KERALA TECHNOLOGICAL UNIVERSITY

ERNAKULAM – I CLUSTER

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

COMPUTER SCIENCE : SPECIALIZATION IN INFORMATION SYSTEMS

(2015 ADMISSION ONWARDS)

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN COMPUTER SCIENCE : SPECIALIZATION IN INFORMATION SYSTEMS

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 3	Mathematical Foundation For Computer Science	Core	4-0-0	40	60	3	4
B	06 CS 6 02 3	Advanced Data Structures	Core	4-0-0	40	60	3	4
C	06 CS 6 03 3	Operating System Design	Core	4-0-0	40	60	3	4
D	06 CS 6 04 3	Computer System Design and Architecture	Core	3-0-0	40	60	3	3
E	06 CS 6 x5 3	Elective I	Elective	3-0-0	40	60	3	3
	06 CS 6 06 3	Research Methodology	Core	0-2-0	100	0	0	2
	06 CS 6 07 3	Seminar	Seminar	0-0-2	100	0	0	2
	06 CS 6 08 3	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 3	Digital Image Processing
06 CS 6 25 3	Data Mining Concepts
06 CS 6 35 3	Object Oriented Software Engineering
06 CS 6 45 3	Information Theory and Coding
06 CS 6 55 3	Foundation of Information Security
06 CS 6 65 3	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 4	Algorithm Analysis and Design	Core	4-0-0	40	60	3	4
B	06 CS 6 02 4	Advanced Computer Networks	Core	3-0-0	40	60	3	3
C	06 CS 6 03 4	Computer Security and Applied Cryptography	Core	3-0-0	40	60	3	3
D	06 CS 6 x4 4	Elective II	Elective	3-0-0	40	60	3	3
E	06 CS 6 x5 4	Elective III	Elective	3-0-0	40	60	3	3
	06 CS 6 06 4	Mini Project	Project	0-0-4	100	0	0	2
	06 CS 6 07 4	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 4	Pattern Recognition
06 CS 6 24 4	Natural Language Processing & Text Mining
06 CS 6 34 4	Software Architecture
06 CS 6 44 4	Soft Computing
06 CS 6 54 4	Parallel Computer Architecture
06 CS 6 64 4	Wireless Sensor Networks

Semester II – 06 CS 6 x5 4 Elective III	
06 CS 6 15 4	Computer Vision
06 CS 6 25 4	Ontology and Semantic Web
06 CS 6 35 4	Software Project Management
06 CS 6 45 4	Cloud Computing
06 CS 6 55 4	Compiler Design
06 CS 6 65 4	Advanced Database Concepts

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 3	Elective IV	Elective	3-0-0	40	60	3	3
B	06 CS 7 x2 3	Elective V	Elective	3-0-0	40	60	3	3
	06 CS 7 03 3	Seminar	Seminar	0-0-2	100	0	0	2
	06 CS 7 04 3	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 3	Data Compression
06 CS 7 21 3	Data Analytics
06 CS 7 31 3	Advanced Software Testing
06 CS 7 41 3	High Performance Computing
06 CS 7 51 3	Mobile Network Security

Semester III – 06 CS 7 x2 3 Elective V	
06 CS 7 12 3	Content Based Image and Video Retrieval
06 CS 7 22 3	Social Network Analytics
06 CS 7 32 3	Cyber Forensics
06 CS 7 42 3	Real Time Systems
06 CS 7 52 3	Advanced Information Security Concepts

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 4	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 3	MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE	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:

- To provide students with a good understanding of the concepts of information theoretic methods, linear algebra, fuzzy theory and abstract algebra described in the syllabus.
- To help the students develop the ability to solve problems using the learned concepts.
- To connect the concepts to other domain both within and without mathematics such as machine learning, pattern recognition and cryptography.

SYLLABUS:

Concept of amount of information, Linear Algebra, Crisp sets and Fuzzy sets, Basic concepts of Groups.

EXPECTED OUTCOME:

Students will be able to:

1. Apply the mathematical concepts of information theoretic methods for the identification of information flow over channels (noisy and noiseless).
2. Analyze the fundamental use of matrices in the computer algorithms related to dimensionality reduction and feature extraction.
3. Visualize the use of fuzzy set and apply the concepts of abstract algebra in different algorithms related to cryptography.

TEXT BOOKS:

1. R Bose, “Information Theory, Coding and Cryptography”, TMH 2007
2. J Gilbert, L Gilbert, “Linear Algebra and Matrix Theory”, Academic Press, Elsevier
3. George J Klir and Bo Yuan, ”Fuzzy sets and Fuzzy logic” Prentice-Hall of India,1995
4. David S Dummit, Richard M. Foote- “Abstract Algebra”, 3rd Edition Wiley ISBN:978-81-265-3228-5

REFERENCES:

1 William Stallings, “Cryptography and network security- principles and practice”, 3rd Edition, Pearson Prentice Hall.
2 Jospeh A Gallian, “Contemporary Abstract Algebra”, Fourth Edition, Narosa Publication.
3 Stefan M. Moser, Po-Ning Chen, "A Student's Guide to Coding and Information Theory", Cambridge University Press (2012),ISBN-10: 1107684579, ISBN-13: 978-1107684577
4 Peter D. Lax, "Linear Algebra and Its Applications, 2nd Edition", ISBN: 978-0-471-75156-4, 392 pages, August 2007

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Concept of amount of information-Entropy-Joint and Conditional Entropy-Relative Entropy-Mutual information-Relationship between Entropy and Mutual information-Rate of information-Channel capacity-Redundancy and efficiency of channels – Huffman Codes	**12**	**25%**
II	Linear Algebra – Linear transformation – matrices & operations – eigenvalues and eigenvectors – covariance matrices, modulo arithmetic – Additive and multiplicative inverses of natural numbers under modulo arithmetic - Euler's theorem & Fermat's theorem – Chinese Remainder theorem– Cauchy Schwarz Inequality – Cosine similarity – Function continuity and monotonic functions	**14**	**25%**
FIRST INTERNAL EXAM			
III	Crisp sets and Fuzzy sets-, α-cuts, Convex fuzzy sets, Fuzzy cardinality, Algebra of fuzzy sets, Standard fuzzy set operations-(complement, union and intersection), Yager and Sugeno classes. Crisp relations and Fuzzy relations, Operations on Fuzzy relations. Fuzzy Cartesian product. Fuzzy Equivalence relations and similarity relations.	**12**	**25%**
IV	Basic concepts of Groups, rings with examples, Field Theory: basic theory of field extensions, algebraic extensions, classical straightedge and compass constructions, splitting fields and algebraic closures, separable and inseparable extensions, cyclotomic polynomials and extensions	**12**	**25%**
SECOND INTERNAL EXAM			
IV	Galois Theory: basic definitions, the fundamental theorem of Galios theory, Finite Fields, composite extensions and Abelian extensions over Q, Galios groups of polynomials, solvable and radical extensions, computations of Galios Groups over Q, Transcendental extensions, inseparable extensions, infinite Galios Groups	**10**	

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 02 3	ADVANCED DATA STRUCTURES	4-0-0-4	2015

PREREQUISITES:

- Basics of Datastructures and its implementation
- Fundamentals of algorithm analysis and design

COURSE OBJECTIVES:

- Introduce new & advanced data structures
- Introduce algorithmic design and analysis
- Solve problems using different data structures and design techniques, and compare their performance and tradeoffs
- Choose the data structures that effectively model the problem.
- Identify problems where advanced ADTs are appropriate and select or design the most suitable ADT for the given task.

SYLLABUS:

Trees, Priority Queues, Data Structures for Disjoint Sets, Maximum Flow.

EXPECTED OUTCOME:

The students will be able to

- understand and implement advanced data structures such as trees and heaps.
- evaluate the performance of basic operations (like serach, insert, delete) associated with the data structure.
- apply the advanced data structures on domain specific application areas such as computer networks, image segmentation, text mining process scheduling problems etc.

TEXT BOOKS:

- Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008
- Thomas Cormen, Charles E. Leiserson, Ronald Rivest, Introduction to algorithm,3rd edition, PHI Learning.
- Mark Allem Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson.

REFERENCES:

- Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Data Structures using C and C++, Second Edition, PHI Learning Private Limited, 2010
- Ellis Horowitz and Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms,Universities Press, 2nd Edition, Hyderabad .
- Sara Baase & Allen Van Gelder , Computer Algorithms – Introduction to Design and Analysis, Pearson Education
- Algorithm Design: Jon Kleinberg and Eva Tardos, Addison Wesley

- Anany V. Levitin. Introduction to the Design & Analysis of Algorithms (2nd Ed): Addison Wesley.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Trees - Threaded Binary Trees, Selection Trees, Forests and binary search trees, Counting Binary Trees, Red-Black Trees, Splay Trees, Suffix Trees, Digital Search Trees, Tries- Binary Tries, Multiway Tries**,** k-d Trees, Point Quadtrees	**15**	**25%**
II	Priority Queues - Single and Double Ended Priority Queues, Leftist Trees, Skew Heaps, Binomial Heaps, Fibonacci Heaps, Pairing Heaps, Symmetric Min-Max Heaps, Interval Heaps	**15**	**25%**
FIRST INTERNAL EXAM			
III	Data Structures for Disjoint Sets, Disjoint-set operations, Linked-list representation of disjoint sets, Disjoint-set, forests, Analysis of union by rank with path compression, Medians and Order Statistics, Minimum and maximum, Selection in expected linear time, Selection in worst-case linear time, Polynomials and the FFT, Representation of polynomials, The DFT and FFT, Efficient FFT implementations	**15**	**25%**
IV	Maximum Flow-Flow Networks, Ford-Fulkerson method-analysis of Ford-Fulkerson, Edmonds-Karp algorithm, Maximum bipartite matching, Bi-connected Components, Finding strong components.	**7**	**25%**
SECOND INTERNAL EXAM			
IV	Computational Geometry- Line segment properties, Finding the convex hull **,** Finding the closest pair of points. Skip lists, Hash Tables: Direct address tables, hash tables, open addressing, rehashing, extensible hashing.	**8**	

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 03 3	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 3	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 3	DIGITAL IMAGE PROCESSING	3-0-0-3	2015

PREREQUISITES: Matrix operations, linear algebra, probability and calculus

COURSE OBJECTIVES:

- To learn fundamental of image processing and different image processing techniques
- To learn morphological operations, image registration and reconstructions

SYLLABUS:

Operating Systems Concepts, Process Management, Process Scheduling, Threads. Dead Lock, Memory Management, Memory Scheduling Algorithms, Windows Management Mechanisms, Principles of protection, Domain of protection, Technologies, Case Study.

EXPECTED OUTCOME:

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

- Develop research projects and applications projects using image processing techniques

TEXT BOOKS:

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 and practice. CRC Press, 2012.

REFERENCES:

1. Richard Szeliski,"Computer Vision: Algorithms and Applications" , Springer, 1st Ed.,2010.
2. William K. Pratt, Digital Image Processing: PIKS Scientific Inside , Wiley Interscience, 4th Ed.,2007..
3. Christopher D. Manning, Hinrich Schuetze, "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.	**10**	**25%**

	Convolution and Correlation. Basic graph theory , Paths, trees and connectivity. Geometric primitives and 2D transformations.		
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%**
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 3	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 3	OBJECT ORIENTED SOFTWARE ENGINEERING	3-0-0-3	2015

PREREQUISITES: Software Engineering

COURSE OBJECTIVES:

- To provide an in depth knowledge on software life-cycle process with object-oriented concept.

SYLLABUS:

Software Life Cycle models, SRS Documentation, UML Diagrams, Analysis Phase, Design Phase, Mapping, Testing & Implementation

EXPECTED OUTCOME:

The students will be able to

4. Understand different software life cycle concept.
5. Study and design SRS documents for software projects.
6. Study and model software projects using different modeling techniques.
7. Understand different techniques to map models to code

TEXT BOOK:

1. Bernd Bruegge, Alan H Dutoit, "Object-Oriented Software Engineering" Second edition,Pearson Education, 2004.
2. Craig Larman, "Applying UML and Patterns" Third edition, Pearson Education, 2005.

REFERENCES:

1. Stephen Schach, " Software Engineering" Seventh edition, McGraw-Hill, 2007.
2. Ivar Jacobson, GrandyBooch, James Rumbaugh, " The Unified Software Development Process", Pearson Education, 1999.
3. Alistair Cockburn, "Agile Software Development" Second edition, Pearson Education,2007.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Software Life Cycle Models**: System Concepts – Project Organization – Communication- Life cycle models – Unified Process –Iterative and Incremental - Workflow – Agile Processes-Project Planning & Estimation	**10**	**25%**
II	**SRS Documentation**: Requirements Elicitation – Requirement Documentation-Use Cases- Unified Modeling language-Introduction. **UML Diagrams: –** Class diagrams, Sequence diagrams, Object diagrams, Deploymentdiagrams, Use case diagrams, State	**10**	**25%**

	diagrams, Activity diagram, Component diagrams, Case Study, Identifying Classes- Noun Phrase Approach, Common class Pattern Approach, Use-CaseDriven Approach, CRC.		
FIRST INTERNAL EXAM			
III	**Analysis Phase:** Analysis Object Model (Domain Model) – Analysis Dynamic Models- Non-functional requirements– Analysis Patterns. **Design Phase:** System Design Architecture – Design Principles – Design Concepts – DesignPatterns – Architectural Styles-Dynamic Object Modeling – Static Object Modeling – InterfaceSpecification – Object Constraint Language.	**10**	**25%**
IV	**Mapping:** Mapping Design (Models) to Code – Model Transformation- Refactoring- Mapping Associations- Mapping Activities- **Testing & Implementation:** Testing- Configuration Management – Maintenance process- Systemdocumentation – program evolution dynamics	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 45 3	INFORMATION THEORY AND CODING	3-0-0-3	2015

PREREQUISITES:

1. A good understanding of probability theory is required.
2. Knowledge of communication theory would be advantageous.
3. A firm knowledge in Discrete Mathematics is required.
4. Solving of Mathematical Methods for Computer Science is essential.

COURSE OBJECTIVES:

- To equip students with the basic understanding of the fundamental concept of entropy and information as they are used in communications.
- To enhance knowledge of probabilities, entropy, measures of information.
- To guide the student through the implications and consequences of fundamental theories and laws of information theory and coding theory with reference to the application in modern communication and computer systems

SYLLABUS:

Source Coding, Channel capacity and coding, Cyclic codes, Convolutional codes

EXPECTED OUTCOME:

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

- Calculate the information content of a random variable from its probability distribution.
- Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities.
- Define channel capacities and properties using Shannon's Theorems.
- Construct efficient codes for data on imperfect communication channels.
- Generalize the discrete concepts to continuous signals on continuous channels.

REFERENCES:

1. . Ranjan Bose, “Information theory, coding and cryptography”, Tata McGraw Hill, 2002.
2. Viterbi, “Information theory and coding”, McGraw Hill, 1982.
3. John G. Proakis, “Digital Communications”, 2nd Edition, McGraw Hill, 1989.
4. 4.Shu Lin and Daniel. J. Costello Jr., “Error Control Coding: Fundamentals and applications”, Second Edition Prentice Hall Inc, 2004.
5. Robert McEliece “The theory of Information and Coding”, Cambridge University Press, 2002
6. RobertGallager, “Information Theory and Reliable Communication”, John Wiley & Sons.
7. Thomas M. Cover and Joy A. Thomas, “Elements of Information Theory”, John Wiley & Sons, 2006
8. R. J. McEliece, “The Theory of Information & coding”, Addison Wesley Publishing Co., 1977.
9. 8. T. Bergu, “Rate Distortion Theory, a Mathematical Basis for Data Compression” PH Inc. 1971.

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem Exam Marks**
I	**Source Coding -** Introduction to information theory, uncertainty and information, average mutual information and entropy, source coding theorem, Shannon-Fano coding, Huffman coding, Arithmetic coding, Lempel-Ziv algorithm, run-length encoding and rate distortion function.	**10**	**25%**
II	**Channel capacity and coding** - channel models, channel capacity, channel coding, information capacity theorem, random selection of codes.	**5**	**25%**
FIRST INTERNAL EXAM			
II	**Error control coding**: linear block codes and their properties, decoding of linear block code, perfect codes, hamming codes, optimal linear codes and MDS codes.	**5**	
III	**Cyclic codes** - polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, burst error correction, fire codes, golay codes, CRC codes, circuit implementation of cyclic codes. BCH codes: minimal polynomials, generator polynomial for BCH codes, decoding of BCH codes, Reed-Solomon codes and nested codes.	**10**	**25%**
IV	**Convolutional codes** - tree codes and trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, generation function, matrix description of convolutional codes, viterbi decoding of convolutional codes, distance bounds for convolutional codes, turbo codes and turbo decoding, Trellis Coded Modulation - concept of coded modulation, mapping by set partitioning, ungerboeck's TCM design rules, TCM decoder.	**10**	**25%**

Course No.	**Course Name**	**L-T-P-Credits**	**Year of Introduction**
06 CS 6 55 3	FOUNDATION OF INFORMATION SECURITY	3-0-0-3	2015

PREREQUISITES:
Prior knowledge on computing and software systems.

COURSE OBJECTIVES:

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SYLLABUS:

Security Elements, Watermarking, Web application security, Malware and types

EXPECTED OUTCOME:

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

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REFERENCES:

1. Joseph M Kizza, "Computer Network Security", Springer Verlag, 2005.
2. Swiderski, Frank and Syndex, "Threat Modeling", Microsoft Press, 2004.
3. William Stallings and Lawrie Brown, "Computer Security: Principles and Practice", Prentice Hall, 2008.
4. Thomas Calabres and Tom Calabrese, "Information Security Intelligence: Cryptographic Principles & Application", Thomson Delmar Learning, 2004.
5. Cox I., M. Miller, J. Bloom, J. Fridrich and T Kalker, "Digit Watermarking and Steganography", Second Edition, Morg Kaufmann Publishers, 2008.
6. Dafydd Stuttard, Marcus Pinto, The Web Application Hacker's Handbook, 2nd Edition, Wiley Publishing, Inc.
7. Michael Sikorski and Andrew Honig, PRACTICAL MALWARE ANALYSIS, The Hands-On Guide to Dissecting Malicious Software, No Starch Press, ISBN:978-1-59327-290-6, Year 2012, Pages 800

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Security Elements: Authorization and Authentication - types, policies and techniques – Security certification - Security monitoring and Auditing - Security Requirements Specifications - Security Policies and Procedures, Firewalls, IDS, Log Files, Honey Pots. Access control, Trusted Computing and multilevel security - Security models, Trusted Systems, Software security issues, Physical and infrastructure security, Human factors – Security awareness, training , Email and Internet use policies.	**12**	**25%**
II	Watermarking, applications of watermarking, Watermarking host signals: Image, Video, and Audio, Communication-Based Models of Watermarking, Geometric Models of Watermarking, watermark security and cryptography, attacks on watermark, Steganography, Steganographic communications, Steganographic method, steganalysis algorithms.	**15**	**25%**

III	Web application security- Key Problem factors – Core defense 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 Attacking access controls – Common vulnerabilities – Securing access controls.	**15**	**25%**
IV	Malware and types, basic static analysis techniques, malware analysis in virtual environment, basic dynamic analysis, malware behavior, covert malware launching, packers and unpackers, anti debugging and anti disassembling and anti virtual machine analysis	**15**	**25%**

Course No.	**Course Name**	**L-T-P-Credits**	**Year of Introduction**
06 CS 6 65 3	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 3	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 3	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 3	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 4	**ALGORITHM ANALYSIS AND DESIGN**	4-0-0-4	2015

PREREQUISITES: Advanced Data Structures

COURSE OBJECTIVES:

- To improve creative thinking, problem solving and analytical ability
- To analyze the asymptotic performance of algorithms.
- To apply important algorithmic design paradigms and methods of analysis.
  To synthesize efficient algorithms in common engineering design situations.

SYLLABUS:

Algorithms - Sorting Networks - String Matching - Randomization - Approximation Algorithms

EXPECTED OUTCOME:

- Graduates will be able to analyze worst-case running times of algorithms using asymptotic analysis.
- Graduates will be able to identify when divide-and-conquer paradigm can be applied to solve a problem, derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- Graduates will be able to identify when dynamic-programming paradigm can be applied to solve a problem, synthesize dynamic-programming algorithms, and analyze them.
- Graduates will be able to identify when greedy paradigm can be applied to solve a problem, synthesize greedy algorithms, and analyze them.
- Graduates will be able to explain the different ways to analyze randomized algorithms.
- Graduates will be able to explain what an approximation algorithm is, and the benefit of using approximation algorithms.

TEXT BOOKS:

1. Introduction to Algorithms (3rd Ed):Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT Press
2. Horowitz, Sahni, Rajasekharan, "Fundamentals of computer algorithms", Galgotia Publications
3. Lectures in Computational Complexity , Jin-Yi Cai , Department of Computer Sciences , University of Wisconsin
4. Algorithm Design: Jon Kleinberg and Eva Tardos, Addison Wesley
5. Anany V. Levitin. Introduction to the Design & Analysis of Algorithms (2nd Ed): Addison Wesley
6. Randomized Algoritms: Rajeev Motwani and Prabhakar Raghavan, Cambridge University Press

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks

I	**Algorithms** – Complexity and notations – Recurrences - Algorithmic Techniques: Backtracking – Branch and bound - Divide-and-Conquer – Merge Sort– Dynamic Programming – All pair shortest path problem – Greedy strategy – Knapsack problem - Space Bounded Computation (basic concept only)	**10**	**25%**
II	**Sorting Networks** - Comparison networks - The zero-one principle - A bitonic sorting network - A merging network - A sorting network **String Matching** - The naive string-matching algorithm - The Rabin-Karp algorithm - String matching with finite automata - The Knuth-Morris-Pratt algorithm	**10**	**25%**
FIRST INTERNAL EXAM			
III	**Randomization** - Basic Probability - Markov's Inequality - Chebyshev Inequality - Universal Hashing - Expectations - Tail Bounds – Chernoff bound, Markov Chains and Random Walks – Applications of randomized algorithms	**10**	**25%**
IV	**Approximation Algorithms** - Approximation Algorithms for NP - Hard Problems - Approximation Algorithms for the Traveling Salesman Problem - Approximation Algorithms for the Knapsack Problem Algorithms for Solving Nonlinear Equations - Bisection Method - Method of False Position - Newton's Method	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 02 4	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:

- Kurose and Ross, Computer Networks A systems approach , Pearson Education.
- 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 /	**5**	**25%**

	Classless Addressing, Datagram Fragmentation,		
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 4	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 4	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 24 4	NATURAL LANGUAGE PROCESSING & TEXT MINING	3-0-0-3	2015

PREREQUISITES: Nil

COURSE OBJECTIVES:

1.

SYLLABUS:

Introduction, Features and Unification, Overview of Text Mining, Finding Structure in a Document Collection

EXPECTED OUTCOME:

Students who successfully complete this course will be able to

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REFERENCES:

1. Daniel Jurafsky & James H.Martin, " Speech and Language Processing", Pearson Education (Singapore) Pte. Ltd., 2002.
2. "Fundamentals of Predictive Text Mining", Sholom M. Weiss, Nitin Indurkhya, Tong Zhang .Springer.
3. James Allen, "Natural Language Understanding", Pearson Education, 2003.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Introduction**,** Regular Expressions and automata: Regular expressions - Finite-State automata. Morphology and Finite-State Transducers: Finite-State Morphological parsing - Combining FST lexicon and rules, Porter Stemmer Algorithm. Part-of-speech tagging - Rule-based part-of-speech tagging - Stochastic part-of-speech tagging - Transformation-based tagging. Parsing with Context-Free Grammars: Parsing as search - A Basic Top-Down parser - Problems with the basic Top-Down parser - The early algorithm.	**10**	**25%**
II	Features and Unification: Feature structures - Unification of feature structures - Features structures in the grammar - Implementing unification - Parsing with unification constraints. Meaning structure of language - First order predicate calculus. Semantic Analysis: Syntax-Driven semantic analysis - Attachments for a fragment of English. Lexical semantics: relational among lexemes and their senses - WordNet: A database of lexical relations. Word Sense Disambiguation – Methods. Machine Translation-	**10**	**25%**

	Methods.		
III	Overview of Text Mining. From Textual Information to Numerical vectors - Collecting Documents, Document Standardization, Tokenization, Lemmatization, and Vector Generation of Prediction. Using Text for Prediction - Document Classification, Learning to Predict from Text-Similarity and Nearest –Neighbor methods, Document Similarity, Decision rules, Decision Trees, Scoring by Probabilities.	**10**	**25%**
IV	Finding Structure in a Document Collection - Similarity of Composite Documents – k-Means Clustering, Hierarchical Clustering .Looking for Information in Documents- Co reference and Relationship Extraction. Case Studies – Assigning Topics to News Articles, E-mail Filtering. Emerging Directions- Summarization, Distributed Text Mining.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 34 4	SOFTWARE ARCHITECTURE	3-0-0-3	2015

PREREQUISITES: Software Engineering

COURSE OBJECTIVES:

- To improve creative thinking, problem solving and analytical ability
- To analyze the asymptotic performance of various architectures.
- To apply important database integration in shared information schemas.
- To synthesize efficient architecture in common engineering design situation

SYLLABUS:
Architectures - Architecture Styles - Shared Information Systems- Architectural Design Guidence

EXPECTED OUTCOME:
Students who successfully complete this course will be able to

- Graduates will be able to analyze software processes
- Graduates will be able to identify the best Architecture which can be applied to solve a problem.
- Graduates will be able to design shared information systems with database integration applied to solve a problem, and analyze them.
- Graduates will be able to explain the different ways to analyze randomized architectures.
- Graduates will be able to develop user interface architectures and the benefit of using design space and rules for developing user interface architectures.

TEXT BOOK:

1. Mary Shaw, David Garlan, "Software Architecture", Prentice Hall India, 2000.
2. Len Bass, Paul Clements, Rick Kazman, "Software architectures in practice", Addison-Wesley, 2003.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Introcuction to Architecures** – Introduction to Software Architecture, Architecture Business Cycle:-, Where do Architectures Come from, Software Processes and the Architecture Business Cycle, Features of Good Architecture. What is software architecture:- Architectural patterns- Reference Models, and Reference Architectures, Importance of software Architecture, Architectural structures and views.	**10**	**25%**

II	**Architectural Styles** - Pipes and Filters-Data Abstraction and Object Oriented Organization-Event based, Implicit Invocation-Layered Systems-Repositories-Interpreters-Process Control-Process control Paradigms-Software Paradigm for Process Control-Distributed processes-Main program / subroutine organizations – Domain – specific software architecture – heterogeneous architectures. Case Study:- Keyword in Context, Mobile Robotics	**10**	**25%**
FIRST INTERNAL EXAM			
III	**Shared Information Systems-** Shared Information Systems Database Integration:- Batch Sequential, Simple Repository, Virtual Repository, Hierarchical layers, Evolution of shared information systems in business data processing, Integration in Software Development Environments, Integration in the design of Buildings, Architectural Structures for Shared Information Systems Database Integration	**10**	**25%**
IV	**Architectural Design Guidance** -Guidance for User-Interface Architectures -Design Space and rules-Design Space for User Inter face Architectures-Design. Rules for User Interface Architecture applying the Design Space – Example – A Validation Experiment – How the Design Space Was Prepared	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 44 4	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:

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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%**
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	**10 Hrs**	**25%**

	theorem; Multiobjective & Multimodal optimization in GA		
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 4	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:

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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%**
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 aware data replication in caches, Cache compression techniques; cache block eviction using reference predictions, cache management using reuse distance, adaptive cooperative set granular caching.	**10 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 64 4	WIRELESS SENSOR NETWORKS	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To impart an introduction to wireless communication technology.
- To develop knowledge on how communication happens in wireless environment
- To provide exposure to cellular concepts.

SYLLABUS:

Introduction And Overview Of Wireless Sensor Networks, Communication In Ad Hoc Sensor Networks, Sensor Network Architecture & Design Challenges, Energy Management, Security & Reliability

EXPECTED OUTCOME:

This course requires the student to demonstrate the ability to:

- The course provides a good understanding of wireless communication.
- The student is provided with mathematical foundation for understanding the principles of wireless communication.
- Enables Student to compare the various digital modulation techniques.
- Enables the students to map the basic concepts of wireless communication with the real world applications.

REFERENCES:

1. Kazem Sohraby, Daniel manoli , "Wireless Sensor networks- Technology, Protocols and Applications ", Wiley InterScience Publications 2010.
2. Smart Dust: Sensor Network Applications, Architecture and Design By Mohammad Ilyas, Imad Mahgoub, Taylor and francis, international Standard Book No-13:978-1-4200-0306-2
3. Protocols and Architectures for Wireless Sensor Networks, By Holger Karl, Andreas Willig , John Wiley & Sons, 2007.
4. C.Siva Ram Murthy and B.S. Manoj, "Ad-hoc wireless networks-architecture and protocols", Pearson education, 2nd, 2005.
5. Mohammad Ilyas and Imad Mahgoub, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems" CRC Press 2005.
6. Rajeev Shorey and A.Ananda , "Mobile, Wireless and Sensor Networks Technology,Applications and Future Directions, John Wiley & Sons, 2006.
7. Wlliam Stallings, "Wireless Communication and Networks", Prentice Hall, 2nd edition, 2005.
8. Kaveh Pahlavan and Prashant Krishnamurthy, "Principle of Wireless network- A unified approach", Prentice Hall, 2006
9. Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005.
10. C.S Raghavendra, Krishna M.Sivalingam, Taieb znati "Wireless Sensor Networks", Springer Science 2004.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Background of Sensor Network Technology , Applications of Sensor Networks , Characteristics of wireless sensor networks, Basic Sensor Network Architectural Elements, Sensor Taxonomy, Wireless Network operating environment, Wireless transmission technology and systems- Propagation and Propagation Impairments, Modulation, MAN/WAN applications, challenges of wireless sensor networks, Overview of issues in designing a wireless sensor networks- medium access scheme, routing, multicasting, transport layer protocol, pricing scheme, QoS provisioning, self-organization, security, addressing, service discovery, energy management, deployment consideration, ad-hoc wireless internet, Basics of mathematical modeling of a wireless sensor network and its design parameters. Introduction to Simulation tools: ns 2, MATLAB, OPNET	**14**	**25%**
II	Wireless Communication standards, Comparison of IEEE standards, characteristics of mobile radio environment and propagation phenomena- Path loss modeling and signal coverage- free- space propagation, two ray model, distance-power relationship and shadow fading, effects of multi path and Doppler- modeling of multi path fading, Doppler spectrum, multi path delay spread, Coverage in Wireless Sensor Networks – Area Coverage, Point Coverage, Barrier Coverage, Node discovery and localization protocols	**14**	**25%**
III	Functional Architecture for sensor networks, sample implementation scenarios-SINA, data dissemination, data gathering, fundamentals of wireless Mac protocols, classification of MAC protocols, MAC protocols for sensor network, quality of sensor network , Routing Protocols for Wireless Sensor Networks- Routing Strategies in Wireless Sensor Networks, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocol, WSN Design Issues- MAC Protocols, Routing Protocols, Transport Protocols, Performance Modeling of WSN.	**12**	**25%**
IV	Dynamic Power Management in Sensor Networks- Idle Power Management, Active Power Management, System Implementation, Security and Privacy Protection in Wireless Sensor Networks -Unique Security Challenges in Sensor Networks and Enabling Mechanisms, Security Architectures, Privacy Protection. Reliability Support in Sensor Networks- Reliability Problems in Sensor Networks, Architecture of a Distributed Sensor System, Distributed Services, Mechanisms and Tools, Dynamic Adaptation of Distributed Sensor Applications	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 15 4	COMPUTER VISION	3-0-0-3	2015

PREREQUISITES: Basics of Image processing , filtering techniques, probability, data mining and machine learning

COURSE OBJECTIVES:

- To learn different transformations applied in image processing
- To learn machine learning techniques used in computer vision
- To learn about the feature extraction techniques , object recognition and identification

SYLLABUS:
Elements of image processing, Introduction to Machine Learning, Image distance measures, Pinhole camera model.

EXPECTED OUTCOME:
Students will be able to:

- develop research projects using computer vision

TEXT BOOKS:

1. Richard Szeliski,"Computer Vision: Algorithms and Applications" , Springer, 1st Ed.,2010
2. Linda G. Shapiro,"Computer Vision", Prentice Hall, 1st Ed., 2001
3. Rafael C. Gonzalez, Richard E. Woods,"Digital Image Processing",3rd Edition
4. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision ,Second Edition,Cambridge University Press, March 2004.

REFERENCES:

1. Bishop, Christopher M. Pattern recognition and machine learning. Vol. 4. No. 4. New York: springer, 2006.
2. David A. Forsyth , Jean Ponce, Computer Vision: A Modern Approach

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Elements of image processing, Intensity transformation and spatial filtering, Histogram processing, Edge detection filters, Image segmentation, Image formation, Geometric primitives and transformations,2D transformations,3D transformations, 3D to 2D projections Photometric image formation, Lighting, Reflectance and shading, Optics..	**10**	**25%**

II	- Introduction to Machine Learning, Regression, Classification problem, Feature vectors, Dimensionality reduction,	**5**	**25%**
FIRST INTERNAL EXAM			
II	RANSAC, Neural nets, Support Vector Machine, Clustering Methods, k-Nearest Neighbors, k means , Deep convolutional networks.	**5**	
III	Image distance measures, color similarity measures, Texture similarity measures, shape similarity measures, Feature detection and matching, Feature detectors, Feature descriptors, SIFT, SURF, HOG, bag of visual words, Feature matching, Edge detection, edge linking, Computing motion vectors from image sequences. Optical flow. Recognition, Object detection, face recognition, Eigenfaces.	**10**	**25%**
IV	Pinhole camera model, Computation of fundamental matrix and essential matrix, Camera calibration, Stereo camera model, Epipolar Geometry,, Structure from motion, Three-View Geometry, The geometric basis for the trifocal tensor, The trifocal tensor and tensor notation, The fundamental matrices for three views. Introduction to Visual simultaneous localization and mapping (VSLAM).	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 25 4	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 nonmonotonic, 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 4	SOFTWARE PROJECT MANAGEMENT	3-0-0-3	2015

PREREQUISITES: Nil.

COURSE OBJECTIVES:

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SYLLABUS:

Introduction to Projects and Project Characteristics, Project Planning, Software Metrics & Quality Assurance, Other Topics

EXPECTED OUTCOME:

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

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REFERENCE:

1. Bob Huges & Mike Cotterell, "Software Project Management", Tata McGraw Hill, New Delhi, 2002.
2. Pankaj Jalote, "Software Project Management in Practice", Pearson Education Ltd, 2005.
3. Gopalaswamy Ramesh, "Managing Global Software Projects", Tata McGraw Hill, New Delhi, 2006.
4. Roger S Pressman, "Software Engineering: A Practitioner's Approach", Tata McGraw Hill, New Delhi, 2001.
5. Pankaj Jalote, "An Integrated Approach to Software Engineering".

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Projects and Project Characteristics, Project Constraints, Software Projects vs. Other Projects, Problems with Software Projects, Software Project Failures & Major Reasons, What is Project Management?, Need for Software Project Management, Project Management Framework – Project Stakeholders, PM Competencies, Project Environment, Project Organization Types, Project Management Life Cycle, Business Case, Cost Benefit Analysis, Project Charter.	**11 Hrs**	**25%**
II	Basic Objectives, Key Planning Tasks, Scope Definition, Work Breakdown Structure (WBS), Activity Planning, Activity Sequencing, Activity Duration Estimation, Network Models – PDM, CPM, Identifying Critical Path, Resource Assignment, Gantt Chart, Project Plan Development, Other Plans – SQA Plan, Test Plan, Risk Management Plan, Configuration Management Plan, Resource Plan, Communication Plan, Contents of a	**11 Hrs**	**25%**

	Typical Software Project Plan, Project Monitoring and Control, Project Tracking using Earned Value Analysis, Tracking Gantt, Project Scheduling and Tracking using MS Project.		
III	Software Metrics: Product and Process Metrics – Size, Effort, Duration, Productivity, Defect Density, Reliability; Software Estimation Techniques – Function Point Analysis, Effort and Schedule Estimation using COCOMO, WBS based Estimation. Software Quality Assurance: Concepts of Quality Assurance, Quality Control, Cost of Quality, Verification and Validation; Quality Planning; Quality Control Tools	**10 Hrs**	**25%**
IV	Project Risk Management – Risk Identification, Top 10 Software Project Risks, Risk Analysis and Prioritization, Risk Response Planning, Risk Resolution, Risk Tracking and Control, Software Configuration Management – Software Configuration Items (SCI), Change Control, Version Control, Agile Project Management using Scrum	**10 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 45 4	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 4	COMPILER DESIGN	3-0-0-3	2015

PREREQUISITES: Awareness of different phases of compilers

COURSE OBJECTIVES:

- To learn different optimization techniques used in compilers
- To learn different intermediate languages

SYLLABUS:

Principles Of Compiler, Optimization, Register allocation and assignment, Case Studies

EXPECTED OUTCOME:

Students will be able to:

- Understand different optimizations used in compilers

TEXT BOOKS:

1. Steven S. Muchnick, Koffman, "Advanced Compiler Design & Implementation", Elsevier Science, 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.

REFERENCES:

1. Alfred Aho, V. Ravi Sethi, D. Jeffery Ullman, "Compilers Principles Techniques and Tools", Addison Wesley, 1988.
2. Charles N. Fischer, Richard J. Leblanc, "Crafting a compiler with C", Benjamin-Cummings Publishing 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 – 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	**10**	**25%**
II	Optimization – Early optimization – Constant folding – scalar replacement of aggregates Simplification – value numbering – copy propagation	**5**	**25%**
	FIRST INTERNAL EXAM		
II	Redundancy elimination – loop optimization. Procedure	**5**	

	optimization – in-line expansion – leaf routine optimization and shrink wrapping		
III	Register allocation and assignment – graph coloring – control flow and low level optimizations - 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 65 4	ADVANCED DATABASE CONCEPTS	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

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SYLLABUS:

Parallel and Distributed Databases, Object and Object relational databases, Enhanced Data models, Emerging Technologies

EXPECTED OUTCOME:

Students will be able to:

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REFERENCES:

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education/Addison Wesley, 2007.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.
3. Vijay Kumar," Mobile Database Systems", A John Wiley & Sons, Inc., Publication.
4. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Fifth Edition, McGraw Hill, 2006.
5. C.J. Date, A.Kannan and S.Swamynathan,"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
6. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition 2004.
7. IBM Zikopoulos, Paul, Chris Eaton, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data" McGraw Hill Professional

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Three Tier Client Server Architecture- Case Studies	**10**	**25%**
II	Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL /	**10**	**25%**

	Oracle – Case Studies		
III	Active Database Concepts and Triggers – Temporal Databases – Spatial Databases – Multimedia Databases – Deductive Databases – XML Databases: XML Data Model – DTD - XML Schema - XML Querying - Geographic Information Systems - Genome Data Management	**10**	**25%**
IV	Big data, Parallel processing and query optimization, Hadoop, MAP REDUCE XML, Object relational data base, Spatial database, Temporal databases, Intelligent databases, Multimedia databases	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 6 06 4	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. 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 4	ADVANCED COMPUTING LAB-II	0-0-2-1	2015

COURSE OBJECTIVES:

To gain expertise in the areas of Linux, Data processing and Analysis, Information Security, Network Simulation.

SYLLABUS:

Linux Internals

1. Introduction to Linux and Basic commands
    a. Installation of Unix/Linux operating system; understand booting process.
    b. Study of Unix/Linux general purpose utility command list obtained from (man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown, grep, mount) commands.
    c.. Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system.
2. Basic Shell Programming
3. Implementing IPC using message queue, Semaphore and Shared Memory.
4. SSH, NFS and SAMBA Configurations.
5. DNS Server & Web server configuration
6. Write a program to print boot block, super block, inode table, data block, set permissions for a file and securing the file using suid bits.

Data Processing and Analysis.

1. Implement various feature selection/extraction technique available in Weka (image/text).
    1. Information Gain
    2. Sequential Selection
    3. Fisher's Linear Discriminant analysis
    4. Principal Component Analysis (PCA)
2. To perform classification like Decision tree, Naive Bayes, Random Forest, Rotation Forest, SVM, Multinomial Naive Bayes Classifiers using bench mark data sets from UCI Machine Learning Repository (with Weka toolkit).
3. Implement ensemble classification algorithm.
4. Implement clustering techniques (divisive, agglomerative, K-means and K-mediod), and perform clustering using WEKA.
5. Implement linear regression using Weka.
6. Analyze different evaluation metrics such as TPR, FPR, Accuracy, Precision, Recall, AUC, F1-measure, ROC etc in binary class and multiclass classification problems.

Information Security

1. Implement substitution ciphers (a) Playfair cipher (b) Hill cipher
2. Implement S-DES algorithm.
3. Perform encryption and decryption on a file/image using (a) Knapsack cryptosystem (b) RSA algorithm (c) Rabin cryptosystem (d) ELGAMA cryptosystem
4. Configure GnuPG, Configure SSH

5. Managing and creation of encrypted partitions in Linux.
6. Secure Linux File access
7. Generate Self signed certificate

Network Simulation Lab

1. A thorough study of packet capturing tool called WireShark.
2. Familiarizing Network Simulator – 2 (NS2) with suitable examples.
3. Simulate a wired network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script.
4. Performance evaluation of different routing protocols in wired network environment using NS2.
5. Performance evaluation of different queues and effect of queues and buffers in wired network environment using NS2.
6. Compare the behavior of different variants of TCP (Tahoe, Reno, Vegas….) in wired network using NS2. Comparison can be done on the congestion window behavior by plotting graph.
7. Simulate a wireless network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script.
8. Performance evaluation of different ad-hoc wireless routing protocols (DSDV, DSR, AODV …) using NS2.

Create different Wired-cum-Wireless networks and MobileIP Simulations using NS2.

EXPECTED OUTCOME:

- Familiarization and internals of Linux.
- Acquiring knowledge of data processing and analysis
- Ability to implement Cipher tools
- Knowledge of Network Simulation tools

SEMESTER 3

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 11 3	DATA COMPRESSION	3-0-0-3	2015

PREREQUISITES: Basic awareness of algorithms and mathematical course

COURSE OBJECTIVES:

- To learn compression techniques
- To learn different coding techniques

SYLLABUS:

Compression Techniques, The Huffman coding, Arithmetic Coding, Mathematical Preliminaries for Lossy Coding.

EXPECTED OUTCOME:

Graduates will be able to:

- develop some compression algorithms

TEXT BOOKS:

- Introduction To Data Compression, 3rd Edition , 2010 by Sayood Khalid

REFERENCES:

- The Data Compression Dec 2008 by Mark Nelson

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	Module I: Introduction Compression Techniques: Loss less compression, Lossy Compression, Measures of prefonnance, Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.	10	25%
II	The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure.	5	25%
	FIRST INTERNAL EXAM		
II	Golomb codes, Rice codes, Tunstall codes, Applications of Hoffman coding: Loss less image compression, Text compression, Audio Compression.	5	
III	Arithmetic Coding Coding a sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression-The JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary:	10	25%

	Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression- UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits, Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPE SYMBOL, length of context, The Exclusion Principle, The Burrows- Wheeler Transform: Move-to-front coding, CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression.		
IV	Mathematical Preliminaries for Lossy Coding Distortion criteria, Models, Scalar Ouantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization. Vector Quantization Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree structured Vector Quantizers. Structured Vector Quantizers.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 21 3	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:

- Hastie, Trevor, The elements of statistical learning, Springer 2009

REFERENCES:

- 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 Analysis- Quadratic Discriminant Analysis- Regression and Classification Trees- Support Vector Machines- Ensemble Methods: Random Forest- Neural Networks- Deep learning	**10**	**25%**
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 3	ADVANCED SOFTWARE TESTING	3-0-0-3	2015

PREREQUISITES:

- Software Engineering

COURSE OBJECTIVES:

- Understand the need of testing and how it contributes to improve software quality.
- Understand the established testing concepts, the fundamental test process, test approaches, and principles to support test objectives.
- Be familiar with different types of testing tools, their uses and the issues and challenges in test automation.

SYLLABUS:

Fundamentals of Testing - Approaches to Testing - Test Management - Testing tools

EXPECTED OUTCOME:

Graduates will:

- have the knowledge on the different types of software testing and the general principles of testing.
- have the knowledge on how the test process is planned and managed.
- have the knowledge on the essential characteristics of tools used for test automation and the issues and challenges in automating tests.
- be able to effectively participate in reviews of small projects by using the principles of research ethics.
- be able to design and prioritize tests by using established techniques; analyze both functional and non-functional specifications at all test levels for systems with a low complexity.
- be able to analyze different approaches to software testing and select optimal solutions based on the situations.

TEXT BOOK:

1. Software Testing Foundations, Andreas Spillner, Tilo Linz, Hans Schaefer, Shoff Publishers and Distributors
2. Software Testing: Principles and Practices by Srinivasan D and Gopalswamy R, PearsonEd, 2006
3. Software Testing: An ISTQB-ISEB Foundation Guide, Brian Hambling, Peter Morgan, Angelina Samaroo, Geoff Thompson and Peter Williams, British Informatics Society Limited, 2010
4. Foundations of Software Testing by Aditya P. Mathur – Pearson Education custom edition 2000
5. Testing Object Oriented Systems: models, patterns and tools, Robert V Binder, Addison Wesley, 1996
6. Software Engineering – A practitioner's approach by Roger S. Pressman, 5th Edition, McGraw Hill
7. The art of software testing by GJ Myers, Wiley.

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem Exam Marks**
I	**Fundamentals of Testing:** Role of Testing in SDLC, Testing and Debugging, Software Quality, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, Test Metrics. Review of software development models (Waterfall Models, Spiral Model, W Model, V Model) Agile Methodology and Its Impact on testing, Test Levels (Unit, Component, Module, Integration, System, Acceptance, Generic)	**10**	**25%**
II	**Approaches to Testing:** Static Testing Structured Group Examinations Static Analysis Control flow & Data flow, Determining Metrics Dynamic Testing Black Box Testing Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing and Decision Table Technique and Used Case Testing and Advanced black box techniques White Box Testing Statement Coverage, Branch Coverage, Test of Conditions, Path Coverage, Advanced White Box Techniques, Instrumentation and Tool Support Gray Box Testing, Intuitive and Experience Based Testing	**10**	**25%**
III	**Test Management:** Test Organization Test teams, tasks and Qualifications Test Planning Quality Assurance Plan, Test Plan, Prioritization Plan, Test Exit Criteria Cost and economy Aspects Test Strategies Preventive versus Reactive Approach, Analytical versus heuristic Approach Test Activity Management, Incident Management, Configuration Management Test Progress Monitoring and Control Specialized Testing: Performance, Load, Stress & Security Testing	**10**	**25%**
IV	**Testing tools:** Automation of Test Execution, Requirement tracker, High Level Review Types of test Tools, Tools for test management and Control, Test Specification, Static Testing, Dynamic Testing, Non functional testing Selection and Introduction of Test Tools Tool Selection and Introduction, Cost Effectiveness of Tool Introduction	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 41 3	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 3	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 12 3	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 3	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 information attention – linear influence model – Rich interactions	**10 Hrs**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 32 3	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** 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	**14 Hrs**	**25%**
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 3	REAL TIME SYSTEMS	3-0-0-3	2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

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SYLLABUS:

Issues in Real Time Computing, Programming Languages And Tools, Real Time Databases, Communication, Evaluation Techniques

EXPECTED OUTCOME:

- Explain the issues related to the design and analysis of systems with real-time constraints.
- Describe the foundation for programming languages developed for real time programming

TEXT BOOK:

1. C.M. Krishna, Kang G. Shin, "Real-Time Systems", McGraw-Hill International Editions, 1997

REFERENCES:

1. Stuart Bennett, "Real Time Computer Control-An Introduction",Second edition , Perntice Hall PTR, 1994.
2. Peter D. Lawrence, "Real time Micro Computer System Design – An Introduction", McGraw Hill, 1988.
3. S.T. Allworth and R.N. Zobel, "Introduction to real time software design", Macmillan, II Edition, 1987.
4. R.J.A Buhur, D.L. Bailey, "An Introduction to Real-Time Systems", Prentice-Hall International, 1999.
5. Philip.A.Laplante "Real Time System Design and Analysis" PHI, III Edition, April 2004.

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**INTRODUCTION** - Issues in Real Time Computing, Structure of a Real Time System. Task Classes, Performance Measures for Real Time Systems, Estimating Program Run times. Task Assignment and Scheduling - Classical Uniprocessor scheduling algorithms, UniProcessor scheduling of IRIS Tasks, Task Assignment, Mode Changes, and Fault Tolerant Scheduling	**10**	**25%**
II	**PROGRAMMING LANGUAGES AND TOOLS** – Desired Language characteristics, Data Typing, Control structures, Facilitating Hierarchical Decomposition, Packages, Run-time (Exception) Error handling, Overloading and Generics, Multitasking, Low Level programming, Task scheduling, Timing Specifications, Programming Environments, Run-time Support.	**10**	**25%**
III	**REAL TIME DATABASES** - Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency Control	**10**	**25%**

	Issues, Disk Scheduling Algorithms, Two-phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time systems.		
IV	**COMMUNICATION** - Real-Time Communication - Communications Media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques - Fault Types, Fault Detection. Fault Error containment Redundancy, Data Diversity, Reversal Checks, Integrated Failure handling. **EVALUATION TECHNIQUES** - Reliability Evaluation Techniques - Obtaining Parameter Values, Reliability Models for Hardware Redundancy, Software Error models. Impact of Faults, Fault Tolerant Synchronization in Hardware, Fault Tolerant Synchronization in Software	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 52 3	ADVANCED INFORMATION SECURITY CONCEPTS	3-0-0-3	2015

PREREQUISITES: Basics of Programming and computer security

COURSE OBJECTIVES:

- To learn different secure coding practises
- To learn ethical hacking practises
- To learn web, cloud and biometric security concepts

SYLLABUS:
Secure Coding, Etihcal Hacking, Web application and Cloud security, Biometric Security.

EXPECTED OUTCOME:
Students will be able to:

- Apply secure coding practises
- Apply ethical hacking practises
- Demonstrate Web, Cloud and Biometric security practises

REFERENCES:

1. Howard, LeBlanc, and Viega, "24 Deadly Sins of Software Security", ISBN: 978-0-07-162675-0.
2. CEH: Certified Ethical Hacker Study Guide, Kimberly Graves, SERIOUS SKILLS.
3. D. Stuttard and M. Pinto, "The Web Application Hacker's Handbook", Wiley, 2008
4. Biometrics and Network Security, Paul Reid, Prentice Hal, ISBN 9788131716007
5. Ronald L. Krutz, Russell Dean Vines, Cloud Security, Wiley publication 2010

COURSE PLAN

Module	Contents	Hours	Sem Exam Marks
I	**Secure Coding:** Buffer Overrun, Format String Problems, Integer Overflow, and Software Security Fundamentals, SQL Injection, Command Injection, Cross Site Scripting, Magic URLs, Weak Passwords, Information Leakage, Race Conditions.	**10**	**25%**
II	**Ethical Hacking:** Hacking Fundamentals, Reconnaissance, Scanning and Enumeration, Sniffers, ARP poisoning and MAC Flooding, Denial of Service, Session Hijacking, Social Engineering Web server-working, vulnerability and attack, Web Application Penetration Testing, Structure of Penetration Testing, reverse engineering (using debuggers such ollydbg or immunity debugger),	**10**	**25%**

	Digital Forensics (different approaches basic idea)		
FIRST INTERNAL EXAM			
III	**Web application and Cloud Security:** Web Application Technologies-HTTP protocol, Attacking, Session Management- Weaknesses in Session Token Generation, Weaknesses in Session Token Handling, Securing Session Management, Attacking Access Controls-vulnerabilities, attacks and countermeasures, Attacking Application Logic- Fooling a Password Change Function, Abusing a Search Function, Cloud architecture model – Cloud delivery model, SPI framework, SaaS, PaaS, Iaas, Deployment models –Public, community, Private, Hybrid Cloud, Cloud security design principles, Secure cloud software requirements, Secure development practice, Virtualization security Management- virtual threats, VM security recommendations, VM security techniques – hardening, securing VM remote access	**10**	**25%**
IV	**Biometric Security:** Biometric Security: The Need for Strong Authentication. The role of Strong Authentication with Single Sign-On (SSO), Biometric Technologies: Finger-representation of finger image, types of algorithms for interpretation, Face- representation of face image, types of algorithms for interpretation, Voice- voice capturing, types of algorithms for interpretation, Iris- capturing iris image, types of algorithms for interpretation, general spoofing techniques.	**10**	**25%**

Course No.	Course Name	L-T-P-Credits	Year of Introduction
06 CS 7 03 3	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 3	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 4	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