of HCI - Mental models - Cognitive architecture - task loading and stress in HCI - Human error identification. Input technologies - sensor and recognition based input visual displays		7	15
MODULE 2 Haptic interfaces Non speech auditory output network based interactions. Designing human computer interaction Visual design principles intercultural user interface designs Conversational speech interface multimodal interface adaptive interfaces and agents		7	15
FIRST INTERNAL TEST			
MODULE3 Tangible user interfaces Information visualization Human centered designs of DSS Online communities Visual environment. Domain specific design - HCI in healthcare games - older adults - kids		7	15
MODULE 4 Physical disabilities - Perpetual Impairments - Deaf and Hard of Learning users.		7	15
SECOND INTERNAL TEST			
MODULE 5 Developments process - requirement specification - User experiences and HCI - Usability Engineering life cycle - Task analysis - prototyping tools and techniques		7	20

MODULE 6 Scenario based design - Participatory design - Testing and evaluation - Usability testing - Inspection based evaluation - Model based evaluation.	7	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7207	ADVANCED DATABASE MANAGEMENT SYSTEM	3-0-0: 3	2015

Pre-requisites:

Concepts of Database Management System

Course Objectives:

- To familiarize the fundamentals of Database System Architectures
- To understand Object and Object relational databases
- To gather information about widely used Emerging Technologies such as Mobile Databases

Syllabus

Parallel and Distributed Databases: Database System Architectures. I/O Parallelism Three Tier Client Server Architecture- Case Studies .Object and Object relational databases: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL / Oracle – Case Studies .Enhanced Data models: Active Database Concepts and Triggers XML Databases: XML Data Model – DTD - XML Schema - XML Querying - Geographic Information Systems - Genome Data Management. Emerging Technologies: Mobile Databases Mobile Transaction Models –Concurrency Control Mechanism- Transaction Commit Protocols- Mobile database Recovery: Log management in mobile database systems – Mobile database recovery schemes.

Course Outcome:

The student will be able to demonstrate Object relational databases and Mobile databases

References:

1. Elmasri R., Navathe S.B., “Fundamentals of Database Systems”, Pearson Education/Addison Wesley, Fifth Edition, 2007.
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Pearson Education, Third Edition, 2007.
3. Henry F Korth, Abraham Silberschatz, Sudharshan S., “Database System Concepts”, McGraw Hill, Fifth Edition, 2006.
4. Date C.J, Kannan A. and SwamynathanS.,”An Introduction to Database Systems”, Pearson Education, Eighth Edition, 2006.
5. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, McGraw Hill,Third Edition, 2004.
6. Vijay Kumar, “Mobile Database Systems”, A John Wiley & Sons, Inc., Publication

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7207	ADVANCED DATABASE MANAGEMENT SYSTEM	3-0-0: 3	
MODULES(42Hrs)		**Contact hours**	**Sem. Exam Marks;%**
MODULE 1 Parallel and Distributed Databases: Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems. Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism.		7	15
MODULE 2 Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Three Tier Client Server Architecture- Case Studies.		7	15
FIRST INTERNAL TEST			
MODULE 3 Object and Object relational databases: Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence.Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design.		7	15
MODULE 4 ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL / Oracle – Case Studies. Enhanced Data models: Active Database Concepts and Triggers – Temporal Databases.		7	15
SECOND INTERNAL TEST			
MODULE 5 Spatial Databases – Multimedia Databases – Deductive Databases – XML Databases. XML Data Model – DTD - XML Schema - XML Querying - Geographic Information Systems - Genome Data Management		7	20

MODULE 6 Emerging Technologies: Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution. Mobile Database Systems - Transaction Execution in MDS- Mobile Transaction Models –Concurrency Control Mechanism- Transaction Commit Protocols- Mobile database Recovery: Log management in mobile database systems – Mobile database recovery schemes.	7	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7204	BIG DATA ANALYTICS	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To familiarize the fundamentals of Bigdata and Data Analysis.
- To understand Stream Computing.
- To gather information about widely used Predictive Analytics and Frameworks.

Syllabus

Introduction to Big Data .Best Practices for Big data Analytics .Big data characteristics Data Analysis Evolution of analytic scalability Cloud computing – grid computing. Analysis approaches – Statistical significance – business approaches – Analytic innovation .Stream Computing:- Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream .Predictive Analytics and Frameworks:- Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models. Hadoop. Hive. Sharding.

Course Outcome:

The student will be able to demonstrate Big Data Analysis, Stream Computing and Predictive Analytics and Frameworks

References:

1. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series, 2012.
2. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier, 2007
3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
4. AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
5. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012.
6. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill, 2011.
7. Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan, “Harness the Power of Big data – The big data platform”, McGraw Hill, 2012.
8. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007
9. Pete Warden, Big Data Glossary, O’Reilly, 2011.

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7204	BIG DATA ANALYTICS	3-0-0: 3	
MODULES(42Hrs)		**Contact hours**	**Sem. Exam Marks;%**
MODULE 1 Introduction to Big Data:- Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of Big Data - Security, Compliance, auditing and protection - Evolution of Big data		7	15
MODULE 2 Best Practices for Big data Analytics - Big data characteristics - Volume, Veracity, Velocity, Variety – Data Appliance and Integration tools – Greenplum – Informatica Data Analysis:- Evolution of analytic scalability – Convergence – parallel processing systems – Cloud computing – grid computing		7	15
FIRST INTERNAL TEST			
MODULE 3 Map reduce – enterprise analytic sand box – analytic data sets – Analytic methods –analytic tools – Cognos – Microstrategy - Pentaho. Analysis approaches – Statistical significance – business approaches – Analytic innovation – Traditional approaches – Iterative		7	15
MODULE 4 Stream Computing:- Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window - Realtime Analytics Platform(RTAP) applications IBM Infosphere – Big data at rest – Infosphere streams – Data stage – Statistical analysis – Intelligent		7	15
SECOND INTERNAL TEST			
MODULE 5 Predictive Analytics and Frameworks:- Predictive Analytics – Supervised –		7	20

Unsupervised learning – Neural networks – Kohonen models – Normal – Deviations from normal patterns – Normal behaviours – Expert options – Variable entry - Mining Frequent itemsets - Market based model		
MODULE 6 Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream –Clustering Techniques – Hierarchical – K- Means. Framework and applications: Map Reduce Framework - Hadoop – Hive – Sharding.	7	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7211	SEMANTIC WEB	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To familiarize the fundamentals of RDF and Querying the Semantic Web
- To understand Ontology movement
- To gather information about Logic and Inference.

Syllabus

Introduction. Semantic web layers .Semantic web technologies - Querying RDF and Querying the Semantic Web SPARQL-Basics-Filters-Constructs-Organizing result sets-Querying schemas. Ontology : Introduction Ontology movement –Ontology engineering : Introduction – Constructing ontologies – Reusing ontologies – On-To-Knowledge semantic web architecture. Logic and Inference : Logic – Description logics - Rules – Monotonic rules: syntax, semantics and examples – Non-monotonic rules – Motivation, syntax, and examples – Rule markup in XML: Monotonic rules - Non-Monotonic rules .Applications of Semantic Web Technologies .

Course Outcome:

The student will be able to demonstrate RDF and Querying the Semantic Web.

Text Books:

1. Grigorous Antoniou and Van Hermelen, A Semantic Web Primer. New Delhi: The MIT Press,2012.

References:

1. James Hendler, Henry Lieberman and Wolfgang Wahlster, Spinning the Semantic Web: Bringing the world wide web to its full potential. New Delhi: The MIT Press, 2005.
2. Shelley Powers, Practical RDF. Mumbai: O'reilly publishers, 2004
3. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, Chapman & Hall/CRC, 2004

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7211	SEMANTIC WEB	3-0-0: 3	
MODULES(42Hrs)		**Contact hours**	**Sem. Exam Marks;%**
MODULE 1 Introduction: History – Semantic web layers –Semantic web technologies – Semantics in semantic web		7	15
MODULE 2 XML: Structuring – Namespaces – Addressing – Querying-Processing XML. RDF and Querying the Semantic Web : RDF data model-syntaxes-Adding semantics-RDF schema		7	15
FIRST INTERNAL TEST			
MODULE 3 Querying the semantic web-SPARQL-Basics-Filters-Constructs-Organizing result sets-Querying schemas. Ontology : Introduction – Ontology movement – OWL – OWL specification - OWL elements		7	15
MODULE 4 OWL constructs: Simple and complex – Ontology engineering : Introduction – Constructing ontologies – Reusing ontologies – On-To-Knowledge semantic web architecture.		7	15
SECOND INTERNAL TEST			
MODULE 5 Logic and Inference : Logic – Description logics - Rules – Monotonic rules: syntax, semantics and examples – Non-monotonic rules – Motivation, syntax, and examples		7	20
MODULE 6 Rule markup in XML: Monotonic rules - Non-Monotonic rules .Applications of Semantic Web Technologies .		7	20
END SEMESTER EXAM			

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7213	OBJECT ORIENTED SOFTWARE ENGINEERING	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To familiarise the fundamentals of Object Oriented Software Engineering
- To gather information about UML Modeling
- To understandObject Oriented Analysis and Design.

Syllabus

Introduction to Object Oriented Software Engineering: A detailed review of software development activities. Object Oriented Methodologies for Software development.

Introduction to UML Modeling structural things: Class diagram –elements – advance classes and relationships .Object diagram. Modeling Behavior: Activity diagrams- Action and activity states. Object Oriented Analysis: use case driven approach Classification. Object Oriented Design: Design process and design axioms.Designing Classes: class visibility, refining attributes, designing methods and protocols, designing methods, packages.

Course Outcome:

The student will be able to demonstrate Object Oriented Analysis and Design. The student will be able to demonstrate Object Oriented Analysis and Design.

References:

1. Ali Bahrami, Object Oriented Systems Development using the Unified Modeling Language, McGraw Hill.
2. Booch et al., The UML User Guide, Addison-Wesley.
3. Bernd Oestereich, Developing Software with UML, Object-Oriented Analysis and Design in Practice, Addison-Wesley

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7213	OBJECT ORIENTED SOFTWARE ENGINEERING	3-0-0: 3	
MODULES(42Hrs)		**Contact hours**	**Sem. Exam Marks;%**
MODULE 1 Introduction to Object Oriented Software Engineering: A detailed review of software development activities.-Analysis, Design, Coding and Testing.Object Oriented Concepts in Software Development- objects, classes, attributes, behavior and methods, data abstraction, encapsulation and information hiding, Generalization, polymorphism, associations, aggregations and object containment		7	15
MODULE : 2 Object Oriented Methodologies for Software development-Rambaugh et al's Object Modeling Technique, Jacobson's methodology, Booch's methodology.		7	15
FIRST INTERNAL TEST			
MODULE : 3 Introduction to UML Modeling structural things: Class diagram –elements – advance classes and relationships.Object diagram-Objects and Links.Modeling user's view- Use case diagram – Actors – use cases-relationships.Modeling interactions: Interaction diagrams -Sequence diagram and Collaboration diagram.-Organizing Messages		7	15
MODULE : 4 Modeling Behavior: Activity diagrams- Action and activity states-fork and join – branching –swim lanes. State chart diagrams-states-transitions.Modeling architectural view-Component diagram, Deployment diagram.Design patterns and frameworks.		7	15
SECOND INTERNAL TEST			

MODULE : 5 Object Oriented Analysis: use case driven approach Classification: Classification theory, noun phrase approach, common class patterns approach, use-case driven approach, classes, responsibilities, and collaborators, naming classes.Identifying Object Relationships, Attributes And Methods: Association, super-subclass relationships, a-part of relationships, case study- class responsibility, defining attributes , object responsibility, defining methods	7	20
MODULE : 6 Object Oriented Design: Design process and design axioms.Designing Classes: class visibility, refining attributes, designing methods and protocols, designing methods, packages and managing classes.Access Layer: object storage and interoperability.View Layer: Designing interface objects.	7	20
END SEMESTER EXAM		

COURSE NO.	COURSE TITLE	CREDITS	YEAR
04 CS 7215	MOBILE COMMUNICATION NETWORKS	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To understand Mobile computing environment
- To describe Mobile Network and Transport Layer

Syllabus

Introduction:Wireless networks,Mobile Telephone Systems, emerging technologies. Broadcast Systems: Overview –Cyclic Repetition of Data-Digital Audio Broadcasting – Digital Video Broadcasting. Location management: Handoff in wireless mobile networks-reference model-handoff schemes. Location management in cellular networks location and tracking management schemes-time, movement, profile and distance based update strategies

Mobile Network and Transport Layer -WAP: WAP push architecture -Datagram Protocol-Transport Layer Security- Transaction Protocol. Session Protocol. Open protocols: Service discovery technologies-SDP, Jini, SLP, UpnP protocols.

Course Outcome:

The student will be able to demonstrate Mobile computing environment.

References:

1. Ivan Stojmenovic , Handbook of Wireless Networks and Mobile Computing, John Wiley & sons Inc, Canada, 2002.
2. Asoke K Taukder,Roopa R Yavagal,Mobile Computing, Tata McGraw Hill Pub Co. , New Delhi, 2005.
3. J.Schiller, Mobile Communication, Addison Wesley, 2000.
4. William Stallings, Wireless Communication and Networks, Pearson Education, 2003.
5. Singhal, WAP-Wireless Application Protocol, Pearson Education, 2003

COURSE PLAN

COURSE NO:	COURSE TITLE:	CREDITS	
04 CS 7215	MOBILE COMMUNICATION NETWORKS	3-0-0: 3	
MODULES(42Hrs)		**Contact hours**	**Sem. Exam Marks;%**
MODULE 1 Introduction: Wireless networks,Mobile Telephone Systems, emerging technologies, WiFi, WiMAX, 3G-Telecommunications:GSM-DECT-TETRA–UMTS-IMT-2000.Satellite Systems: Basics-Routing-Localization-Handover		6	15
MODULE : 2 Broadcast Systems: Overview –Cyclic Repetition of Data-Digital Audio Broadcasting – Digital Video Broadcasting. Mobile computing environment: Functions-architecture-design considerations, content architecture -CC/PP exchange protocol, context manager		6	15
FIRST INTERNAL TEST			
MODULE : 3 Location management: Handoff in wireless mobile networks-reference model-handoff schemes. Location management in cellular networks - location and tracking management schemes-time, movement, profile and distance based update strategies.		6	15
MODULE : 4 Mobile Network and Transport Layer -WAP: WAP push architecture - Datagram Protocol-Transport Layer Security- Transaction Protocol		6	15
SECOND INTERNAL TEST			
MODULE : 5 Session Protocol-Application Environment, Wml scripts and applications – Wireless Telephony Application.		9	20
MODULE : 6 Open protocols: Service discovery technologies-SDP, Jini, SLP, UpnP protocols–data synchronization-Sync ML framework -Context aware mobile services -Context aware sensor networks-Context aware security		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 6291/7291	SEMINAR	0-0-2: 2	2015

Course Objectives:

1. Improve the technical presentation skills of the students.
2. To train the students to do literature review.
3. To impart critical thinking abilities.

Methodology

Individual students are required to choose a topic of their interest from related topics to the stream of specialization, preferably from outside the M. Tech syllabus. The students are required to do a moderate literature review on the topic and give seminar. A committee consisting of at least three faculty members (preferably specialized in the respective stream) shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation. Each student shall submit two copies of a write up of his seminar topic. The seminar report shall not have any plagiarised content (all sources shall be properly cited or acknowledged). One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other shall be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. It is encouraged to do simulations related to the chosen topic and present the results at the end of the semester.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CS 7293	PROJECT PHASE - I	0-0-12: 6	2015

Course Objectives:

The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real-life problems related to industry and current research.

The project work can be a design project/experimental project and/or computer simulation project on any of the topics related to the stream of specialisation. The project work is chosen/allotted individually on different topics. Work of each student shall be supervised by one or more faculty members of the department. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to carry out their main project outside the parent institute, subject to the conditions specified in the M. Tech regulations of the Kerala Technological University. Students are encouraged to take up industry problems in consultation with the respective supervisors.

The student is required to undertake the main project phase-1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase-1 consist of preliminary work, two reviews of the work and the submission of a preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 CS 7294	PROJECT PHASE - II	0-0-21: 12	2015

Main project phase II is a continuation of project phase-I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre -submission presentation before the evaluation committee to assess the quality and quantum of the work done. It is encouraged to prepare at least one technical paper for possible publication in journals or conferences. The project report (and the technical paper(s)) shall be prepared without any plagiarised content and with adequate citations, in the standard format specified by the Department /University.