KERALA TECHNOLOGICAL UNIVERSITY

ERNAKULAM – I CLUSTER

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

COMPUTER SCIENCE AND ENGINEERING

(2015 ADMISSION ONWARDS)

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN COMPUTER SCIENCE AND ENGINEERING

SEMESTER 1 (CREDITS: 23)

Exam Slot	Course No	Course Title	Core/ Elective	L-T-P	Internal Marks	End Semester Exam		Credits
						Marks	Duration (hrs)	
A	06 CS 6 01 1	Computational Intelligence	Core	4-0-0	40	60	3	4
B	06 CS 6 02 1	Advanced Data Structures and Algorithms	Core	4-0-0	40	60	3	4
C	06 CS 6 03 1	Operating System Design	Core	4-0-0	40	60	3	4
D	06 CS 6 04 1	Computer System Design and Architecture	Core	3-0-0	40	60	3	3
E	06 CS 6 x5 1	Elective I	Elective	3-0-0	40	60	3	3
	06 CS 6 06 1	Research Methodology	Core	0-2-0	100	0	0	2
	06 CS 6 07 1	Seminar	Seminar	0-0-2	100	0	0	2
	06 CS 6 08 1	Advanced Computing Lab I	Lab	0-0-2	100	0	0	1
				24 Hrs				**23 Credits**

Semester I – 06 CS 6 x5 3 Elective I	
06 CS 6 15 1	Web Services
06 CS 6 25 1	Data Mining Concepts
06 CS 6 35 1	Natural Language Processing
06 CS 6 45 1	Real Time Systems
06 CS 6 55 1	Neural Networks
06 CS 6 65 1	Wireless Communication

SEMESTER 2 (CREDITS: 19)

Exam Slot	Course No	Course Title	Core/ Elective	L-T-P	Internal Marks	End Semester Exam		Credits
						Marks	Duration (hrs)	
A	06 CS 6 01 2	Advanced Database Management Systems	Core	4-0-0	40	60	3	4
B	06 CS 6 02 2	Advanced Computer Networks	Core	3-0-0	40	60	3	3

C	06 CS 6 03 2	Computer Security and Applied Cryptography	Core	3-0-0	40	60	3	3
D	06 CS 6 x4 2	Elective II	Elective	3-0-0	40	60	3	3
E	06 CS 6 x5 2	Elective III	Elective	3-0-0	40	60	3	3
	06 CS 6 06 2	Mini Project	Project	0-0-4	100	0	0	2
	06 CS 6 07 2	Advanced Computing Lab II	Lab	0-0-2	100	0	0	1
				22 Hrs				**19 Credits**

Semester II - 06 CS 6 x4 4 Elective II	
06 CS 6 14 2	Pattern Recognition
06 CS 6 24 2	Object Oriented Software Engineering
06 CS 6 34 2	Compiler Design
06 CS 6 44 2	Soft Computing
06 CS 6 54 2	Parallel Computer Architecture
06 CS 6 64 2	Bio Computing
06 CS 6 74 2	Advanced Algorithms and complexity

Semester II – 06 CS 6 x5 4 Elective III	
06 CS 6 15 2	Digital Image Processing
06 CS 6 25 2	Ontology and Semantic Web
06 CS 6 35 2	Machine Learning Techniques
06 CS 6 45 2	Cloud Computing
06 CS 6 55 2	Design Patterns
06 CS 6 65 2	Web Security
06 CS 6 75 2	Advanced Dataware housing

SEMESTER 3 (CREDITS: 14)

Exam Slot	**Course No**	**Course Title**	**Core/ Elective**	**L-T-P**	**Internal Marks**	**End Semester Exam**		**Credits**
						Marks	**Duration (hrs)**	
A	06 CS 7 x1 1	Elective IV	Elective	3-0-0	40	60	3	3
B	06 CS 7 x2 1	Elective V	Elective	3-0-0	40	60	3	3
	06 CS 7 03 1	Seminar	Seminar	0-0-2	100	0	0	2
	06 CS 7 04 1	Project – Phase I	Project	0-0-12	50	0	0	6
				20 Hrs				**14 Credits**

Semester III – 06 CS 7 x1 3 Elective IV	
06 CS 7 11 1	Multi Core Architecture
06 CS 7 21 1	Data Analytics
06 CS 7 31 1	Computer Vision
06 CS 7 41 1	High Performance Computing
06 CS 7 51 1	Mobile Network Security
06 CS 7 61 1	Virtualization Systems

Semester III – 06 CS 7 x2 3 Elective V	
06 CS 7 12 1	Content Based Image and Video Retrieval
06 CS 7 22 1	Social Network Analytics
06 CS 7 32 1	Cyber Forensics
06 CS 7 42 1	Wireless Adhoc &Sensor Networks
06 CS 7 52 1	Parallel Algorithms
06 CS 7 62 1	Embedded Systems

SEMESTER 4 (CREDITS: 12)

Exam Slot	Course No	Course Title	Core/ Elective	L-T-P	Internal Marks	End Semester Exam		Credits
						Marks	Duration (hrs)	
	06 CS 7 01 2	Project – Phase II	Project	0-0-21	70	30	0	12
				21 Hrs				**12 Credits**

Total Credits for the Course: 68 credits

SEMESTER I

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 01 1	Computational Intelligence	4-0-0-4	2015

PREREQUISITES:

1. Knowledge of probability theory
2. Basic idea of matrices, operations and set theory
3. Knowledge of different types of functions (transitive, asymmetric, symmetric etc) and relations.

COURSE OBJECTIVES:

- This course provides a study of Fuzzy systems, Artificial Neural networks, Genetic Algorithms and Swarm Intelligent systems which can be used in classification problems of diverse areas
- It also introduces the basics of building an expert system.

SYLLABUS:

Fuzzy systems, Artificial Neural Networks, Genetic Algorithms, Swarm intelligent systems, Expert Systems

EXPECTED OUTCOME:

Students will be able to:

- Students will be familiar with the different methodologies for solving problems

REFERENCES:

1. N.P. Pandy, Artificial Intelligence and Intelligent systems, Oxford Press, New Delhi
2. Hung T. Nguyen,Elbert A. Walker,A First Course in Fuzzy Logic,2nd Edn.
3. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, 1997.
4. Yegnanarayana B, Artificial Neural Networks, PHI.
5. David E. Goldberg, Genetic algorithms in search, optimization & Machine Learning, PearsonEducation, 2006
6. Jang J.S.R., Sun C.T. and Mizutani E, Neuro-Fuzzy and Soft computing, Pearson Education 2003.
7. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall,1998.

Andries Engelbrecht, Computational Intelligence: An Introduction, 2007

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Fuzzy systems: Introduction, fuzzy relations, arithmetic operations of fuzzy numbers, linguistic descriptions, fuzzy measures, defuzzification methods, fuzzy logic in control and decision making application	12	25%
II	Artificial Neural Networks**:** Introduction, artificial neurons, feed forward neural network, back propagation neural network, functional link neural network, cascade correlation neural network	14	25%
	FIRST INTERNAL EXAM		
III	Genetic Algorithms: Introduction, theoretical foundation of genetic algorithm, implementation of	12	25%

	genetic algorithm, Applications of GA in Machine Learning – machine learning approach to knowledge acquisition. support vector machines for learning – linear learning machines – support vector classification – support vector regression - applications		
IV	Swarm intelligent systems**:** Introduction, ant colony systems, development of ant colony systems, working of ant colony systems Expert Systems:- Introduction, stages in the development of an expert system, probability based expert systems, expert system tools	**12**	**25%**
SECOND INTERNAL EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 02 1	ADVANCED DATA STRUCTURES AND ALGORITHMS	4-0-0-4	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

- Upon completion of this course, students will be able to do the following:
- Analyze different tree structures.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- To synthesize efficient algorithms in common engineering design situations

SYLLABUS:

Introduction to Basic data structures, Trees, Partially Ordered Data, Algorithm Design Techniques - Greedy Method, Divide and Conquer Method, Dynamic Programming, Randomized Data Structure, Probabilistic Data Structures, Introduction to Approximation Algorithms, Some Problems for Analysis: Shortest Path in Graphs, Satisfiability(SAT) Problem.

EXPECTED OUTCOME:

Students who successfully complete this course will be able to:-

- Argue the correctness of algorithms using inductive proofs and invariants.
- Analyse worst-case running times of algorithms using asymptotic analysis.
- Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyse them.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize greedy algorithms, and analyse them.
- Explain the major tree algorithms and their analyses. Employ trees to model engineering problems, when appropriate. Synthesize new tree algorithms and algorithms that employ tree computations as key components, and analyse them.
- Compare between different data structures. Pick an appropriate data structure for a design situation.

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, University Press
2. Ellis Horowitz and Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms,Universities Press
3. Thomas Cormen, Charles, Ronald Rives, Introduction to algorithm, PHI Learning.
4. Yedidyah Langsam, Moshe J. Augenstein, Aaron M.Tenenbaum, Data Structures using C and C++, Second Edition, PHI Learning Private Limited , 2010.
5. Brassard and P. Bratley, Algorithmics: Theory and Practice, Prentice –Hall

6. Hari Mohan Pandey, Design Analysis and Algorithms, University Science Press
7. Aho, Hopcroft and Ullman, The Design and Analysis of Computer Algorithms, Pearson Education.
8. V.S Subramanian, Principles of Multimedia Database systems, Morgan Kaufman, 1998.
9. Rajeev Motwani and Prabakhar Raghavan, Randomized Algorithms. Cambridge University Press, Foundation Books.
10. Vijay Vazirani. Approximation Algorithms. Springer (2001).

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction to Basic data structures—Sequential Lists, Random Access Lists, Stacks, Queues, Binary trees, Graph Representation (Graph Traversal) Trees--Binary Search Trees, AVL Trees, B-Trees, Red Black Trees, Splay Trees, k-d Trees, Generic Trees—Trie, Compressed Trie, Suffix Trie (with Analysis) Partially Ordered Data -- Priority Queues, Binomial Heaps, Deaps.	**14 Hrs**	**25%**
II	Algorithm Design Techniques, Greedy Method – Knapsack Problem, Job Sequencing, Divide and Conquer Method – Quick Sort, Finding Maximum and Minimum, Dynamic Programming- Matrix chain multiplication. Analysis of Algorithms, Algorithm Complexity, Asymptotic Notations, Amortized Analysis, Recurrence Equations, Solving Recurrence Equations (through Substitution Method, Master Theorem)	**14 Hrs**	**25%**
III	Randomized Data Structure: Basic Data Structures (Hash tables and Universal Hashing), Random Treaps. Probabilistic Data Structures – Bloom Filters (Motivation, Design and Analysis). Introduction to Game Theory and Lower Bounding; Game tree Evaluation; Minmax principle, Introduction to Approximation Algorithms—The greedy Algorithm for Set Cover, Layering.	**14 Hrs**	**25%**
IV	Some Problems for Analysis: Shortest Path in Graphs, Minimum Spanning Tree. Find the convex hull, Huffman Coding, Task Scheduling Problem; Satisfiability(SAT) Problem, Vertex Cover Problem, Primality Testing and Factorization	**14 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 03 1	OPERATING SYSTEM DESIGN	4-0-0-4	2015

PREREQUISITES: Nil

COURSE OBJECTIVES:

This course provides a study of internal algorithms and basic structure and organization of file system, processes, and memory management of Unix Operating System, relationship to programmer interface, understanding of how the unix kernel works and a deeper understanding of how unix programs interact with the system.

SYLLABUS:

Overview of the System, File Subsystems, Processes, Memory Management

EXPECTED OUTCOME:

Students will have master understanding of design issues associated with unix operating systems- file system, process and memory management concepts.

REFERENCES:

1. Maurice J. Bach, "The Design of the Unix Operating System", First Edition, Prentice Hall of India, 1986.
2. William Stallings, "Operating Systems", Fourth Edition, Pearson Education, 2004
3. Uresh Vahalia, "Unix Internals - The new Frontiers", Pearson Education, 2006
4. B. Goodheart, J. Cox, "The Magic Garden Explained", Prentice Hall of India, 1986.
5. S. J. Leffler, M. K. Mckusick, M. J. .Karels and J. S. Quarterman., "The Design
6. And Implementation of the 4.3 BSD Unix Operating System", Addison Wesley, 1998

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Evolution of operating system -Characteristics of modern operating system- Traditional and Modern Unix systems- Introduction to the Kernel -Architecture of the UNIX operating system - Introduction to system concepts - Kernel data structures - System administration. The Buffer Cache: Buffer headers - Structure of the buffer pool - Scenarios for retrieval of a buffer - Reading and writing disk blocks - Advantages and disadvantages of the buffer cache.	**12 Hrs**	**25%**
II	Inode - Regular file - Directories - Conversion of a path name to an Inode - Super block – Inode assignment to a new file - Allocation of disk blocks- System Calls for the	**14 Hrs**	**25%**

	file system: Open - Read - Write - File and record locking - Adjusting the position of file I/O - lseek - close - File creation - Creation of special files - Changing directory, root, owner, mode - stat and fstat - Pipes - Dup - Mounting and unmounting file systems - link- unlink - File system abstraction and maintenance.		
III	Process states and models - Process context - Manipulation of the process address space -Sleep- Process Control - Process creation - Signals - Process termination - Invoking other programs - user id of a process - Changing the size of a process - Shell - System boot and the INIT process- Process Scheduling-Unix concurrency mechanisms- Distributed Process Management – Process migration- Distributed Mutual Exclusion.	**16 Hrs**	**25%**
IV	Swapping - Demand paging - Hybrid System- I/O Subsystem - Driver Interface - Disk Drivers - Terminal Drivers- Streams - Inter process communication- Process tracing - System V IPC - Network Communications - Sockets.	**14 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 04 1	COMPUTER SYSTEM DESIGN AND ARCHITECTURE	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, students will be able to do the following:

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SYLLABUS:

Fundamentals of Computer Design, **Instruction Level parallelism**, **Memory hierarchy**, **Introduction to storage systems**

EXPECTED OUTCOME:

Students who complete the course will have demonstrated the ability to do the following:

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REFERENCES:

1. John L. Hennessey & David Paterson, "**Computer Architecture A Quantitative Approach**", 4th edition, Morgan Kauffman Publishers, 2010.
2. Kai Hwang, & Naresh Jotwani, "**Advanced Computer Architecture, Parallelism, Scalability and Programmability**", 2nd edition, Mcgraw Hill Publications, 2011.
3. Bruce Jacob, Spencer W.Ng & David T. Wang, "**Memory Systems, Cache, DRAM and Disk**", Morgan Kauffman Publishers, 2008.
4. 4. David Culler, J. Pal Singh, & Anoop Gupta, "**Parallel Computer Architecture– A hardware/ software approach**", Morgan Kauffman Publishers, 2008.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Fundamentals of Computer Design**-Classes of computers, defining computer architecture, instruction set architecture, encoding an instruction set, trends in technology, power, dependability, measuring performance, benchmarks summarizing performance, Amdahl's law. Overview of computer architecture, processor performance equation, performance evaluation of processors, simple numerical exercises on Amdahl's law, and performance.	**10 Hrs**	**25%**
II	**Instruction Level parallelism-** Basic concepts in pipelining, 5-stage RISC pipeline of MIPS processor, various types of pipeline hazards, techniques to minimize hazards, exception handling in pipeline, MIPs pipeline extension for multi cycle operations.	**10 Hrs**	**25%**

	Compiler techniques for ILP exploitation- static scheduling and loop unrolling. branch predication techniques, dynamic scheduling using Tomasulo's approach, hardware speculation, multi issue processors, concept of re-order buffers. Case study: Pentium IV & core- i3.		
III	**Memory hierarchy:** fundamentals of cache memory, principle of locality, types of misses, block placement, block identification, block replacement, write strategy, average memory access time and cache performance, basic & advanced cache optimizations. SRAM and DRAM technology, DRAM controller architecture, Concepts of channels, rank and banks, row buffer management policy & address mapping. Virtual memory, techniques for address translation, TLB, segmentation and protection. Virtual machine monitors. Case study: AMD Opteron memory hierarchy.	**10 Hrs**	**25%**
IV	**Introduction to storage systems:** Basic hard disk organization, disk arrays, RAID standards. I/O performance measures and benchmarks. **Shared shared memory designs: S**ymmetric shared memory architecture, cache coherence protocols, snooping protocols and directory based protocols. Memory consistency models.	**10 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 15 1	WEB SERVICES	3-0-0-3	2015

PREREQUISITES: Matrix operations, linear algebra, probability and calculus

COURSE OBJECTIVES:

Upon completion of this course, students will be able to do the following:

- Understand primary concepts of SOA
- Know the integration of SOA technological points with Web Services.
- Implement of SOA in development cycle of Web Services.
- To provide students with an opportunity to implement a network based application modeled in terms of a "Service Oriented Architecture.
- To provide students with an opportunity to reflect on the differences between traditional client server, SOA, and Web service approaches to systems.
- To understand Simple Object Access Protocol (SOAP) and Web Services.
- To familiarize the UDDI registries and their operations.
- To understand the concept of XML and to implement Web services using XML based standards.
- To understand the advantages of using XML technology family
- To learn the Web services building blocks
- To implement e-business solutions using XML based web services

To familiarize the students with the recent trends in industry and academia to address Web service research issues.

SYLLABUS:

Introduction to Web Services, SOAP, WSDL. UDDI, XML Processing and Data Binding with Java APIs, XML Messaging Using JAXM and SAAJ.

EXPECTED OUTCOME:

Students who complete the course will have demonstrated the ability to do the following:

- Design and develop web systems that allow people to conduct business.
- Understand the nature, functionality, and limitations of various standards and specifications that support service orientation and the various parser API's like JAXP.
- Students will be able to understand the development and deployment cycles of enterprise applications.
- Students will be able to understand the protocols behind web services including: SOAP, UDDI etc.
- Students will be able to understand and experiment with the deployment of enterprise applications.
- Students will be able to develop network applications using Web Services (SOAP).

REFERENCES:

1. Ramesh Nagappan, Robert Skoczylas,Rima Patel Sriganesh, Developing Java Web Services, Wiley Publishing Inc.,2003.
2. Richard Monson Haefel, J2EE Web Services, Pearson Education, 2004.
3. Travis Vandersypen, Jason Bloomberg, Madhu Siddalingaiah, Sam Hunting, Michael D Qualls, David Houlding, Chad Darby, Diane Kennedy, XML and Web Services Unleashed, Pearson Education, 2002.
4. Frank P Coyle, XML Web Services and Data Revolution, Pearson Education, 2002.

Mark Hansen, SOA Using Java Web Services, Pearson Education, 2007.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Web Services** – Introduction to Web Services , Web Services Architecture, Web Services Communication Models, Implementing Web Services	**10**	**25%**
II	**SOAP**- Anatomy of a SOAP Message, SOAP Encoding, SOAP Message Exchange Model, SOAP Communication, SOAP Messaging, SOAP Bindings for Transport Protocols, SOAP Security, Building SOAP Web Services, Developing SOAP Web Services Using Java	**10**	**25%**
III	**WSDL**- Anatomy of a WSDL Definition Document, WSDL Bindings, WSDL Tools **UDDI**- UDDI Registries, Programming with UDDI, Implementations of UDD, Registering as a Systinet, UDDI Registry User ,Publishing Information to a UDDI Registry, Searching Information in a UDDI Registry,Deleting Information from a UDDI Registry	**10**	**25%**
IV	**XML Processing and Data Binding with Java APIs** - Extensible Markup Language (XML)Basics, Java API for XML Processing (JAXP), Java Architecture for XML Binding (JAXB) **XML Messaging Using JAXM and SAAJ** - The Role of JAXM in Web Services, JAXM API Programming Model, Basic Programming Steps for Using JAXM, JAXM Deployment Model, Developing JAXM-Based Web Services	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 25 1	DATA MINING CONCEPTS	3-0-0-3	2015

PREREQUISITES: Mathematical Foundation For Computer Science

COURSE OBJECTIVES:

- Be able to understand the concepts, strategies, and methodologies related to the design and construction of data mining.
- Be able to comprehend several data preprocessing methods.
- Be able to determine an appropriate mining strategy for given large dataset
- Be familiar with different data mining tools, their uses and the issues and challenges in solving problems.
- Be able to obtain knowledge of current data mining applications

SYLLABUS:
Data Mining - Rule Discovery - Classification and Prediction - Cluster Analysis and Applications and Trends in Data Mining

EXPECTED OUTCOME:

- Graduates will understand various data mining process and issues.
- Graduates will learn various techniques for data mining, and apply the techniques in solving data mining problems .
- Graduates will have the knowledge on the various data mining tools used solving problems.

TEXT BOOK:

1. Jiawei Han and Micheline Kamber "Data Mining Concepts and Techniques" Second Edition, Elsevier, Reprinted 2008.
2. A.B.M. Shawkat Ali, Saleh A. Wasimi "Data Mining: Methods and Techniques", Cengage Learning, 2009.
3. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
4. G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Data Mining:** Introduction to Data Mining - Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Attribute selection - Data Discretization and Concept Hierarchy Generation – Attribute construction.	5	25%
II	**Rule discovery:** Association Rule Mining: -Efficient and scalable frequent item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining	8	25%
III	**Classification and Prediction:** Issues Regarding Classification	4	

	and Prediction –Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification		
FIRST INTERNAL EXAM			
III	**Classification and Prediction:** Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section	**10**	**25%**
IV	**Cluster Analysis and Applications and Trends in Data Mining:** Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis - Outlier analysis Mining Complex Data Types – Methodologies of Data Mining – Data Mining Applications: Financial Data Analysis – Text and Web Mining – Intrusion Detection and Prevention – Privacy, Security and Social Impact of Data Mining	**13 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 35 1	NATURAL LANGUAGE PROCESSING	3-0-0-3	2015

PREREQUISITES: Software Engineering

COURSE OBJECTIVES:

- To introduce the general introduction including the use of finite state automata for language Processing.
- To introduce the fundamentals of syntax including parsing
- To explain the advanced features like feature structures and realistic parsing methodologies.
- To explain the basic concept of remote processing
- To give details about NLP applications.

SYLLABUS:

Introduction, Syntax, Advanced Features and Syntax, Semantic Representing Meaning

EXPECTED OUTCOME:

The students will be able to

- Acquire knowledge in Morphological features of English language.
- Design a parser for English language
- To design a good Syntax representation a language.
- Represent syntax and semantics of a language.
- Do projects in Translation,Disambiguation,Discourse analysis etc

REFERENCES:

1. Daniel Jurafsky & James H.Martin, "Speech and Language Processing", Pearson Education (Singapore) Pte. Ltd., 2002.
2. James Allen, "Natural Language Understanding", Pearson Education, 2003.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval Systems", Kluwer academic Publishers, 2000.
4. Tomek Strzalkowski "Natural Language Information Retrieval", Kluwer academic Publishers, 1999.
5. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing ", MIT Press, 1999

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Introduction** -Knowledge in speech and language processing - Ambiguity - Models and Algorithms - Language, Thought and Understanding. Regular Expressions and automata: Regular expressions -Finite-Stateautomata. Morphology andFinite-StateTransducers: Survey of English morphology -Finite-StateMorphological parsing- Combining FST lexicon and rules -Lexicon-	**10**	**25%**

	FreeFSTs: The porter stammer - Human morphological processing		
II	**Syntax** -Word classes andpart-of-speechtagging: English word classes - Tagsets for English -Part-of-speechtagging - Rule-basedpart-of-speechtagging - Stochasticpart-of-speechtagging -Transformation-basedtagging - Other issues.Context-FreeGrammars for English: Constituency - Context-Freerules and trees -Sentence-levelconstructions - The noun phrase - Coordination - Agreement - The verb phase and sub categorization - Auxiliaries - Spoken language syntax - Grammars equivalence and normal form - Finite-StateandContext-Freegrammars - Grammars and human processing. Parsing withContext-FreeGrammars: Parsing as search - A BasicTop-Downparser - Problems with the basicTop-Downparser - The early algorithm - Finite-Stateparsing methods	**10**	**25%**
FIRST INTERNAL EXAM			
III	**Advanced Features and Syntax** -Features and Unification: Feature structures - Unification of feature structures - Features structures in the grammar - Implementing unification - Parsing with unification constraints - Types and Inheritance. Lexicalized and Probabilistic Parsing: Probabilisticcontext-freegrammar - problems with PCFGs - Probabilistic lexicalized CFGs - Dependency Grammars - Human parsing.	**10**	**25%**
IV	**Semantic Representing Meaning** -Computational desiderata for representations - Meaning structure of language - First order predicate calculus - Some linguistically relevant concepts - Related representational approaches - Alternative approaches to meaning. Semantic Analysis:Syntax-Drivensemantic analysis-Attachmentsfor a fragment of English - Integrating semantic analysis into the early parser - Idioms and compositionality - Robust semantic analysis. Lexical semantics: relational among lexemes and their senses - WordNet: A database of lexical relations - The Internal structure of words - Creativity and the lexicon. Application: Word sense Disambiguation	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 45 1	REAL TIME SYSTEMS	3-0-0-3	2015

PREREQUISITES: Nil

COURSE OBJECTIVES:

The primary goal of this course is to meet the participant with basics of real-time systems and to give the participant knowledge and skills necessary to analyze and design various aspects of real-time operating systems.

- To understand the definition and important characteristics of real time systems
- To evaluate the performance of soft and hard real time systems.
- To Identify and understand multi tasking techniques in real time systems
- To analyze multi task scheduling algorithms for periodic, aperiodic and sporadic tasks.

SYLLABUS:

Introduction, Commonly used approaches to Real time scheduling, Priority driven scheduling of Periodic jobs, Scheduling Aperiodic and Sporadic Jobs in Priority Driven Systems

EXPECTED OUTCOME:

Upon completion of this course, students should be able to:

- Explain and apply the fundamental concepts and terminology of real-time systems;
- Explain and address the fundamental problems of real-time systems;
- Analyze and Design real time operating systems.
- Identify and assess the relevant literature and research trends of real-time systems.

REFERENCES:

1. Jane W.S. Liu,"Real-TimeSystems", Pearson Education, 2000, ISBN NO:81–7758–575-4.
2. Phillip A. Laplante,"Real-TimeSystems Design and Analysis",Prentice Hall of India, Second Edition, 2001, ISBN NO:81-203-1684-3.
3. Krishna C. M., Kang G. Shin,"Real-TimeSystems",McGraw-HillInternational Edition ISBN:0-07-114243-6.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction: Hard Versus Soft Real time Systems: Jobs and Processors–Realtimes, Deadlines and Timing constraints – Hard and Soft timing constraints – Hard Real time systems – Soft Real time systems – A reference model of Real time systems: Processors and resources – Temporal parameters of Real time workload – Periodic task model– Precedence constraints and data dependency – Other types of dependencies – Functional Parameters – Resource Parameters of Jobs and Parameters of resources – Scheduling hierarchy	**10**	**25%**
II	Commonly used approaches to Real time scheduling: Clock	**5**	**25%**

	driven approach – Weighted round robin approach – Priority Driven approach – Dynamic versus Static systems– Effective Release times and Deadlines – Optimality of EDF and LST – Challenges in validating timing constraints in Priority driven systems – Offline versus Online scheduling– Clock driven scheduling: Notations and assumptions – Static Timer driven scheduler–General structure of Cyclic schedules – Cyclic executives – Improving average response time of Aperiodic jobs – Scheduling Sporadic jobs		
FIRST INTERNAL EXAM			
III	Priority driven scheduling of Periodic jobs: Static assumptions – Fixed priority versus Dynamic priority algorithms – Maximum schedulable utilization – Optimality of RM and DM algorithms – Schedulability test for Fixed priority tasks with Short response times – Schedulability Test for Fixed priority tasks with arbitrary response times – Sufficient Schedulability conditions for RM and DM algorithms	**10**	**25%**
IV	Scheduling Aperiodic and Sporadic Jobs in Priority Driven Systems: Assumptions and Approaches – Deferrable servers – Sporadic servers – Constant Utilization,. Resources and Resource Access Control: Assumptions on resources and their usage – Effects of resource contention and resource access control – Non preemptive Critical Sections – Basic Priority Inheritance Protocol – Basic Priority Ceiling Protocol - Stack Based Priority ceiling Protocol – Preemption Ceiling Protocol	**10**	**25%**

Course No.	**Course Name**	**L-T-P-Credits**	**Year of Introduction**
06 CS 6 55 1	NEURAL NETWORKS	3-0-0-3	2015

PREREQUISITES: Nil

COURSE OBJECTIVES:

Introduce basic concepts of neural networks. Understand different neural network models. Understand different basic learning algorithms. Demonstrate neural network applications on real-world tasks. Give design methodologies for artificial neural network

SYLLABUS:

Introduction to biological neuron, Back propagation network, Recurrent neurodynamical systems, ART: Noise saturation dilemma

EXPECTED OUTCOME:

Students who successfully complete this course will be able to:-

- Describe the relation between real brains and simple artificial neural network models.
- Explain the differences between networks for supervised and unsupervised learning
- Discuss the main factors involved in achieving good learning and generalization performance in neural network systems.
- Analyze the performance of neural networks models.
- Discuss the limitations and possible applications of ANNs

REFERENCES:

1. Satish Kumar, "Neural Networks- A classroom Approach", TheMcGraw-HillCompanies.
2. James A. Anderson , "An introduction to Neural Networks" ,PHI.
3. Simon Haykin, "Neural Networks :A comprehensive foundation", Pearson Education.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction to biological neuron, Artificial Neuron, Feedforward neural networks and supervised learning- Abstraction - Activation functions – mathematical preliminaries – Architecture – Properties and applications. Geometry of binary threshold neurons and their networks, Perceptrons and LMS.	**12**	**25%**
II	Back propagation network – BPN Learning algorithm - Examples. Considerations in implementing Back Propagation Algorithm. Structure growing algorithm, fast relatives of BPN- Applications of feed forward neural networks. Bayes' theorem- Implementing classification decisions with Bayes theorem.	**15**	**25%**
III	Recurrent neurodynamical systems: Dynamical systems – Stability-Linear and nonlinear dynamicalsystems-Lyapunovstability. Associative Memory- Linear associative memory, Hopfield networks- Applications- Boltzmann machine. BAM- BAM stability analysis- Continuous BAM-Adaptive BAM-Applications.	**15**	**25%**
IV	ART: Noise saturation dilemma – solution.ART-Outstar-Instar-ART1-Applications. The new generation- pulsed neuron model- Integrate and fire neurons- conductance	**15**	**25%**

	based models		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 65 1	WIRELESS COMMUNICATION	3-0-0-3	2015

PREREQUISITES:

COURSE OBJECTIVES:

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SYLLABUS:

Introduction to Wireless Communications, Random Signal Theory, Digital Modulation Techniques, The Cellular Concept.

EXPECTED OUTCOME:

Students who successfully complete this course will be able to:-

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REFERENCES:

1. Kaveh Pahlavan, Prashant Krishnamurthy., Principles of Wireless Networks.- Pearson Education, 2002
2. Stallings, William., Wireless Communications and Networks.- Pearson Education, 2002.
3. T. S. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall, (1996)
4. D. Tse, P. Viswanath, Fundamentals of Wireless Communications, Cambridge Press, (2005)
5. G. L. Stuber, Principles of Mobile Communication, Kluwer Acdemic, (1996)
6. J. G. Proakis, Digital Communications, McGraw-Hill, (1995)
7. A Goldsmith Wireless Communication Cambridge 2008

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction to Wireless Communications –Radio spectrum for Wireless communication, Evolution of Wireless Technologies, Satellite communication, Cordless Systems and Wireless Local Loop- WiMAX and IEEE 802.16 Broadband Wireless Access Standards, Wireless LAN Technology-Infrared LANs, Spread spectrum LANs ,Narrowband Microwave LANs. Wi-Fi and the IEEE 802.11 Wireless LAN standard, Bluetooth Technology.	**10 Hrs**	**25%**

II	Random Signal Theory: Joint Probability, Statistical independence, Cumulative Distribution function and Probability Density function, Error function, Rayleigh and Gaussian Probability Density, Stationary and Ergodic Process. Wireless Communication Technology: Antennas and propagation-Propagation modes, Line of sight transmission, Fading in mobile environment, signal encoding Techniques, Spread spectrum –Frequency Hopping spread spectrum, Direct sequence spread spectrum, Coding and Error control-Error detection and Block error correction codes, convolution codes.	**11 Hrs**	**25%**
III	Digital Modulation Techniques: Performance Analysis of BPSK, DPSK, QPSK, M-ary PSK, BFSK, M-ary FSK, MSK, QAM, OFDM for wireless transmission. Mobile Radio Interferences & System Capacity: Co-channel Interference and System Capacity, Channel planning for Wireless Systems, Adjacent channel interferences, Power control for reducing interference, Inter-symbol Interference.	**11 Hrs**	**25%**
IV	The Cellular Concept: Frequency Assignment and Channel Assignment, Frequency Reuse, Handoff, Sectoring, Microcell zone, Spectral efficiency. Multiple Access techniques: FDMA, TDMA, CDMA, OFDMA, OFDM-CDMA, MIMO-OFDM and QOS issues.	**10 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 06 1	RESEARCH METHODOLOGY	0-2-0-2	2015

PREREQUISITES: Introduction to statistics.

COURSE OBJECTIVES:

- To be aware of ethical practises in research
- To be able to apply appropriate methods for research
- To be able to understand good practises for thesis writing

SYLLABUS:

Research Objectives, Data Collection, Analysis, Interpretation, Forming a research problem, Basic statistical measures, Ethics of Research, Guidelines in report writing, Intellectual Property Rights.

EXPECTED OUTCOME:

The students will be able to

- Apply statistical measures for evaluation
- Able to apply correct research methods for the project
- Able to write a thesis and select good publications based on different metrics

TEXT BOOKS:

1. Research Methodology By R Panneerselvam - Prentice Hall International 2004 - Eleventh printing, 2013.
2. Research Methodology By CR Kothari - New Age International publishers Second Revised Edition, Reprint 2013.

REFERENCES:

1. A beginners guide to uncertainty of measurement by Stephanie Bell, NPL Publishing
2. Research Methodology By Francis C. Dane, Brooks/Cole Publishing Company, California

COURSE PLAN

Module	Contents	Hours	Internal Marks
I	Introduction - Meaning of Research, Objectives, Motivation, Types of Research. Research process- Problem definition-Objectives of Research- Research design- Data collection –Data Analysis –Interpretation of	**10**	**25%**

	Results- Validation of Results. Formulation of a Research problem.		
II	Basic Statistical measures - Measures of central tendency – Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean	**5**	**25%**
FIRST INTERNAL EXAM			
II	Measures of variation – Range, Mean Deviation, Quartile Deviation, Coefficient of Variation and Standard Deviation, Measures of skewness	**5**	
III	Ethics of Research- Scientific Misconduct- Forms of Scientific Misconduct. Measurement of errors - Measurement uncertainty. Statistical test of hypothesis- T-test, Z Test, F-test, Chi-square test.	**10**	**25%**
IV	Guidelines for writing a PhD thesis - Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. Impact factor-Validity, Merits, limitations. Other measurements of impact. h-index-advantages, criticism of h-index-modification of h-index, Intellectual property rights (IPR)- forms of IPR- patents-copyrights-Trademarks-Industrial design-geographical indication.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 07 1	SEMINAR	0-0-2-2	2015

PREREQUISITES: Good presentation skills

COURSE OBJECTIVES:

- To learn the recent developments in the research areas.

SYLLABUS:

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. Programme. He / she shall select the topic based on the References: from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester.

EXPECTED OUTCOME:

- develop their presentation skills
- acquire the knowledge about emerging research areas

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 08 1	Advanced Computing Lab I	0-0-2-1	2015

COURSE OBJECTIVES: To explore the Data Structures, Mathematical Foundation in Computer Science, Operating Systems, CASE, Computer Architecture etc. and to acquaint them to simulation tools.

SYLLABUS:
(Choose any two, left to the choice of the college)
Part A: (DS and MFCS)
Experiments would be designed to provide hands-on experience in programming data structures and algorithms, (Any experiment with DS theory course can be added.)

Implementation of B trees, threaded binary trees, red black trees

Complexity analysis of sorting algorithms with large input

Implementation of hashing functions

Implementation of simple cryptographic algorithms

Part B Operating Systems
Experiments would be designed to provide hands-on experience in computer systems, to learn unix system calls, posix threads, operating system concepts,

Study performance improvement in using threads as compared with process.(Examples like Matrix Multiplication, Hyper quicksort, Merge sort, Traveling Sales Person problem)

Implement all CPU Scheduling Algorithms using your thread library

Study the concept of Synchronization and implement the classical synchronization problems using Semaphores, Message queues and shared memory

NFS server and NFS client implementation using RPC

Part C: CASE
Familiarization of UML diagrams using CASE tools
Planning and scheduling using Analysis and design practice using CASE tools
SRS, Design document and Test Plan preparation for a given project.

Part D: Computer Architecture
Familiarization of open source CPU tool- GEM5/MARSS
Basic simulations using out of order pipeline
Implementation of Tomasulao dynamic scheduling
Study on CPU performance with varying cache statistics
Implementation of coherence protocols
Implementation of cache replacement algorithms

EXPECTED OUTCOME:

- Ability to implement the Data Structures, Mathematical Foundation in Computer Science, Operating Systems, CASE, Computer Architecture etc. and to acquaint them to simulation tools.
- Gaining knowledge about the tools like CASE

SEMESTER 2

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 01 2	ADVANCED DATABASE MANAGEMENT SYSTEMS	4-0-0-4	2015

PREREQUISITES: Knowledge on database management systems with emphasis on Modelling and Transactions

COURSE OBJECTIVES:

- It gives broader introduction to post-relational database.
- To understand more advanced database technology required for larger, high performance and complex databases.
- To learn how enterprise application use database technologies.

SYLLABUS:
Web Databases, Embedded Databases, Advanced databases, Distributed databases, Next Generation Databases-Cloud database, Graph databases, Emerging Technologies-Multimedia Databases, Mobile Databases

EXPECTED OUTCOME:

- Students will be able to identify the different categories of databases, their implementation issues and the usage of systems.
- They will be able to acquire inquisitive attitude towards research topics in emerging databases in Cloud and Big Data.

REFERENCES:

1. Serge Abiteboul, Ioana Manolescu, Philippe Rigaux, Marie -Christine Rousset, Pierre Senellart, Web Data Management, Cambridge University Press, 450 pages,2011. (also available online)
2. Bhavani Thuraisingham, XML Databases and the Semantic Web, CRC Press, 2002.
3. Elmasri R., Navathe S.B., "Fundamentals of Database Systems", Pearson Education/Addison Wesley, Fifth Edition, 2007.
4. Henry F Korth, Abraham Silberschatz, Sudharshan S., “Database System Concepts”, McGraw Hill, Fifth Edition, 2006
5. SQLite, FromWikipedia,the free encyclopedia, http://en.wikipedia.org/wiki/SQLite
6. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, McGraw Hill, Third Edition, 2004.
7. Dale Anderson, Big Data and NoSQL Technologies at http://dbbest.com/blog/big-datanosql-technologies/ L T P C 3 1 0 4
8. Dale Anderson, Column Oriented Database Technologies at http://dbbest.com/blog/column-oriented-database-technologies/
9. Big Table and Column Databases,Ling Liu,College of Computing http://www.cc.gatech.edu/~lingliu/courses/cs4440/notes/17.BigTableColumnDB.pdf
10. Fay Chang, Jeffrey Dean, Sanjay Ghemawat, Wilson C. Hsieh, Deborah A. Wallach Mike Burrows, Tushar Chandra, Andrew Fikes, Robert E. Gruber, Bigtable: A Distributed Storage System for Structured Data at

http://static.googleusercontent.com/external_content/untrusted_dlcp/research.google.com/ en//archive/bigtable-osdi06.pdf
11. Graph databases- Ian Robinson, Jim Webber, Emil Eifrem, O'Reilly
12. Klint Finley, 5 Graph Databases to Consider at http://readwrite.com/2011/04/20/5-graphdatabases-to-consider
13. Vijay Kumar, "Mobile Database Systems", A John Wiley & Sons, Inc., Publication.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Web Databases**: NoSQL Databases - MongoDB example - Semi-structured data managementXML, XPath and XQuery, Document data-stores -Examples, Key-Value data-stores – Examples- In-memory databases-VoltDB example Embeeded Databases - definition- Example - SQLite internal architecture and data types	**10**	**25%**
II	**Advanced databases**: Spatial Data Management: Types Of Spatial Data And Queries- Point And Region Data-Queries-Applications Involving Spatial Data, -Spatial Indexes-indexing using Space Filling Curves- Region Quad Trees and Z Ordering – Index Structures - Grid Files, Rtrees Distributed databases- distributed file systems- Examples- distributed query processing	**10**	**25%**
FIRST INTERNAL EXAM			
III	**Next Generation Databases:** Cloud Databases- methods to run- virtual machine deployment, as a service- Column Stores-Examples- Cassandra, HBase-Aggregation and Join, -Case study- BigTable Google's distributed storage system for structured data-building blocks-GFS, Scheduler, Lock Service, MapReduce Graph databases- Comparison of Twitter's FlockDB and Neo4j- Overview of NewSQL- Case study -Google's Spanner	**10**	**25%**
IV	**Emerging Technologies**: Multimedia Databases-Multimedia Sources-ImageDatabases-Compressed Representations Similarity Based Retrieval **Mobile Databases**- Mobile Database Systems-Issues and Applications-Query processingQuery types – Transaction Execution in MDS- Mobile Transaction Models - Concurrency Control Mechanism-Transaction Commit Protocols- Mobile database Recovery: Log management in mobile database systems	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 02 2	ADVANCED COMPUTER NETWORKS	3-0-0-3	2015

PREREQUISITES:

- **Basic Awareness of Computer Networks and Reference models.**
- **Awareness of Data Communication.**

COURSE OBJECTIVES:

The Student will be able to:-

- **To learn TCP/IP networks and protocols involved in each layer.**
- **To learn IP distribution and network management practices.**

SYLLABUS:

Physical Layer and Data link layer, Network Layer, Transport Layer and ATM Networks, Application Layer

EXPECTED OUTCOME:

Students who successfully complete this course will have demonstrated an ability to:-

- Learn protocols of TCP/IP suite
- Understand IP distribution, Subnetting, network management practices.
- Understand the basics of real-time data transfer

TEXT BOOK:

1. William Stallings, Data and Computer Communications , Pearson Education.
2. Behrouz A Forouzan, TCP/IP Protocol Suite , Tata McGraw-Hill.
3. Peterson and Davie, "Computer Networks -A systems approach", Elsevier

REFERENCES:

1. Kurose and Ross, Computer Networks A systems approach , Pearson Education.
2. Behurouz A Forouzan, "Data Communications & Networking", 4th edition, McGraw-Hill

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Physical Layer:** Transmission Media- Wired Transmission, Wireless Transmission, Wireless Propagation, Signal Encoding Techniques. **Data link layer:** TCP/IP Protocol Architecture, Framing, Reliable Transmission, Ethernet (802.3) and Token Ring (802.5).	**10**	**25%**

II	Connecting Devices. ARP, RARP. IP Address – Sub netting / Super netting, Packet Forwarding with Classfull / Classless Addressing, Datagram Fragmentation,	**5**	**25%**
FIRST INTERNAL EXAM			
II	Components in IP software, Private IP and NAT. ICMP. Routing Protocols -Distance Vector Routing-RIP, Link-State Routing-OSPF	**5**	
III	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. SCTP- SCTP services and features, Packet format, SCTP connection, State Transitions, Flow and Error control. ATM NETWORKS - ATM Layer Structure, ATM Cell, Routing:-VPI, VCI, AAL	**10**	**25%**
IV	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**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 03 2	COMPUTER SECURITY AND APPLIED CRYPTOGRAPHY	3-0-0-3	2015

PREREQUISITES:

1. Basics of Linear Algebra..
2. Basics of Computer Security and Networks.

COURSE OBJECTIVES:

To provide an in depth knowledge about computer security, network security and cryptography. The overall aim is to gain an understanding of fundamental cryptographic concepts ,approaches and principles of digital information security, linear algebraic concepts, Symmetric and Asymmetric key cryptography, Message Authentication and Hash functions, Network Security

SYLLABUS:

Introduction to cryptography Concepts, Symmetric Key cryptography, Message Authentication and Hash functions, Network Security

EXPECTED OUTCOME:

The students will be able to

1. Explain the concepts related to applied cryptography, including plaintext, ciphertext, Substitution and transposition techniques.
2. Understand the basic linear algebraic techniques applied to cryptography.
3. Explain the symmetric and asymmetric cryptographic algorithms(DES,AES.RSA etc), and key managment techniques like Diffie Hellman key exchange algorithm etc.
4. Explain the data integrity algorithms including Hash and Message Authentication Code algorithms ,digital signature.
5. Understand the concepts of network and internet security like IP Security, System security ,Intrusion detection techniques.

TEXT BOOK:

1. William Stallings, "Cryptography and network security-principles and practice", 3 rd Edition, Pearson Prentice Hall.

REFERENCES:

1. Charlie Kaufman, Radia Perl man, Mike Speciner, "Network Security private communication in a practice", 2nd Edition Pearson Prentice Hall.
2. Douglas A. Stinson, "Cryptography, Theory and Practice", 2nd edition, Chapman & Hall, CRC Press Company, Washington
3. Neal Koblitz, "A Course in Number Theory and Cryptography", 2nd Edition, Springer, 2002.

4. Behrouz A Forouzan, "Cryptography & Network Security", Tata McGraw-Hill

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Introduction to cryptography Concepts**, approaches and principles of digital information security, types of attacks, model, cryptographic techniques – substitution and transposition techniques, Euclidean algorithm – Congruences: Definitions and properties – linear congruences, residue classes, algebraic structures (groups, rings fields), Galios Filed, Euler's phi function – Fermat's Little Theorem – Chinese Remainder Theorem, Factorization methos, Pollard rho	**13**	**25%**
II	**Symmetric Key cryptography:** Block cipher design principles and criteria, DES, 2DES, triple DES, AES, RC4, Blowfish, Differential and linear cryptanalysis.	**6**	**25%**
FIRST INTERNAL EXAM			
II	**Asymmetric key cryptography:** Principles of public key crypto systems, RSA , Rabin Cryptosystem, ELgamal cryptosystem, key management, Diffie-Hellman key exchange, elliptic curve cryptography, exponentiation and logarithm, discrete logarithm, primitive roots.	**11**	
III	**Message Authentication and Hash functions**, Authentication functions, message authentication codes, Hash functions and their security, MD5 , SHA, HMAC. Digital signatures and authentication protocols, Digital Signature standards, Kerberos, X.509 authentication service, PGP.	**15**	**25%**
IV	**Network Security:** Introduction, IP Security-Overview, Architecture, AH, ESP, Combining Security Associations, Key Management. System Security- Intrusion Detection, Password Management, Viruses and related threats, Virus Counter measures, Firewalls-Design Principles, Secure Socket Layer, Transport Layer Security, Secure Electronic Transaction.	**15**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 14 2	PATTERN RECOGNITION	3-0-0-3	2015

PREREQUISITES: Data mining, probability, machine learning and calculus

COURSE OBJECTIVES:

The Student will be able to:-

- Learn fundamentals of pattern recognition
- Learn different feature extraction and dimensionality reduction techniques.

SYLLABUS:

Introduction to Pattern Recognition**,** Different Estimations, Component Analysis and Discriminants, Non parametric techniques.

EXPECTED OUTCOME:

The students will be able to

- Understand the application of pattern recognition in research
- Develop applications using different machine learning techniques.

TEXT BOOKS:

1. RO DUDA , Pattern Classification, Wiley India, 2nd Edition, 2006
2. Tou Gonzalves , Pattern recognition principles. 2nd Edition
3. Christopher Bishop, Pattern Recognition and Machine Learning, February 2010, Springer Publication

REFERENCES

1. William Gibson, Pattern Recognition, Penguin, Re-edition 2011

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction to Pattern Recognition, Design Cycle of Pattern Recognition System, Bayesian Decision Theory – Continuous Features, Two category classification, classifiers, Discriminant Functions and decision Surface, Multi category case, two category case. Bayesian Decision theory- Discrete Features, Independent Binary Features	**10**	**25%**
II	Component Analysis and Discriminants – Principle component analysis, Fisher Linear Discriminant, Multiple Discriminant Analysis. Hidden Markov Models- First Order, First Order HMM, HMM Computation, Evaluation and decoding, Learning.	**5**	**25%**
	FIRST INTERNAL EXAM		
II	Parameter Estimation- Univariate and multivariate case. Problems of dimensionality, Accuracy, Dimension and Training sample Size, Computational Complexity.	**5**	

III	Component Analysis and Discriminants – Principle component analysis, Fisher Linear Discriminant, Multiple Discriminant Analysis. Hidden Markov Models- First Order, First Order HMM, HMM Computation, Evaluation and decoding, Learning.	**10**	**25%**
IV	Non parametric techniques – Density estimation, Coverage of the mean, variance, Probabilistic Neural Networks, Choosing the window functions. K-nearest neighbor estimation, Parzen window estimation, Nearest neighbor rule, Distance Measures, Coverage of nearest neighbor, Clustering in Feature selection, Feature selection through entropy minimization. Application of pattern recognition	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 01 4	**OBJECT ORIENTED SOFTWARE ENGINEERING**	4-0-0-4	2015

PREREQUISITES:

Knowledge on object oriented software engineering and to design software using tools

COURSE OBJECTIVES:

- To understand the importance of object oriented software engineering
- To understand the importance of requirement analysis.
- To analyze and design software using tools.
- To develop efficient software, deploy and maintain after production

SYLLABUS:

Software Engineering Concepts, Requirements Elicitation, Design, Mapping Design (Models) to Code, Testing.

EXPECTED OUTCOME:

- To prepare object oriented design for small/ medium scale problem.
- To apply the various tools and patterns while developing software
- Testing the software against usability, deployment, maintenance.

TEXT BOOKS:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd ed, Pearson Education,2004.
2. Craig Larman, Applying UML and Patterns 3rd ed, Pearson Education, 2005.
3. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.
4. Alistair Cockburn, Agile Software Development 2nd ed, Pearson Education, 2007

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Software Engineering Concepts – Development Activities – Managing Software Development – Project Organization – Communication- UML Diagrams	**10**	**25%**
II	Requirements Elicitation- Concepts – Activities – Management-Analysis- Concepts – Activities – Management.	**10**	**25%**
FIRST INTERNAL EXAM			
III	Design: System Design, Architecture – Design Principles - Design Patterns – Addressing Design Goals – Managing System Design. Mapping Design (Models) to Code – Model Transformation- Refactoring- Mapping Associations- Mapping Activities	**10**	**25%**
IV	Testing- Configuration Management –Rational Management-	**10**	**25%**

	configuration management-project management-software life cycle.		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 34 2	**COMPILER DESIGN**	3-0-0-3	2015

PREREQUISITES: Knowledge on compiler construction and design

COURSE OBJECTIVES:

- The course is intended to teach the students the basic techniques that underline the practice of Compiler Construction. The course will introduce the theory and tools that can be standarly employed in order to perform syntax-directed translation of a high-level programming language into an executable code.

The primary objectives of this course are to:

- Describe the theory and practice of compilation, in particular, the lexical analysis,parsing and code generation and optimization phases of compilation.
- Develop an understanding of the compilation process
- Be competent with control-flow and dataflow analysis,codeoptimizations,generation of machine code and optimizations.
- Be exposed to different optimization techniques.

Be exposed to SPIM-compiler testing tool.

SYLLABUS:

Principles Of Compiler , Importance of Code optimization ,Intermediate representation –low level intermediate languages, Run-time support – Register usage, Optimization, Simplification, Procedure optimization, Register allocation, Code Scheduling, Case Studies – Sun Compilers for SPARC – IBM XL Compilers, Compiler testing tools – SPIM

EXPECTED OUTCOME:

- Explain and apply the fundamental concepts and terminology of compiler design.
- Design routines to handle a range of compiler specific optimizations.
- Apply simple intermediate code optimizations.

TEXT BOOKS:

1. Steven S Muchnik, “Advanced Compiler Design and Implementation”, Morgan Kaufmann publishers, Elsevier Science, India, Indian Reprint 2003.
2. Keith D Cooper and Linda Torczon, “Engineering a Compiler”, Elsevier Science, India.
3. Sivarama P. Dandamudi, “Introduction to Assembly language programming: for Pentium and RISC processors”.
4. Allen Holub “Compiler Design in C”, Prentice Hall of India, 1990.
5. Alfred Aho, Ravi Sethi V., Jeffery Ullman D., “Compilers Principles, Techniques and Tools”,Addison Wesley, 1988.
6. Charles N. Fischer, Richard J. Leblanc, “Crafting a compiler with C”, BenjaminCummingsPublishing Co., Inc. Redwood City, CA, USA.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Principles Of Compiler – Compiler Structure – Properties of a Compiler – Optimization – Importance of Code optimization – Structure of Optimizing compilers –	**10**	**25%**

	placement of optimizations in optimizing compilers – ICAN – 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		
II	Run-time support – Register usage – local stack frame – run-time stack – Code sharing – position– independent code – Symbolic and polymorphic language support - 2 Optimization – Early optimization – Constant folding – scalar replacement of aggregates Simplification – value numbering – constant propagation – redundancy elimination – loop optimization. Procedure optimization – in-line expansion – leaf routine optimization and shrink wrapping.	**10**	**25%**
FIRST INTERNAL EXAM			
III	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 pipelining – trace scheduling – percolation scheduling	**10**	**25%**
IV	Case Studies – Sun Compilers for SPARC – IBM XL Compilers – Alpha compilers – PA –RISC assembly language – COOL – (Classroom Object oriented language) - Compiler testing tools – SPIM	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 44 2	SOFT COMPUTING	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

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SYLLABUS:

Artificial Neural Network, Models Of Neural Network, Genetic Algorithm, Hybrid Systems

EXPECTED OUTCOME:

This course requires the student to demonstrate the ability to:

-

REFERENCES:

1. Neural Networks- A Comprehensive foundation, Simon Haykin, 2nd Ed; Pearson
2. Neural Networks, Fuzzy Logic & Genetic Algorithms – Synthesis & applications, T.S. Rajasekaran & G.A. Vijaylakshmi Pai, PHI
3. Genetic Algorithm & fuzzy Logic Systems - Sanchez, Takanori, Zadeh; World Scientific
4. Genetic Algorithm, Goldberg David E.; Pearson
5. Principles of Softcomputing, S.N. Sivanandam, S.N.Deepa, Wiley India.
6. Jyh-Shing Roger Jang., Chuen-Tsai Sun ,Eiji Mizutani, "Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence", Prentice-Hall of India Pvt. Ltd., 2004. ISBN:978-0-13261-066-7
7. K.H. Lee, "First Course on Fuzzy Theory and Applications", Springer, 2005
   George J. Klir., Yuan Bo; Fuzzy Sets and Fuzzy Logic – Theory and Applications

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model, Properties of neural network, Typical architectures: single layer, multilayer, competitive layer; Different learning methods: Supervised, Unsupervised & reinforced; Common activation functions; Feed forward, Feedback & recurrent N.N; Application of N.N	**11 Hrs**	**25%**
II	Architecture, Algorithm & Application of -- McCulloh-Pitts, Hebb Net, Perceptron (with limitations & Perceptron learning rule Convergence theorem), Backpropagation NN, ADALINE, MADALINE, Discrete Hopfield net, BAM, Maxnet , Kohonen Self Organizing Maps Learning Vector Quantization.	**11 Hrs**	**25%**
FIRST INTERNAL EXAM			
III	Basic concept; role of GA in optimization, Fitness function, Selection of initial population, Cross over(different types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation; Genetic Programming; Schema theorem; Multiobjective & Multimodal optimization in GA	**10 Hrs**	**25%**

IV	Hybrid systems, GA based BPNN(Weight determination, Application); Neuro Fuzzy Systems, Fuzzy backpropagations networks, architecture, learning, application; Fuzzy Logic controlled G.A,; Application: Travelling Salesman Problem, a fusion approach for multispectral images with synthetic aperture radar for food analysis, GA for internet search technique, case study in Matlab (neural network toolbox, fuzzy logic toolbox, genetic algorithm tool box)	**10 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 54 2	PARALLEL COMPUTER ARCHITECTURE	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

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SYLLABUS:

Parallel computer models, Parallel processors standards, On-chip Interconnection systems, Cache memory designs for multi core processors

EXPECTED OUTCOME:

This course requires the student to demonstrate the ability to:

-

REFERENCES:

1. Kai Hwang, & Naresh Jotwani, "**Advanced Computer Architecture, Parallelism, Scalability and Programmability**", 2nd edition, Mcgraw Hill Publications, 2011.
2. David Culler, J. Pal Singh, & Anoop Gupta, "**Parallel Computer Architecture– A hardware/ software approach**", Morgan Kauffman Publishers, 2008.
3. William J. Dally & Brian Towles, "**Principles and practices of interconnection networks"**, Morgan Kauffman Publishers, 2010.
4. Bruce Jacob, Spencer W.Ng & David T. Wang, "**Memory Systems, Cache, DRAM and Disk**", Morgan Kauffman Publishers, 2008.
5. Selected papers from proceedings of computer architecture conferences-ISCA, HPCA, and MICRO, 2011-2014. (For module 4)

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Multiprocessors and multi-computers**,** fundamental design issues in parallel computer models. Parallel application case studies. parallelization process and steps. Snoop based coherence protocols- ESI, MESI. Memory based and cache based directory protocols. Concept of multithreading and hyper-threading	**11 Hrs**	**25%**
II	Super scalar processors**,** VLIW processors, vector processing and array processing. Basic concepts of GPU and CUDA programming. Organization of GPU based systems. Case study. NVIDIA-Tesla. Multicore programming with OpenMP	**11 Hrs**	**25%**
	FIRST INTERNAL EXAM		
III	Principles of network on chip (NoC), various topologies, traffic patterns, performance measures, taxonomy of routing algorithms, deterministic, oblivious and adaptive routing, flit buffer and bufferless flow control designs, overview of router architecture, arbitration and allocation.	**10 Hrs**	**25%**
IV	Last level cache management in multi-core designs, locality	**10 Hrs**	**25%**

	aware data replication in caches, Cache compression techniques; cache block eviction using reference predictions, cache management using reuse distance, adaptive cooperative set granular caching.		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 64 2	**BIOCOMPUTING**	3-0-0-3	2015

PREREQUISITES:

- Knowledge of molecular biology
- Knowledge of gene structure and chemical bonding

COURSE OBJECTIVES:

- To understand the science of storing, extracting,organizing, analysing and interpreting biological data.

SYLLABUS:

Molecular Biology and Biological Chemistry,Gene Analysis and Gene Mapping,Alignment of Pairs of Sequences, Hidden Markov Models,Protein Classification and Structure Visualization

EXPECTED OUTCOME:

- The students will have an overall idea about BioComputing.
- They will be prepared to use different computational techniques, with the exploding information resources of the human genome and the related data.

TEXT BOOKS:

1. S C Rastogi, N Mendiratta, P Rastogi, Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery, Third Edition, PHI Learning Private Limited, 2011
2. Vittal R Srinivas, Bioinformatics A modern Approach, PHI Learning Private Limited, 2009
3. Bryan Bergeron, Bioinformatics Computing PHI Learning Private Limited, 2010
4. Dan E Krane, Michael L Raymer, Fundamental Concepts of Bioinformatics, Pearson Education, 2003
5. T K Attwood, D J Parry Smith, Introduction to Bioinformatics, Pearson Education, 2003.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Molecular Biology and Biological Chemistry -** The Genetic Material, Gene Structure and Information Content, Protein Structure and Function, The Nature of Chemical Bonds, Molecular Biology Tools, Genomic Information Content, Major Databases in Bioinformatics Information Search and Data Retrieval- Tools for Web Search, Data Retrieval Tools, Data Mining of Biological Databases Gene Analysis and Gene Mapping- Genome Analysis, Genome Mapping, Physical Maps, Cloning The Entire Genome, Genome Sequencing,The Human Genome Project	**10**	**25%**

	(HGP		
II	**Alignment of Pairs of Sequences -** Methods of Sequence Alignments, Using Scoring Matrices, Measuring Sequence Detection Efficiency, Methods of Multiple Sequence Alignment, Evaluating Multiple Alignments, Phylogenetic Analysis, Tree Evaluation Tools for Similarity Search and Sequence Alignment – Working with FASTA, BLAST, FASTA and BLAST Algorithms Comparison	**10**	**25%**
FIRST INTERNAL EXAM			
III	**Profiles and Hidden Markov Models -** Using Profiles, Hidden Markov Models Gene Identification and Prediction – Basis of Gene Prediction, Pattern Recognition, Gene Prediction Methods Gene Expression and Microarrays – Working with DNA Microarrays, Clustering Gene Expression Profiles, Data Sources and Tools for Microarray Analysis, Applications of Microarray Technology	**10**	**25%**
IV	**Protein Classification and Structure Visualization -** Protein Structure Visualization, Protein Structure Databases, Protein Structure Alignment, Domain Architecture Databases, Protein Classification Approaches, Protein Identification and Characterization, Primary and Secondary Structure Analysis and Prediction, Patterns and Fingerprints Search, Methods of 2D Structure Prediction, Protein Prediction from a DNA Sequence Proteomics – Tools and Techniques in Proteomics, Protein-Protein Interactions, Methods of Gene Family Identification Computational Methods for Pathways and Systems Biology – Analysis of Pathways, Metabolic Control Analysis, Simulation of Cellular Activities, Biological Markup Languages	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 74 2	**ADVANCED ALGORITHMS AND COMPLEXITY**	3-0-0-3	2015

PREREQUISITES: Knowledge on design and analysis of algorithms

COURSE OBJECTIVES:

- To know problem solving techniques.
- To understand techniques for the design and analysis of efficient algorithms.
- To be able to design algorithms for new problems with volume of data.

SYLLABUS:

Algorithms - Problem Solving and Important problem types, Problem Solving Techniques, Randomized Algorithms, Limitations of Algorithm power, Modern Algorithms.

EXPECTED OUTCOME:

The goals of the course are to give the students

- the fundamental skills needed to develop algorithms using data structures and analyze their correctness and efficiency,
- an introduction to complexity theory,

so that they will be able to

- design programs that use computer resources efficiently,
- realize that there are problems that are impractical or even impossible to solve by a computer.

REFERENCES:

1. Introduction to Algorithms (3rd Ed):Thomas H. Cormen, Charles E. Leiserson, Ronald L Design: Jon Kleinberg and Eva Tardos, AW (2005)
2. Anany V. Levitin. Introduction to the Design & Analysis of Algorithms (2nd Ed): A W (2006)
3. Rivest and Clifford Stein, MIT Press (2009)
4. Algorithm Randomized Algoritms: Rajeev Motwani and Prabhakar Raghavan, Cambridge University Press; Reprint edition (2010)
5. Introduction to evolutioary computing: Agoston E. Eiben, J.E. Smith, Springer (2010)
6. Dexter Kozen, The Design and Analysis of Algorithms, Springer, 1992.
7. S. Basse, Computer Algorithms: Introduction to Design and Analysis, Addison Wesley, 1998.
8. U. Manber, Introduction to Algorithms: A creative approach, Addison Wesley, 1989.
9. V. Aho, J. E. Hopcraft, J. D. Ullman, The design and Analysis of Computer Algorithms, Addison Wesley, 1974.

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem Exam Marks**
I	**Introduction:** Algorithms - Problem Solving and Important problem types-Fundamental Data Structures-Asymptotic Notations and Basic Efficiency classes-Analysis of Recursive and Non-Recursive Algorithms-Probability- Random Variables and Expectations, Moments and Deviations, distributions, conditional probability, Bayes Theorem- Tail Bounds, Chernoff Bound.	**10**	**25%**
II	Problem Solving Techniques- Brute force, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, greedy technique. Randomized Algorithms : Finger Printing, Pattern Matching, Graph Problems, Algebraic Methods, Probabilistic Primality Testing, De-Randomization**.**	**10**	**25%**
FIRST INTERNAL EXAM			
III	Limitations of Algorithm power -P, NP and NP complete problems-Back tracking , branch and bound and approximations algorithms- probabilistic analysis , Randomized algorithms, Birthday Paradox, Quick sort, bucket sort, mini-cut, median finding- Random graphs, Ramsey number, Hamiltonian cycles.	**10**	**25%**
IV	Modern Algorithms- Markov chain, stochastic process, page rank- Components of evolutionary algorithms, ACO,PCO, TSP problem solving.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 15 2	**DIGITAL IMAGE PROCESSING**	3-0-0-3	2015

PREREQUISITES: Knowledge on database management systems with emphasis on Modelling and Transactions

COURSE OBJECTIVES:

- It gives broader introduction to post-relational database.
- To understand more advanced database technology required for larger, high performance and complex databases.
- To learn how enterprise application use database technologies.

SYLLABUS:

Web Databases, Embedded Databases, Advanced databases, Distributed databases, Next Generation Databases-Cloud database, Graph databases, Emerging Technologies-Multimedia Databases, Mobile Databases

EXPECTED OUTCOME:

- Students will be able to identify the different transforms, signals and distribution and basic concepts of graph theory.
- Students will be able to acquire and apply different enhancement techniques.
- Students will be able to apply different methods in Image restoration and reconstruction
- Students will be able to identify different morphological operations, segmentation and compression

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods,"Digital Image Processing",3rd Edition
2. Jain, Anil K. Fundamentals of digital image processing. Vol. 3. Englewood Cliffs: prentice-Hall, 1989.
3. Lézoray, Olivier, and Leo Grady, eds. Image processing and analysis with graphs: theory andpractice. CRC Press, 2012.
4. Richard Szeliski,"Computer Vision: Algorithms and Applications" , Springer, 1st Ed.,2010.
5. William K. Pratt, "Digital Image Processing: PIKS Scientific Inside", Wiley Interscience, 4thEd.,2007..
6. Christopher D. Manning, HinrichSchuetze, "Foundations of Statistical Natural Language Processing, MIT Press, 2003.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Linear systems and shift invariance, Change of basis, Fourier transform, Discrete Fourier Transform, Z transform, Wavelet transform, Toeplitz and circulant matrices, Block matrices and kronecker products, Random signals, Gaussian distributions, multivariate Gaussian distributions, markov model, KL transform, Information and entropy. Convolution and Correlation. Basic graph theory ,Paths,trees and connectivity. Geometric primitives and 2D transformations.	**10**	**25%**
II	Elements of visual perception, Image sensing and acquisition, Image sampling and quantization. Image file formats, Brightness and contrast, Intensity transformations and spatial filtering, Histogram Processing, Histogram Equalization, Contrast limited adaptive histogram equalization (CLAHE),Histogram Matching, Local Enhancement, Histogram statistics, Arithmetic operators , Logic operations, Image Subtraction, Image Averaging, Smoothing spatial filters, sharpening spatial filters, Filtering in frequency domain, Image smoothing and sharpening using frequency domain filters. Affine transformations	**10**	**25%**
FIRST INTERNAL EXAM			
III	Image restoration and reconstruction, Noise models,Band reject and Band pass filters, Notch filters, Inverse filtering, Image pyramids, sub band coding, The Harr transform, Multiresolution expansions, series functions, scaling functions, wavelet functions, Wavelet transform in one dimension, wavelet series expansions,DWT, Wavelet transform in two dimension. Color fundamentals, Color models, RGB, CMYK, HSI,Color image smoothing and sharpening, Color image histogram.	**10**	**25%**
IV	Morphological image processing, Erosion, dilation, Opening and closing, Point line and edge detection, Hough transform, Image segmentation, Thresholding, Otsu's method, Region based segmentation, segmentation using watersheds. Graph models in image processing, Markov random fields, basic graph cuts and binary labels. Image compression, Huffman coding, arithmetic coding, JPEG baseline.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 25 2	ONTOLOGY AND SEMANTIC WEB	3-0-0-3	2015

PREREQUISITES:

- Basic knowledge about web technologies-HTML, XML
- Basic knowledge about predicate logic
- Programming skill

COURSE OBJECTIVES:

- Describe and define the various concepts and technologies that make up the Semantic Web landscape
- Gives a review of XML language structure and XML document model.
- Describes the concepts of graph-based RDF model, XML syntax-based RDF model, and RDF Schema.
- Analyzes the requirements and features of web ontology language (OWL).
- Describes the syntax and semantics of Horn logic, both monotonic and non-monotonic, in the framework of Semantic Web.
- Identifies suitable applications for Semantic Web technologies and show some awareness of existing applications.

SYLLABUS:

Semantic Web, Semantic Modelling, RDF/RDFS languages, Ontologies, Inferences, Semantic Web Frameworks

EXPECTED OUTCOME:

Students who successfully complete this course will have demonstrated an ability to

- Develop a working knowledge of the Semantic Web and its associated tools and technologies.
- Understand the concept structure of the semantic web technology and how this technology revolutionizes the World Wide Web and its uses.
- Understand the concepts of metadata, semantics of knowledge and resource, ontology, and their descriptions in XML-based syntax and Web Ontology Language (OWL).
- Understand the core of basic concepts and fundamental theories describe logic semantics and inference with OWL.
- Get familiarized with Semantic Web programming frameworks such as Jena and useful Semantic Web tools.

TEXT BOOKS:

1. Grigoris Antoniou and Frank van Harmelen. A Semantic Web Primer, MIT Press,2004.
2. John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, Semantic Web Programming, Wiley Publishing, Inc, 2009.

REFERENCES:

1. Thomas B. Passin,Explorer's Guide to the Semantic Web, Manning, Pearson, July 2004.
2. John Davies, Dieter Fensel, Towards the Semantic Web: Ontology-driven Knowledge management,John Wiley& Sons Ltd, 2003.
3. Davies, John, Rudi Studer, and Paul Warren, Semantic Web Technologies : Trends and Research in Ontology-Based Systems, John Wiley & Sons, 2006.
4. BhavaniThuraisingham, XML Databases and the Semantic Web, CRC Press, 2002.
5. Dieter Fensel, James A. Hendler, Henry Lieberman and Wolfgang Wahlster, Spinning the Semantic Web- Bringing the World Wide Web to Its Full Potential, MIT Press, 2002
6. Toby Segaran,ColinEvans,Jamie Taylor, Programming the semantic web, O'Reilly, July 2009

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Foundations of Semantic Web** Today's web and keyword based search, Semantic Web, Examples, Semantic web technologies- Semantic Web versus Artificial Intelligence-Overview of Structured Web Documents in XML, A Layered approach to Semantic Web	**15**	**25%**
II	**Modeling Information** Resource Description Framework–Basic ideas- RDF triple form- RDF Graph-simple examples-advantages-XML based syntax, RDF Schema- Basic Ideas, Language-Exchanging Information With RDF, Statements As Points, RDF Serializations , RDF/XML, Blank Nodes In RDF, Reification, SPARQL- Simple Query Example	**15**	**25%**
FIRST INTERNAL EXAM			
III	**Knowledge Representation** Semantics on the web-Expressing Semantics in RDF-Vocabularies, Taxonomies and Ontologies –Introduction to Ontologies-Overview of Ontology Elements -Requirements of ontology languages, Examples of published Ontology-Web Ontology Language OWL, Three species of OWL	**15**	**25%**
IV	**Logic and Inference** Predicate Logic and Rule Systems, Horn Logic-Monotonic Rule Systems, Non Monotonic Rule Systems -Rule Languages- RuleML, SWRL. Semantic Web Frameworks , Retrieving Information in a Knowledgebase, Realizing the Semantics of OWL,	**15**	**25%**

	Understanding Forward Chaining Inference, Understanding Backward Chaining Inference, Choosing the Right Inference Method- Common Frameworks and Components-Jena, Sesame - RDF store implementations-Retrieval Components-Reasoning Engines		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 35 2	**MACHINE LEARNING TECHNIQUES**	3-0-0-3	2015

PREREQUISITES: Knowledge neural networks

COURSE OBJECTIVES:

- To understand the machine learning theory
- To implement linear and non-linear learning models
- To implement distance-based clustering techniques
- To build tree and rule based models
- To apply reinforcement learning techniques

SYLLABUS:

Foundations of learning, linear models, distance-based models, tree and rule models, reinforcement learning.

EXPECTED OUTCOME:

- To explain theory underlying machine learning
- To construct algorithms to learn linear and non-linear models
- To implement data clustering algorithms
- To construct algorithms to learn tree and rule-based models
- To apply reinforcement learning techniques.

REFERENCES:

1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.
2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.
3. K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
4. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
5. D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press,2012.
6. M. Mohri, A. Rostamizadeh, and A. Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
7. T. M. Mitchell, “Machine Learning”, McGraw Hill, 1997.
8. S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition,Prentice Hall, 2009.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	FOUNDATIONS OF LEARNING -Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization–generalization bound – approximation.	**10**	**25%**
II	LINEAR MODELS - Linear classification – univariate linear regression – multivariate linear regression – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures – support vector machines – soft margin SVM – going beyond linearity – generalization and overfitting – regularization – validation	**10**	**25%**
FIRST INTERNAL EXAM			
III	DISTANCE-BASED MODELS Nearest neighbor models – K-means – clustering around medoids – silhouttes – hierarchical clustering – k-d trees – locality sensitive hashing – non-parametric regression ensemble learning – bagging and random forests – boosting – meta learning	**10**	**25%**
IV	TREE AND RULE MODELS Decision trees – learning decision trees – regression trees - learning ordered rule lists – learning unordered rule lists REINFORCEMENT LEARNING - Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal- difference learning – active reinforcement learning.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 45 2	CLOUD COMPUTING	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To provide architectural as well as technical overview of cloud computing paradigm
- To impart practical working knowledge of working with cloud infrastructures.

SYLLABUS:

Cloud Computing Fundamentals, Cloud Architecture, Programming Models & Applications, Advanced Topics

EXPECTED OUTCOME:

Students will be able to:

1. Understand the working of a cloud infrastructures.
2. Work with cloud applications and programs including Mapreduce and Hadoop.
3. To understand advanced cloud computing concepts, including HPC in cloud and Internet of Things.

TEXT BOOKS:

1. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things – Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra – Morgan Kauffmann.
2. Mastering Cloud Computing – Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi – Tata McGraw Hill Education.

REFERENCES:

1. Enterprise Cloud Computing : Technology, Architecture, Applications - Shroff, Gautam - Cambridge University Press
2. Cloud Computing – A Sreenivasan and J. Suresh – Pearson, Chennai
3. Cloud Security: A comprehensive guide to secure Cloud Computing - Krutz, Ronald L and Russell Dean Vines, Wiley India
4. Cloud Computing: A Practical Approach – Anthony Velte, Toby J Velte and Robert Elsenpeter - McGraw Hill Education (India) Private Limited.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Evolution of Cloud Computing – Parallel computing, Grid computing, Service Oriented Architecture (SOA) and Cloud computing 5-4-3 of Cloud Computing – Characteristics (NIST), Classifications based on deployment model (Public, Private, Hybrid and Community), Classifications based on service model (IaaS, SaaS, PaaS). Virtualization - Basics of Virtualization, Types of	**10**	**25%**

	Virtualization, Implementation Levels of Virtualization, Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource management, Enterprise level virtualization.		
II	Compute, Storage, Database and Networking solutions from enterprise cloud platforms (Amazon, Google, Microsoft). Architectures of open-source cloud platforms (OpenStack, CloudStack, Nebula, Aneka). Data center design – Data center construction, Single cloud site architecture, Redundant 3-tier architecture, Multi-datacenter architecture, Cooling Systems. Data center interconnection networks – Software defined networks, Fat-tree interconnection network, and Server-centric network Green cloud concepts and architectures.	**10**	**25%**
III	Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce, Hadoop Library from Apache . Developing cloud applications – CRM, productivity, social networking (using Facebook API, Twitter API, Flickr API and Google Maps API), Media applications, and scientific applications – in Private clouds, Amazon AWS, Azure, Force.com & Google App Engine	**10**	**25%**
IV	Cloud security - Access control, Attacks on VMs, Storage security, Data security. Compliance issues – compliance for the cloud provider vs. compliance for the customer, Ownership of data. Cloud for HPC, HTC and ubiquitous computing – containers (Docker, LXC) and light weight Operating Systems (OS). Performance of Clouds: Quality of Service (QoS) in Cloud, Performance metrics for HPC/HTC in cloud, Cloud simulations using CloudSim. Internet of Things – Federated cloud/InterCloud, Sensor networks, Global Positioning System (GPS), Smart power grid and smart cities.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 55 2	**DESIGN PATTERNS**	3-0-0-3	2015

PREREQUISITES: Knowledge on various design patterns

COURSE OBJECTIVES:

Upon completion of this course, students will be able to do the following:

- To discuss the different types of design problems
- To select a design pattern
- To understand about design problems.
- To understand the Document Structure.
- To discuss the Formatting, Embellishing the User Interface.
- To understand the user operations Spelling Checking and Hyphenation
- To Study the intent of Abstract Factory pattern

SYLLABUS:

Design Pattern, Design Patterns in Smalltalk MVC , Designing a Document Editor, Creational Patterns, Structural Pattern

EXPECTED OUTCOME:

Students who complete the course will have demonstrated the ability to do the following:

- Will be able to explain what is a design pattern the various catalog of design pattern.
- Will be able to understand the purpose of structural patterns.
- Will be able to understand the Discussion of Creational Patterns.

REFERENCES:

1. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides ,Design Patterns Elements of Reusable Object-Oriented Software.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Introduction:** What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern	**10**	**25%**
II	**A Case Study**: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, and Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary.	**10**	**25%**
FIRST INTERNAL EXAM			

III	**Creational Patterns:** Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns	**10**	**25%**
IV	**Structural Pattern Part-I:** Adapter, Bridge and Composite.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 65 2	**WEB SECURITY**	3-0-0-3	2015

PREREQUISITES:

- Core security concepts, such as logins and access control.
- Core web technologies, such as browsers, web servers, and HTTP.
- Basics of database and SQL queries.
- Basics of Linux and Shell commands.

COURSE OBJECTIVES:

- Master the implementation of various authentication methods and evaluate the design flaws in web applications.
- Be familiar with SQL injection attacks and various preventive measures.
- Evaluate different attack models and ways to protect database, user inputs etc.
- Identify and distinguish various security flaws in web applications and list defence mechanisms for each types of attack.

SYLLABUS:

Web application security, SQL Injection, Mod Security and Web server Hacking

EXPECTED OUTCOME:

- To learn the fundamentals of web application attacks.
- To learn the fundamentals of Sql injection attacks and prevention methods.
- To learn about Mod Security for attack prevention, monitoring and intrusion detection.
- To learn basics of DoS attack, Web crawling and Database Hacking.

REFERENCES:

1. Dafydd Stuttard, Marcus Pinto, The Web Application Hacker's Handbook, 2nd Edition, Wiley Publishing, Inc.
2. Justin Clarke, SQL Injection Attacks and Defense, 2009, Syngress Publication Inc.
3. Magnus Mischel , ModSecurity 2.5, Packt Publishing
4. Stuart McClure Joel, ScambRay, George Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Seventh Edition, 2012, The McGraw-Hill Companies.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Web application security-** Key Problem factors – Core defence mechanisms- Handling user access- handling user input- Handling attackers – web spidering – Discovering hidden content Transmitting data via the client – Hidden form fields – HTTP cookies – URL parameters – Handling client-side data securely – Attacking authentication – design flaws in authentication mechanisms –securing authentication	**10**	**25%**

	Attacking access controls – Common vulnerabilities – Securing access controls		
II	**SQL Injection -** How it happens - Dynamic string building - Insecure Database Configuration - finding SQL injection – Exploiting SQL injection – Common techniques – identifying the database – UNION statements – Preventing SQL injection Platform level defenses - Using run time protection - web application Firewalls - Using ModSecurity - Intercepting filters- Web server filters - application filters – securing the database – Locking down the application data – Locking down the Database server	**10**	**25%**
FIRST INTERNAL EXAM			
III	**Mod Security -** Blocking common attacks – HTTP finger printing – Blocking proxied requests – Cross-site scripting – Cross-site request forgeries – Shell command execution attempts – Null byte attacks – Source code revelation – Directory traversal attacks – Blog spam – Website defacement – Brute force attack – Directory indexing – Detecting the real IP address of an attacker	**10**	**25%**
IV	**Web server Hacking -** Source code disclosure – Canonicalization attacks – Denial of service – Web application hacking – Web crawling Database Hacking – Database discovery – Database vulnerabilities	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 75 2	**ADVANCED DATA WAREHOUSING**	3-0-0-3	2015

PREREQUISITES: Nil.

COURSE OBJECTIVES:

This course provides indepth knowledge about data warehousing techniques. To understand the fundamental concepts of data warehousing technology. To learn step by step approach to designing and building a data warehouse

SYLLABUS:

Introduction to data warehousing, Data Design and Data preparation, Data extraction, Transformation and loading(ETL), OLAP in Datawarehouse, Building a data warehouse, Data Warehouse implementation

EXPECTED OUTCOME:

- Students will be familiar with the different data warehousing concepts.

REFERENCES:

1. Paulraj Ponniah "Datawarehousing Fundamentals" by John Wiley & Sons
2. Reema Theraja "Data Warehousing" by Oxford University Press-2011.
3. Prabhu C.S.R., "Data Warehousing Concepts, Techniques, Products and Applications" PHI Learning Private Limited, Third Edition, 2011.
4. Amitesh Sinha, "Data Warehousing", Thomson Asia Pte Ltd-2001.
5. Jiawei Han, Micheline Kamber, Data Mining Concepts and Techniques, 2nd edtn. , Elsevier New Delhi 2010

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Introduction to data warehousing**-Need for data Warehouse-Data Warehouse building blocks-Defining Features-Data marts-Metadata in datawarehouse-Datawarehouse architecture. **Data Design and Data preparation**-Principles of dimensional modeling-Data Warehouse schema-Dimensional modeling-Star schema-Advantages and disadvantages of star schema-Slowly changing dimensions-snowflake schema-Advantages and disadvantages of snowflake schema.	**10**	**25%**

	- Example - SQLite internal architecture and data types		
II	**Data extraction, Transformation and loading (ETL)-**ETL overview-Data extraction-Data Transformation-Data Loading-ETL Tool options. **OLAP in Datawarehouse-**Demand for online analytical processing-Major Features and Functions-OLAP Models-MOLAP model-ROLAP model-ROLAP vs MOLAP.	**10**	**25%**
FIRST INTERNAL EXAM			
III	**Building a data warehouse**-Introduction-critical success factors-Requirement analysis-Planning for the data warehouse-The data warehouse design stage-Building and implementing data marts-Building data warehouses-backup and Recovery-Establish the data quality framework-Operating the Warehouse-Recipe for a successful warehouse-Data warehouse pitfalls.	**10**	**25%**
IV	**Data Warehouse implementation**-Efficient computation of Data Cubes-Indexing OLAP Data- Efficient Processing of OLAP Queries **From Data Warehousing to Data Mining** - Data Warehouse Usage-From On-Line Analytical Processing to On-Line Analytical Mining.-architecture for Analytical Mining.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 06 2	MINI PROJECT	0-0-4-2	2015

SYLLABUS:

The mini project is designed to develop practical ability and knowledge about tools/techniques in order to solve the actual problems related to the industry, academic institutions or similar area. Students can take up any application level/system level experimental design / implementation tasks of relatively minor intensity and scope as compared to the major-project, pertaining to a relevant domain of study, preferably based on security. Projects can be chosen either from the list provided by the faculty or in the field of interest of the student. At the end of each phase, presentation and demonstration of the project should be conducted, which will be evaluated by a panel of examiners. A detailed project report duly approved by the guide in the prescribed format should be submitted by the student for final evaluation.

Publishing the work in Conference Proceedings/ Journals with National/ International status with the consent of the guide will carry an additional weightage in the review process.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 07 2	**NETWORK SIMULATION LAB**	0-0-2-1	2015

PREREQUISITES: Knowledge in computer networks

COURSE OBJECTIVES:

1. Get some exposure to one of the most useful tools in networking research and development.
2. Understand and work with a popular network simulator.
3. Get a better understanding of the networking dynamics.
4. Smooth the learning curve.

SYLLABUS:

A thorough study of packet capturing tool called WireShark. Familiarizing Network Simulator – 2 (NS2) with suitable examples. Simulate a wired network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script. Performance evaluation of different routing protocols in wired network environment using NS2. Performance evaluation of different queues and effect of queues and buffers in wired network environment using NS2. Compare the behaviour of different variants of TCP (Tahoe, Reno, Vegas) in wired network using NS2. Comparison can be done on the congestion window behaviour by plotting graph.

Simulation of wireless Ad hoc networks using NS2. Simulate a wireless network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script. Performance evaluation of different ad-hoc wireless routing protocols (DSDV, DSR, AODV) using NS2. Create different Wired-cum-Wireless networks Simulations using NS2.

EXPECTED OUTCOME:

1. Students will have the ability to simulate wired and wireless ad-hoc networks consisting of TCP and UDP Traffic. Also, calculate their respective throughput using AWK script.
2. Students will have the ability to evaluate the performance of different queues and effect of queues and buffers in wired network environment.
3. Students will have the ability to compare the behaviour of different variants of TCP in wired networks. Comparison can be done on the congestion window behaviour by plotting graph.
4. Students will have the ability to evaluate and compare the performance of different wired routing protocols(DV, LS) and wireless routing protocols(DSDV, DSR, AODV) using NS2.
5. Students have the ability to implement wired cum wireless networks.
6. Students will have the ability to identify, understand, design and develop micro projects in wired and wireless ad-hoc networks.

REFERENCES:

1. Kurose and Ross, “Computer Networks A systems approach” , Pearson Education.
2. Behrouz A Forouzan, ”TCP/IP Protocol Suite”, Tata McGraw-Hill.

3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004.
4. C. K. Toh, "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR, 2001.
5. Wireshark(R) 101: Essential Skills for Network Analysis (Wireshark Solutions) Paperback – Import, 1 Feb 2013 by Gerald Combs, Laura Chappell.
6. Wireshark Network Analysis (Second Edition): The Official Wireshark Certified Network Analyst Study Guide Paperback – Import, 1 Mar 2012 by Gerald Combs, Laura Chappell
7. Introduction to Network Simulator NS2 By, Issariyakul, Teerawat, Hossin, Ekram.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**WIRED NETWORKS AND ROUTING PROTOCOLS** A thorough study of packet capturing tool called WireShark. Familiarizing Network Simulator – 2 (NS2) with suitable examples. Simulate a wired network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script. Performance evaluation of different routing protocols in wired network environment using NS2. Performance evaluation of different queues and effect of queues and buffers in wired network environment using NS2. Compare the behaviour of different variants of TCP (Tahoe, Reno, Vegas) in wired network using NS2. Comparison can be done on the congestion window behaviour by plotting graph. .	**20**	**50%**
FIRST INTERNAL EXAM			
II	**WIRELESS NETWORKS AND ROUTING PROTOCOLS** Simulation of wireless Ad hoc networks using NS2. Simulate a wireless network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script. Performance evaluation of different ad-hoc wireless routing protocols (DSDV, DSR, AODV) using NS2. Create different Wired-cum-Wireless networks Simulations using NS2.	**20**	**50%**

SEMESTER 3

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 11 1	**MULTICORE ARCHITECTURE**	3-0-0-3	2015

PREREQUISITES: Knowledge on Computer Organisation

COURSE OBJECTIVES:

- To understand the recent trends in the field of Computer Architecture and identify performance related parameters.
- To study the need for parallel processing.
- To expose the students to the problems related to multiprocessing.
- To understand the different types of multicore architecture

SYLLABUS:
Superscalar Processor Design, Symmetric shared memory architectures, distributed shared memory architectures, Cache coherence protocols, PowerPC architecture

EXPECTED OUTCOME:

- Students will be able to identify the limitations of ILP and the need for multicore architecture.
- Students can identify the issues related with multiprocessing and can suggest solutions.
- Students can point out the salient features of different multicore architectures and how they exploit parallelism.
- They can analyse the different interconnection networks.

REFERENCES:

1. Hennessey & Paterson, "Computer Architecture A Quantitative Approach", Harcourt Asia, Morgan Kaufmann, 1999.
2. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability and Programmability" McGraw-Hill,1993.
3. Joseph JaJa, " Introduction to Parallel Algorithms", Addison-Wesley, 1992.
4. Richard Y. Kain, "Advanced Computer Architecture: A System Design Approach", PHI,1999.
5. IBM Journals for Power 5, Power 6 and Cell Broadband engine architecture.
6. Rohit Chandra, Ramesh Menon, Leo Dagum, and David Kohr, "Parallel Programming in OpenMP", Morgan Kaufmann, 2000.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Fundamentals of Superscalar Processor Design- Limitations	**10**	**25%**

	of ILP, Super Scalar Processor Design, Multi Threading, Thread Level Parallelism – Introduction to Multicore Architecture – Multicore Vs MultiThreading.		
II	Symmetric shared memory architectures, distributed shared memory architectures, Issues related to multicore caches, Design of mutlicore core caches, levels of caches, cache optimization, Models of memory consistency, Virtual Memory	**10**	**25%**
FIRST INTERNAL EXAM			
III	Cache coherence protocols (MSI, MESI, MOESI),scalable cache coherence, Snoop-based Multiprocessor Design -- Correctness requirements, design with single-level caches and an atomic bus, multilevel cache hierarchies, dealing with split-transaction bus, coherence for shared caches and virtually indexed caches, TLB coherence Overview of directory based approaches, design challenges of directory protocols, memory based directory protocols, cache based directory protocols, protocol design tradeoffs, synchronization.	**10**	**25%**
IV	PowerPC architecture – RISC design, PowerPC ISA, PowerPC Memory Management Power 5 Multicore architecture design, Power 6 Architecture. Cell Broad band engine architecture, PPE (Power Processor Element), SPE (Synergistic processing element) Interconnection Network Design - Interconnection topologies, routing techniques, flow control mechanisms, router architecture, arbitration logic.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 21 1	DATA ANALYTICS	3-0-0-3	2015

PREREQUISITES:

- Linear algebra, Calculus, Knowledge of probability theory, statistics, and programming

COURSE OBJECTIVES:

The Student will be able to:-

- To learn different types of data analytics namely descriptive, inferential, and predicitive analysis

SYLLABUS:

Descriptive Statistics Introduction, Regression & ANOVA, Supervised Learning with Regression and Classification techniques, Associative Rule Mining

EXPECTED OUTCOME:

Students who successfully complete this course will have demonstrated an ability to:-

- analyze data to convert information to useful knowledge

TEXT BOOK:

1. Hastie, Trevor, The elements of statistical learning, Springer 2009

REFERENCES:

1. Montgomery, Dougles, et.al, Applied statistics and probability for engineers, John Wiley & Sons 2010.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Descriptive Statistics Introduction- Descriptive Statistics- Probability Distributions Inferential Statistics:- Inferential Statistics through hypothesis tests-Permutation & Randomization Test	**10**	**25%**
II	Regression & ANOVA, Machine Learning: Introduction and Concepts Differentiating algorithmic and model based frameworks ,Regression, Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification	**10**	**25%**
	FIRST INTERNAL EXAM		
III	Supervised Learning with Regression and Classification techniques:- Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant	**10**	**25%**

	Analysis- Quadratic Discriminant Analysis- Regression and Classification Trees- Support Vector Machines- Ensemble Methods: Random Forest- Neural Networks- Deep learning		
IV	Associative Rule Mining- Challenges for big data anlalytics- Creating data for analytics through designed experiments- Creating data for analytics through Active learning-Creating data for analytics through Reinforcement learning	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 31 1	**COMPUTER VISION**	3-0-0-3	2015

PREREQUISITES: Knowledge on Computer graphic systems and Algorithms

COURSE OBJECTIVES:

To introduce the student to computer vision algorithms, methods and concepts.

SYLLABUS:

Recognition Methodology, Morphological Image Processing, Image Representation and Description, Binary Machine Vision, Area Extraction, Region Analysis, Facet Model Recognition, Object Models And Matching

EXPECTED OUTCOME:

Get introduced to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving

REFERENCES:

1. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, AddisonWesley, 1993.
2. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach"
3. Milan Sonka,Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Thomson Learning.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Module 1:** **Recognition Methodology:** Conditioning, Labeling, Grouping, Extracting, Matching. **Morphological Image Processing:** Introduction, Dilation, Erosion, Opening, Closing,Hit-or-Miss transformation, Morphological algorithm operations on binary images, Morphological algorithm operations on gray-scale images, Thinning, Thickening , Region growing, region shrinking. **Image Representation and Description:** Representation schemes, Boundary descriptors, Region descriptors	**12**	**25%**
II	**Binary Machine Vision:** Thresholding, Segmentation, Connected component labeling, Hierarchal segmentation, Spatial clustering, Split & merge, Rule-based Segmentation, Motion-based segmentation. **Area Extraction:** Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting).	**12**	**25%**

FIRST INTERNAL EXAM			
III	**Region Analysis:** Region properties, External points, Spatial moments, Mixed spatial gray-level moments, Boundary analysis: Signature properties, Shape numbers. **Facet Model Recognition:** Labeling lines, Understanding line drawings, Classification of shapes by labeling of edges, Recognition of shapes, Consisting labeling problem, Back-tracking Algorithm	**12**	**25%**
IV	Perspective Projective geometry, Inverse perspective Projection, Photogrammetry - from 2D to 3D, Image matching : Intensity matching of ID signals, Matching of 2D image, Hierarchical image matching. **Object Models And Matching:** 2D representation, Global vs. Local features	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 41 1	HIGH PERFORMANCE COMPUTING	3-0-0-3	2015

PREREQUISITES: Basic programming skills in any programming language, preferably C and/or C++.

COURSE OBJECTIVES:

The Student will be able to:-

- impart knowledge of state of the art technologies and innovation in high performance computing and to impart practical lessons of programming parallel algorithms that run on high performance clusters.

SYLLABUS:

HPC Fundamentals, Parallel algorithms & applications, Parallel Programming, Advanced HPC Topics.

EXPECTED OUTCOME:

The students will be able to

- Understand the basic tenants of HPC paradigm.
- Understand and develop parallel algorithms.
- Develop OpenMP, MPI and CUDA parallel programs.

TEXT BOOKS:

1. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Pearson.
2. Parallel Programming in C with MPI and OpenMP, Michael J. Quinn , Tata McGraw-Hill Education.

REFERENCES:

1. Introduction to Parallel Computing: A practical guide with examples in C, Wesley Petersen and Peter Arbenz, Oxford University Press.
2. Parallel Computers: Architecture and Programming, V. Rajaraman, C. Siva Ram Murthy, Prentice Hall, New Delhi.
3. High Performance Cluster Computing: Architectures and Systems Vol: 1, Prentice Hall, New Delhi
4. Using Advanced MPI - Modern Features of the Message-Passing Interface, William Gropp, Torsten Hoefler, Rajeev Thakur and Ewing Lusk, MIT Press.
5. Using MPI-2 - Advanced Features of the Message Passing Interface, William Gropp, Ewing Lusk, and Rajeev Thakur, MIT Press.
6. Using MPI - Portable Parallel Programming with the Message-Passing Interface, William Gropp, Ewing Lusk and Anthony Skjellum, MIT Press.
7. Professional CUDA C Programming, John Cheng and Max Grossman, Wiley India Private Limited.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks

I	**HPC Fundamentals:** Parallel computing, Evolution of supercomputing, Data parallelism, Functional parallelism. Interconnection networks – Switch network topologies, 2-D Mesh Network, Binary tree network, Hyper tree network, Butterfly network, Hypercube Network, Shuffle arrays. Multiprocessors – Centralized multiprocessors - Cache coherence problem, Processor synchronization, Distributed multiprocessors – Directory based protocol. Flynn's taxonomy, Moore's Law, Amdhal's law, Speedup, Efficiency, FLOPS.	**10**	**25%**
II	**Parallel algorithms & applications:** The task/channel model, Ian Foster's design methodology, Boundary value problem, finding the maximum, N-Body problem. LAPACK and BLAS, Monte Carlo methods, Parallel Matrix-Vector multiplication (Rowwise 1-D partitioning, 2-D partitioning), Parallel Matrix-Matrix multiplication (Simple algorithm, Cannon's algorithm).	**10**	**25%**
III	**Parallel Programming:** Shared address space platforms: OpenMP programming - Parallel for loops, private variables, critical sections, reductions, data parallelism constructs, functional parallelism constructs. Message Passing Platforms: MPI programming –basic constructs, Groups and communicators, Point-to-point communication (send, recv) – Collective communications (barrier, broadcast, reduce, scatter, gather, all to all), Benchmarking functions – (MPI_Wtime, MPI_Wtick), Example – one dimensional Matrix-Vector Multiplication, single source shortest path.	**10**	**25%**
IV	**Advanced HPC Topics:** Hybrid parallel computing – combining OpenMP & MPI, Accelerators (GPGPUs) – CUDA & OpenCL, basic CUDA programming.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 51 1	MOBILE NETWORK SECURITY	3-0-0-3	2015

PREREQUISITES: Wireless network, Network security concepts

COURSE OBJECTIVES:

- To equip students with the basic understanding of the fundamental concept of wireless security
- To enhance knowledge of security in off-the shelf technologies and emerging technologies
- To make them aware of privacy and trusted communication mobile network

SYLLABUS:

Introduction to Mobile and Wireless Network and security vulnerabilities, security in off-the shelf technologies, security in emerging technologies, privacy and trust in mobile network and mobile security

EXPECTED OUTCOME:

Students who successfully complete this course will be able to:-

- Security mechanism in mobile network
- security issues and available solutions associated with off-the-shelf wireless and mobile technologies such as Bluetooth, WiFi, WiMax, 2G, and 3G.
- security issues and solutions in emerging wireless and mobile technologies such as ad hoc and sensor networks, cellular 4G and IMS networks.
- Privacy and trust management in mobile network

REFERENCES:

1. Hakima Chaouchi, Maryline Laurent-Maknavicius,Wireless and Mobile network security,wiley,2010
2. Stefanos Gritzalis , Tom Karygiannis , Charalabos Skianis ,Security and privacy in mobile and wireless networking, Troubador,2009
3. Peter Reiher, S. Kami Makki, Niki Pissinou,Mobile and wireless network security and privacy,Springer,2007
4. Rogers, David, Mobile Security: A guide for user, Copper Horse Solutions Limited, 2013

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction to Mobile and Wireless Networks: Mobile cellular networks, IEEE wireless networks- WMAN: IEEE 802.16,WMAN mobile: IEEE 802.20,Mobile Internet networks, Vulnerabilities of wireless network, Fundamental security mechanism	**10**	**25%**

II	Off-the shelf Technologies: Bluetooth security, Wi-Fi security, Wi-Max security, Security in mobile telecommunication network	**11**	**25%**
FIRST INTERNAL EXAM			
III	Emerging Technologies- Security in Next Generation Mobile network, Security of IP-based network, security in Adhoc network, key management in Adhoc network.	**11**	**25%**
IV	Research direction in security and privacy of mobile networks, Applying trust in mobile and wireless network, mobile security	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 61 1	**VIRTUALIZATION SYSTEMS**	3-0-0-3	2015

PREREQUISITES: Students should be familiar with the general principles of operating systems. Students should also have had some practical experience in installing operating systems and managing infrastructure. Students should have been exposed to the concepts of an instruction set architecture and a machine architecture.

COURSE OBJECTIVES:

- This course will examine resource virtualization from a practical point of view.
- This course touches on the history of this technology and on current research results that may become practice in the short run

SYLLABUS:

Virtual machines; Application-level and para-virtualized virtual machines; Memory management in virtualization; Virtualizing storage; I/O virtualization; Virtual networking; Virtualized computing.

EXPECTED OUTCOME:

As a result of this course, students will be able to:

- Differentiate among the various forms of CPU virtualization: language-level, OS-level, virtual servers, and emulators.
- Understand how virtualization affects memory management
- Understand what is meant by network virtualization.
- Understand what is meant by storage virtualization and how it differs from network file systems.
- Explain some of the common scenarios in which virtualization is used today, including server consolidation, software development, debugging, fault tolerance, and security.
- Explain the concept of virtual infrastructure.

REFERENCES:

1. "Virtual Machines", James E. Smith and Ravi Nair (Morgan Kaufmann), ISBN 1558609105, April 2005
2. Applied Virtualization Technology - Usage models for IT professionals and Software Developers (1st Ed): Sean Campbell Intel Press (2006).
3. Wolf and Halter, Virtualization: From the Desktop to the Enterprise, Apress, 2005

COURSE PLAN

Module	Contents	Hours	Sem Exam

			Marks
I	Virtual machines: Taxonomy and basic principles; Classic virtual machines; . Architectures comparison. Commercial solutions –VMWare, Xen,KVM . Application-level and para-virtualized virtual machines; Xen Processor extensions in support of virtualization; Intel VT Hardware-based virtual machines and binary translation	**10**	**25%**
II	Memory management in virtualization: partitioning – reclamation –ballooning. Memory sharing. OS-level virtualization . Virtualizing storage: Basic principles; Centralized and distributed file systems; SANs versus file servers; P2P file systems	**10**	**25%**
FIRST INTERNAL EXAM			
III	I/O virtualization: Virtualizing I/O devices -monolithic model -virtual I/O server. Virtual networking –tunneling – overlay networks; Overlay Routing, Applications in distributed systems: grid and cloud computing	**10**	**25%**
IV	Virtualized computing: Virtual machine based distributed computing, elastic cloud computing, clustering, cold and hot migration. Commercial examples. Challenges and future trends.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 12 1	CONTENT BASED IMAGE AND VIDEO RETRIEVAL	3-0-0-3	2015

PREREQUISITES: Knowledge about multimedia system

COURSE OBJECTIVES:

- To learn about Content-Based Image Retrieval with user needs
- To gain knowledge about content-based image and video retrieval system.

SYLLABUS:

Fundamentals, Feature extraction and representation, Clustering, The video problem, Overview of the System.

EXPECTED OUTCOME:

Students who successfully complete this course will be able to

- apply knowledge of content-based image retrieval system
- model and design of Retrieval system.
- develop Content-Based Image Retrieval system with simple case studies.

TEXT BOOK:

- Oge Marques, Borgo Furht, "Content Based Image and Video Retrieval", Kluwer Academic Publishers, 2002.
- Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, "Introduction to information Retrieval", Cambridge University Press, 2008

REFERENCES:

- Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Third Edition, Pearson Education, 2008, New Delhi

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Fundamentals – Definition of CBIR - A typical CBIVR system architecture-User's perspective-Image use in the community- Users needs for image data	**10**	**25%**
II	Feature extraction and representation- Similarity measurements-Dimension Reduction and High dimensional Indexing	**5**	**25%**
	FIRST INTERNAL EXAM		
II	Clustering-The Semantic Gap-Learning-Relevance Feedback(RF)- Benchmarking CBIVR solutions	**5**	
III	The problem – Video Parsing-Video Abstraction and Summarization-Video content representation, Indexing and Retrieval-Video browsing schemes-Examples of Video Retrieval systems.	**10**	**25%**
IV	Overview of the System-User's Perspective-The RF mode-RFC mode-Experiments and Results	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 22 1	SOCIAL NETWORK ANALYTICS	3-0-0-3	2015

PREREQUISITES: Networks and graph theory

COURSE OBJECTIVES:

- Representation and analysis of social networks

SYLLABUS:
Networks of information, Processes on networks, Models for social influence analysis, Social media

EXPECTED OUTCOME:
The students will be able to:

- use social networks as a key feature for next generation usage and exploitation of the Web.

TEXT BOOKS:

1. Networks: An introduction: Mark Newman, Oxford University Press (2010)
2. Social Network Data Analytics: Charu C Aggarwal (ed.), Springer (2011)
3. Networks, Crowds, and Markets: Reasoning about a highly connected World, David Easley and Jon Kleinberg, Cambridge University Press (2010)

REFERENCES:

1. Understanding Social Networks: Theories, Concepts, and Findings: Charles Kadushin, OUP (2012)

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Networks of information – Mathematics of networks – Measures and metrics – Large scale strucuture of networks – Matrix algorithms and graph partitioning Network models – Random graphs – walks on graphs - Communitiy discovery – Models of network formation – Small world model - Evolution in social networks	**10 Hrs**	**25%**
II	Processes on networks – Percolation and network resilience – Epidemics on networks – Dynamical systems on networks – Network search	**10 Hrs**	**25%**
	FIRST INTERNAL EXAM		
III	Models for social influence analysis – Systems for expert location – Link prediction – privacy analysis – visulalization – Data and text mining in social networks - Social tagging	**10 Hrs**	**25%**
IV	Social media - Analytics and predictive models – Information flow – Modeling and prediction of flow - Missing data - Social media datasets – patterns of	**10 Hrs**	**25%**

	information attention – linear influence model – Rich interactions		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 32 1	CYBER FORENSICS	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

- Students can establish responsibility and accountability for information security in organizations.
- The students can also design security procedures and policies.

SYLLABUS:

Introduction to Cyber forensics, Types of Computer Forensics Systems, Ethical Hacking, Identification of Data.

EXPECTED OUTCOME:

- The student will be able to understand contemporary issues in information security management; analyse and prioritise information security risks.
- The student should be able to identify countermeasures and review techniques appropriate to the management of information security risks.
- Students should be able to understand the policy and technology trade-offs involved in developing information security systems of adequate quality.

REFERENCES:

1. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005
2. Christof Paar, Jan Pelzl, Understanding Cryptography: A Textbook for Students and Practitioners, 2nd Edition, Springer's, 2010
3. Ali Jahangiri, Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, Ali Jahangiri, 2009
4. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 2010.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Computer Forensics Technology** Introduction to Cyber forensics , Types of Computer Forensics Technology, Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised Internet Tracing Methods, Security and Wireless Technologies, Avoiding Pitfalls with Firewalls Biometric Security Systems	**12 Hrs**	**25%**
II	**Computer Forensics Systems**	**14 Hrs**	**25%**

	Types of Computer Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems, Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems, Net Privacy Systems, Identity Management Security Systems, Identity Theft, Biometric Security Systems		
FIRST INTERNAL EXAM			
III	**Ethical Hacking** Ethical Hacking: Essential Terminology, Windows Hacking, Malware, Scanning, Cracking. Digital Evidence in Criminal Investigations: The Analog and Digital World, Training and Education in digital evidence, Evidence Collection and Data Seizure: Why Collect Evidence, Collection Options Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody, Reconstructing the Attack, The digital crime scene, Investigating Cybercrime, Duties Support Functions and Competencies.	**12 Hrs**	**25%**
IV	**Identification of Data** Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events: How to Become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files, Investigating Network Intrusions and Cyber Crime, Network Forensics and Investigating logs, Investigating network Traffic, Investigating Web attacks, Router Forensics. Cyber forensics tools and case studies.	**12 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 42 1	**WIRELESS ADHOC & SENSOR NETWORKS**	3-0-0-3	2015

PREREQUISITES: Knowledge in computer networks

COURSE OBJECTIVES:

To study sensor and adhoc wireless networks, and the various protocols used for networking

SYLLABUS:

Adhoc networks and routing protocols , multicast routing and security , multicast routing and security , sensor networks – architecture, routing protocols

EXPECTED OUTCOME:

- Students will be able to implement sensor and adhoc wireless networks using different protocols

REFERECENS:

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004.
2. C. K. Toh, "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR, 2001.
3. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
4. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology- Protocols and Applications", John Wiley & Sons, 2007.
5. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Else vier publication, 2004.
6. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, "Wireless Sensor Networks", Springer publication, 2004.
7. Holger Karl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Jan 2006.
8. K.Akkaya and M.Younis, " A Survey of routing protocols in wireless sensor networks", Elsevier Adhoc Network Journal, Vol.3, no.3,pp. 325-349, 2005.
9. Philip Levis, " TinyOS Programming", 2006 – www.tinyos.net.
10. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.
11. Jamal N. Al-karaki, Ahmed E. Kamal, "Routing Techniques in Wireless sensor networks: A survey", IEEE wireless communication, December 2004, 6 – 28.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**ADHOC NETWORKS AND ROUTING PROTOCOLS** Ad hoc Wireless Networks –Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet . Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV)	**10**	**25%**

	– Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).		
II	**MULTICAST ROUTING AND SECURITY** Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols – Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing – Comparisons of Multicast Routing Protocols - Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks- Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks.	**10**	**25%**
	FIRST INTERNAL EXAM		
III	**QoS AND ENERGY MANAGEMENT -** Issues and Challenges in Providing QoS in Ad hoc Wireless Networks – Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks Energy Management in Ad hoc Wireless Networks – Introduction – Need for Energy Management in Ad hoc Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes – System Power Management Schemes.	**10**	**25%**
IV	**SENSOR NETWORKS – ARCHITECTURE-–** Single node architecture – energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks. , physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management. **ROUTING PROTOCOLS -** Gossiping and agent-based uni-cast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 52 1	**PARALLEL ALGORITHMS**	3-0-0-3	2015

PREREQUISITES: Knowledge on high performance systems

COURSE OBJECTIVES:

- To study the parallel algorithms in various models of parallel computation.
- To study the various measures and different algorithms used in parallel computing.

SYLLABUS:

Sequential model, Performance Measures of Parallel Algorithms, Parallel Sorting Networks, Parallel Searching Algorithm.

EXPECTED OUTCOME:

- Familiar with design of parallel algorithms in various models of parallel system
- Familiar with the performance measures in parallel algorithm.
- Familiar with searching algorithms in parallel computing.

TEXT BOOKS:

1. M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer" by Mc Graw Hill.
2. S.G. Akl, "Design and Analysis of Parallel Algorithms"
3. S.G. Akl, "Parallel Sorting Algorithm" by Academic Press

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Sequential model, need of alternative model, parallel computational models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model, Fully Connected model, PRAM-CREW, EREW models, simulation of one model from another one.	**10**	**25%**
II	Performance Measures of Parallel Algorithms, speed-up and efficiency of PA, Cost optimality, An example of illustrate Cost-optimal algorithms- such as summation, Min/Max On various models.	**10**	**25%**
	FIRST INTERNAL EXAM		
III	Parallel Sorting Networks, Parallel Merging Algorithms on CREW/EREW/MCC/, Parallel Sorting Networks on CREW/EREW/MCC/, linear array, Graph Algorithms – Connected Graphs, search and traversal	**10**	**25%**
IV	Parallel Searching Algorithm, Kth element, Kth element in X+Y on PRAM, Parallel Matrix Transportation and Multiplication Algorithm on PRAM, MCC, Vector-Matrix Multiplication, Solution of Linear Equation, Root finding**.**	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 62 1	**EMBEDDED SYSTEMS**	3-0-0-3	2015

PREREQUISITES: Basic Knowledge of architecture, basic programming

COURSE OBJECTIVES:

- The course provides an overview of embedded systems.
- The course covers the design issues involved in embedded systems and system-on-chip technologies.
- This course introduces platforms, tools, techniques for the design and development of software for portable deviceswith an emphasis of learning an open Android platform.
- This course will provide exposure to the rich, broad and numerous possibilities of portable devices.

SYLLABUS:

Introduction to Embedded Systems; Processors and hardware units in an embedded system; Embedded System Design; Devices and Buses for Devices Network; Embedded Programming; Mobile Operating Systems; Development Framework.

EXPECTED OUTCOME:

- Students will learn about the fundamentals of Embedded Systems
- Students will learn hardware, software and their interdependence in embedded environments
- Students will familiarize themselves with various programming environments typical of embedded systems.
- Students will learn the breadth of applications of portable devices.
- Students will acquire skills for creating and deploying mobile applications, with emphasis on understanding of platforms, tools and development life cycles.

REFERENCES:

1. David E. Simon, “An Embedded Software Primer”, Pearson Education Asia, First Indian Reprint 2000.
2. Wayne Wolf “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers, 2008.
3. Rajkamal, “Embedded Systems Architecture, Programming and Design”, TATA McGraw Hill, First reprint 2003.
4. Professional Android 4 Application Development, by Reto Meier, WROX Press, Wiley Publishing. 2012

5. Dr. Prasad K. V. K. K., "Embedded / Real-Time systems: Concepts, Design and Programming: The Ultimate Reference", Dreamtech Press,2004

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction to Embedded Systems: Definition, Characteristics and Classification –Overview of Processors and hardware units in an embedded system – Software embedded into the system – Embedded System design process- Exemplary Embedded Systems.	**10**	**25%**
II	Devices and Buses for Devices Network: I/O Devices - Device I/O Types and Examples – Synchronous -Iso-synchronous and Asynchronous Communications from Serial Devices - Examples of Internal Serial-Communication Devices -UART and HDLC - Parallel Port Devices - Sophisticated interfacing features in Devices/Ports-Timer and Counting Devices -'12C', 'USB', 'CAN' and advanced I/O Serial high speed buses- ISA, PCI, PCI-X, cPCI and advanced buses.	**10**	**25%**
	FIRST INTERNAL EXAM		
III	Embedded Programming: Programming in assembly language (ALP) vs. High Level Language -C Program Elements, Macros and functions -Use of Pointers -NULL Pointers -Use of Function Calls– Multiple function calls in a Cyclic Order in the Main Function Pointers – Function Queues and Interrupt Service Routines Queues Pointers – Concepts of EMBEDDED PROGRAMMING in C++ - Objected Oriented Programming – Embedded Programming in C++, 'C' Program compilers – Cross compiler – Optimization of memory codes.	**10**	**25%**
IV	Mobile operating systems; Architecture and framework of different mobile Platforms; Development platforms and development tools; Programming languages; Simulator and emulator; An application walkthrough using a Mobile Operating System --Case study: Android; UI Design & Layouts for various devices; UI fundamentals, UI Design constraints and Views; Overview of Intents and Broadcasts; Typical Architecture of Internet Resources and their usage; Data persistence – techniques, saving and loading of data; Saving, loading files and managing local file system	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 03 1	SEMINAR	0-0-2-2	2015

PREREQUISITES:

- Good presentation skills and knowledge about the area of study

COURSE OBJECTIVES:

- To learn the recent developments in the research areas/ area of interest.

SYLLABUS:

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the M. Tech. Programme. He / she shall select the topic based on the References: from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester.

EXPECTED OUTCOME:

The students will be able to:

- develop their presentation skills
- acquire the knowledge about emerging research areas or topic of interest

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 04 1	PROJECT – PHASE I	0-0-12-6	2015

PREREQUISITES:

- Knowledge about programming languages and topic of interest

COURSE OBJECTIVES:

- To develop a project in emerging research area

SYLLABUS:

In master's thesis Phase-I, the students are expected to select an emerging research area in Computer Science or related fields, After conducting a detailed literature survey, they should compare and analyze research work done and review recent developments in the area and prepare an initial design of the work to be carried out as Master's Thesis. It is expected that the students should refer National and International Journals and conference proceedings while selecting a topic for their thesis. He/She should select a recent topic from a reputed International Journal, preferably IEEE/ACM. Emphasis should be given for introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work carried out on the thesis topic.

Students should submit a copy of Phase-I thesis report covering the content discussed above and highlighting the features of work to be carried out in Phase-II of the thesis.

The candidate should present their thesis work and the assessment will be made on the basis of the work and the presentation, by a panel of internal examiners in which one will be the internal guide.

EXPECTED OUTCOME:

The students will be able to

- understand the emerging research areas
- enhance their programming ability
- apply the knowlede acquired to develop any application or research projects

SEMESTER 4

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 01 2	PROJECT – PHASE II	0-0-21-12	2015

PREREQUISITES:

- Knowledge about programming languages
- Knowledge about research area/topic of study

COURSE OBJECTIVES:

- To develop a project in emerging research area

SYLLABUS:

In the fourth semester, the student has to continue the thesis work and after successfully finishing the work, he / she has to submit a detailed bounded thesis report. The work carried out should lead to a publication in a National / International Conference or Journal. The papers received acceptance before the M.Tech evaluation will carry specific weightage.

Students should submit a copy of Project work report.

The candidate should present the thesis work and the assessment will be made on the basis of the work and the presentation, by a panel of examiners in which one will be the internal guide.

EXPECTED OUTCOME:

The students will be able to

- understand the emerging research areas/ topic of interest
- enhance their programming ability
- apply the knowlede acquired to develop any application or research projects