KERALA TECHNOLOGICAL UNIVERSITY

SCHEME AND SYLLABUS

FOR

M. Tech. DEGREE PROGRAMME

IN

COMPUTER SCIENCE AND ENGINEERING

WITH SPECIALIZATION

COMPUTER SCIENCE AND ENGINEERING

CLUSTER 05 (ERNAKULAM II)

KERALA TECHNOLOGICAL UNIVERSITY

CET Campus, Thiruvananthapuram

Kerala, India -695016

(2015 ADMISSION ONWARDS)

KERALA TECHNOLOGICAL UNIVERSITY

SCHEME AND SYLLABUS FOR M. Tech. DEGREE PROGRAMME

Branch: COMPUTER SCIENCE AND ENGINEERING

Specialization: COMPUTER SCIENCE AND ENGINEERING

SEMESTER I

Exam Slot	***Course No***	***Subjects***	**L-T-P**	**Internal Marks**	**End Semester Exam**		**Credits**
					Marks	Duration (hrs)	
A	05CS 6001	Computational Intelligence	3-1-0	40	60	3	4
B	05CS 6003	Advanced Data Structures and Algorithms	3-1-0	40	60	3	4
C	05CS 6005	Data Mining and Warehousing	3-1-0	40	60	3	4
D	05CS 6007	Object Oriented Software Engineering	2-1-0	40	60	3	3
E	05CS 601x	Elective I	2-1-0	40	60	3	3
	05CS 6077	Research Methodology	1-1-0	100	0	0	2
	05CS 6091	CASE Lab	0-0-2	100	0	0	1
							21

Elective – I	
Course No	**Subjects**
05CS 6011	Web Security
05CS 6013	Digital Image processing
05CS 6015	Natural Language Processing

SEMESTER – II

Exam Slot	*Course No*	*Subjects*	*L-T-P*	*Internal Marks*	*End Semester Exam*		*Credits*
					Marks	Duration (hrs)	
A	05CS 6002	Modern Databases	3-1-0	40	60	3	4
B	05CS 6004	Advanced Computer Networks	2-1-0	40	60	3	3
C	05CS 6006	Operating System Design Concepts	2-1-0	40	60	3	3
D	05CS 602x	Elective II	2-1-0	40	60	3	3
E	05CS 603x	Elective III	2-1-0	40	60	3	3
	05CS 6066	Seminar I	0-0-2	100	0	0	2
	05CS 6088	Mini project	0-0-4	100	0	0	2
	05CS 6092	Network Systems Lab	0-0-2	100	0	0	1
							21

Elective – II	
Course No	**Subjects**
05CS 6022	Real Time Systems
05CS 6024	Bio Computing
05CS 6026	Advanced Computer Architecture

Elective – III	
Course No	**Subjects**
05CS 6032	Social Network Analytics
05CS 6034	Embedded Systems
05CS 6036	Cyber Forensics

SEMESTER – III

Exam Slot	*Course No*	*Subjects*	*L-T-P*	*Internal Marks*	*End Semester Exam*		*Credits*
					Marks	Duration(hrs)	
A	05CS 704x	Elective IV	2-1-0	40	60	3	3
B	05CS 705x	Elective V	2-1-0	40	60	3	3
	05CS 7067	Seminar II	0-0-2	100	0	0	2
	05CS 7087	Project (Phase1)	0-0-8	50	0	0	6
							14

Elective – IV	
Course No	**Subjects**
05CS 7041	Big data Processing
05CS 7043	Cloud Computing
05CS 7045	Ontological Engineering

Elective – V	
Course No	**Subjects**
05CS 7051	Web Services
05CS 7053	Information Retrieval
05CS 7055	Distributed Algorithms

SEMESTER – IV

Exam Slot	*Course No*	*Subjects*	*L-T-P*	*Internal Marks*	*End Semester Exam*		*Credits*
					Marks	Duration(hrs)	
	05CS 7088	Project (Phase 2)	0-0-21	70	30	-	12
							12
						Total	68

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6001	COMPUTATIONAL INTELLIGENCE	3-1-0-4	2015

COURSE OBJECTIVES:

- Gain basic understanding of intelligent systems.
- Introduce students to the concepts of fuzzy systems, artificial neural networks, genetic algorithms, support vector machines, swarm intelligence.
- Foster the abilities in designing and implementing intelligent solutions for real-world and engineering problems.
- Learn the working principles of expert systems.

COURSE OUTCOMES:

- Ability to formulate intelligent solutions.
- Basic knowledge and awareness about application of fuzzy systems, artificial neural networks, genetic algorithms, support vector machines, swarm intelligence and expert systems.
- Ability to use and develop computational intelligence techniques in solving real world problems.

MODULE	COURSE CONTENT (56 hrs)	HRS
I	Fuzzy systems: Fuzzy Sets, Membership Functions, Linguistic Variables, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Logic, Fuzzy Reasoning, GMP and GMT, Fuzzy Inference Systems- Defuzzification methods, Fuzzy Controllers-Mamdani and Larsen Models.	15
INTERNAL TEST 1(Module 1)		
II	Artificial Neural Networks: Introduction, Artificial Neurons, Perceptron, Multilayer Perceptron, Back Propagation Algorithm, Competitive Networks, Recurrent Networks, ANFIS, ART Networks.	14
INTERNAL TEST 2(Module 2)		
III	Genetic Algorithms: Introduction, theoretical foundation of genetic algorithm, Multi-objective Genetic Algorithms. Support vector classification–linearly separable and nonlinearly separable – support vector regression -Use of Linear and Polynomial Kernels.	15
IV	Swarm intelligent systems: Introduction, ant colony systems, types of ant colony systems, working of ant colony systems, particle swarm optimization. Expert Systems: Introduction, stages in the development of an expert system.	12

	Implementation: A micro project based on any one of the above technologies should be implemented and evaluated**.**	

END SEMESTER EXAM (ALL Modules)

REFERENCES:

1. Samir Roy, Udit Chakraborty, Introduction to Soft Computing Neuro- Fuzzy Genetic Algorithms, Pearson, 2013.
2. N.P. Padhy, Artificial Intelligence and Intelligent systems, Oxford Press, New Delhi, 2005.
3. Gareth James,Daniela Witlen,Trevor Hastie,Robert Tibshirani, An Introduction to statistical learning with Applications in R,Springer,NewYork, 2013.
4. Hung T. Nguyen,Elbert A. Walker,A First Course in Fuzzy Logic,2nd Edn,CRC Press, 1999.
5. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, 1997.
6. K. Vinoth Kumar, Fundamentals of Soft Computing, S.K Kataria & Sons, 2nd Edn, 2012.
7. Sushil Kumar Singh, Soft Computing (Neural Networks, Fuzzy Logic and Genetic Algorithms), Galgotia, 2012.
8. Satish Kumar, Neural Networks, A Classroom Approach, MC Graw Hill Education pvt ltd., second edition, 2012.
9. Simon O Hayken, Neural Networks: A Comprehensive Foundation (International Edition), Mac Millan Publishing Company, 1994.
10. Yegnanarayana B, Artificial Neural Networks, PHI,2009.
11. David E. Goldberg, Genetic algorithms in search, optimization & Machine Learning, PearsonEducation, 2005.
12. Jang J.S.R., Sun C.T. and Mizutani E, Neuro-Fuzzy and Soft computing, Pearson Education 2003.
13. Soman K.P, Loganathan R, Ajay V, Machine Learning with SVM and Other Kernel Methods , PHI, First Edition, 2009.
14. Sudheep Elayidom.M, Data mining and warehousing, Cengage learning, ISBN: 978-81-315-2586-9, 2015.
15. Wu, Shih-Hung (Ph.D), Dept. of CSIE, CYUT, Support Vector Machines: http://www.csie.cyut.edu.tw/~shwu/PR_slide/SVM.pdf
16. Huang Xiao, Linear Regression and LibSVM in Matlab Anomaly Detection Challenges SS'14, Chair of IT Security (I20), Department of Informatics, Technische Universit¨at M¨unchen, May 5th 2014:http://ml.sec.in.tum.de/adcg/downloads/libsvm_intro.pdf
17. Web Services and Support Vector Machines http://scholarworks.sjsu.edu/cgi/viewcontent.cgiarticle=1312&context=etd_projects
18. Dhruv Jalota, Support Vector Machines(SVM) Introductory Overview http://www.statsoft.com/Textbook/Support-Vector-Machines
19. Chih-Wei Hsu, Chih-Chung Chang, and Chih-Jen Lin, A Practical Guide to Support Vector Classification, Department of Computer Science, National Taiwan University, Taipei 106, Taiwan: http://www.csie.ntu.edu.tw/~cjlin/papers/guide/guide.pdf

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6003	ADVANCED DATA STRUCTURES AND ALGORITHMS	3-1-0-4	2015

COURSE OBJECTIVES:

- Familiarize advanced data structures based trees and heaps.
- Learn to choose the appropriate data structure and algorithm design method for a specified application.
- Study approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.
- Learn different advanced algorithms in dynamic programming, flow network and computational geometry.

COURSE OUTCOMES:

- Be able to compare different implementations of data structures and to recognize the advantages and disadvantages of the different implementations.
- Be able to design, write, and analyze the performance of programs that handle structured data and perform more complex tasks, typical of larger software projects.
- Ability to determine which algorithm or data structure to use in different scenarios.
- Be able to demonstrate analytical comprehension of concepts such as abstract data, algorithms and efficiency analysis.

MODULE	COURSE CONTENT (56 hrs)	HRS
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-Patricia, Multiway Tries.	14
	INTERNAL TEST 1 (Module 1)	
II	Priority Queues - Single and Double Ended Priority Queues, Leftist Trees, Binomial Heaps, Fibonacci Heaps, Pairing Heaps, Symmetric Min-Max Heaps, Interval Heaps.	14
	INTERNAL TEST 2 (Module 2)	
III	Analysis of Algorithms-review of algorithmic strategies, asymptotic analysis, solving recurrence relations through Substitution Method, Recursion Tree, and Master Method. Dynamic Programming-Rod cutting-top down and bottom up approach, matrix chain multiplication-recursive solution, longest common subsequence problem.	14
IV	Maximum Flow-Flow Networks, Ford-Fulkerson method-analysis of Ford-Fulkerson, Edmonds-Karp algorithm, Maximum bipartite matching. Computational Geometry- Line segment properties, finding the convex hull, finding the closest pair of points.	14

	Implementation: Implementations using Python/Java have to be conducted and evaluated for data structures and algorithms.	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008.
2. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Data Structures using C and C++, Second Edition, PHI Learning Private Limited, 2010.
3. Thomas Cormen, Charles, Ronald Rives, Introduction to algorithm,3rd edition, PHI Learning, 2009.
4. Ellis Horowitz and Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms,Universities Press, 2nd Edition, Hyderabad,2008 .
5. Sara Baase & Allen Van Gelder , Computer Algorithms – Introduction to Design and Analysis, Pearson Education, 1999.
6. Anany Levitin, Introduction to The Design & Analysis of Algorithms, Pearson Education, 2nd Edition, New Delhi, 2008.
7. Berman and Paul, Algorithms, Cenage Learning India Edition, New Delhi, 2008.
8. S.K.Basu, Design Methods And Analysis Of Algorithms ,PHI Learning Private Limited, New Delhi,2008.
9. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, NewDelhi, 2005.
10. Hari Mohan Pandey, Design Analysis And Algorithms, University Science Press, 2008.
11. R. Panneerselvam, Design and Analysis of Algorithms, PHI Learning Private Limited, New Delhi, 2009.
12. Udit Agarwal, Algorithms Design And Analysis, Dhanapat Rai & Co, New Delhi, 2009.
13. Aho, Hopcroft and ullman, The Design And Analysis of Computer Algorithms, Pearson Education, New Delhi, 2007.
14. S.E.Goodman and S. T. Hedetmiemi, Introduction To The Design And Analysis Of Algorithms, McGraw-Hill International Editions, Singapore, 2000.
15. Richard Neapolitan, Kumarss N, Foundations of Algorithms, DC Hearth &company, 2014.
16. Sanjay Dasgupta, Christos Papadimitriou, Umesh Vazirani, Algorithms, Tata McGraw-Hill Edition, 2006.
17. Alfred V. Aho,John E. Hopcroft,Jeffrey D. Ullman, Data Structures & Algorithms, Pearson Education,1st edition,1983.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6005	DATA MINING AND WAREHOUSING	3-1-0-4	2015

COURSE OBJECTIVES:

- To understand the concepts, principles, techniques, and applications of data mining to make intelligent use of the information repositories.
- To examine methods to recognize patterns and making predictions from an applications perspective.

COURSE OUTCOMES:

- Be able to comprehend appropriate mining techniques to extract hidden patterns and rules in large databases.
- Ability to determine an appropriate mining strategy for a large dataset.
- Efficiently utilize data warehouses and OLAP for data mining and knowledge discovery activities.
- Gain knowledge of current data mining applications.

MODULE	COURSE CONTENT (56 hrs)	HRS
I	Data Mining: - Tasks and Functionalities–Attribute types-Preprocessing – Similarity and Dissimilarity measures. Association Rule Mining**:** - Efficient and Scalable Frequent Item set Mining Methods - Mining Various Kinds of Association Rules - Correlation Analysis – Mining in Multidimensional space.	14
	INTERNAL TEST 1 (Module 1)	
II	Classification and Prediction:- Issues - Decision Tree Induction - Bayesian Classification – Model Evaluation-Classifier Performance. Advanced Classification**:-** Associative Classification - Lazy Learners.	14
	INTERNAL TEST 2 (Module 2)	
III	Data Warehousing and Business Analysis: Data warehousing Components -Mapping the Data Warehouse to a Multiprocessor Architecture - Metadata –OLTP and OLAP. Cluster Analysis: Requirements-Overview-Partitioning methods-Agglomerative versus Divisive-BIRCH-DBSCAN-CLIQUE.	14
IV	Outlier Analysis:-Statistical approaches-Proximity based approaches-Clustering and Classification based approaches.	14
	Implementation: Implement any of the classification and clustering algorithms using an appropriate data mining tool.	
	END SEMESTER EXAM (ALL Modules)	

REFERENCES:

1. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Third edition, Elsevier, Reprinted 2008.

2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2007.
3. Sudheep Elayidom.M, Data mining and warehousing, Cengage learning, ISBN: 978-81-315-2586-9, 2015.
4. K.P. Soman, Shyam Diwakar and V. Ajay, Insight into Data mining Theory and Practice, Easter Economy Edition, Prentice Hall of India, 2005.
5. G. K. Gupta, Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2005.
6. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw - Hill Edition, Tenth Reprint 2007.
7. Yanchang Zhao, R and Data Mining, Elsevier, 2012.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6007	OBJECT ORIENTED SOFTWARE ENGINEERING	2-1-0-3	2015

COURSE OBJECTIVES:

- To understand the concepts and principles of object oriented software engineering from analysis through testing.
- To impart ideas on building systems through the object oriented modeling approach using the Unified Modeling Language.
- Point out the importance and functions of each UML Model and explain the notation of various elements in these models.

COURSE OUTCOMES:

- Able to understand the fundamental principles underlying object oriented software engineering.
- Capable of recognizing the role and function of each UML model in developing Object Oriented Software.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Software Engineering Concepts – Project Organization – Communication- Software life cycle models – Iterative and Incremental, Code-and-Fix, Waterfall, Spiral, Rapid-Prototyping, Open-Source, Synchronize-and-Stabilize, Agile Processes - Unified Process- Workflow - Project Planning & Estimation.	11
	INTERNAL TEST 1 (Module 1)	
II	Requirements Elicitation – Requirement Documentation-Use Cases- Unified Modeling language- Introduction, UML Diagrams – Class diagrams, Sequence diagrams, Object diagrams, Deployment diagrams, Use case diagrams, State diagrams, Activity diagram, Component diagrams.	11
	INTERNAL TEST 2 (Module 2)	
III	Analysis Object Model (Domain Model) – Analysis Dynamic Models- Non-functional requirements – Analysis Patterns. System Design Architecture – Design Principles – Design Concepts -Design Patterns – Architectural Styles-Dynamic Object Modeling – Static Object Modeling – Interface Specification – Object Constraint Language.	10
IV	Mapping Design (Models) to Code – Model Transformation- Refactoring- Mapping Associations- Mapping Activities- Testing- Configuration Management – Maintenance process- System documentation.	10
	Case Study: Analysis and design of an application (ATM, Library Management System etc) using any CASE Tools.	
	END SEMESTER EXAM (ALL Modules)	

REFERENCES:

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.
3. Stephen Schach, Software Engineering, Seventh edition, McGraw-Hill, 2007.
4. Ivar Jacobson, Grandy Booch, James Rumbaugh, The Unified Software Development Process, Pearson Education, 1999.
5. Alistair Cockburn, Agile Software Development, Second edition, Pearson Education, 2007.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6011	WEB SECURITY	2-1-0-3	2015

COURSE OBJECTIVES:

- To study and practice fundamental techniques in developing secure web based applications, including vulnerability of web based applications and how to protect those applications from attacks.
- Understand security-related issues in Web-based systems and applications.
- Understand the fundamental security components of a computer system.

COURSE OUTCOMES:

- Be able to evaluate a Web-based system with respect to its security requirements.
- Understand the process of developing secure networked systems.
- Understand the fundamental mechanisms of securing a Web-based system.
- Be able to implement security mechanisms to secure a Web-server.
- Understand security issues and common controls in Cloud Security.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Application Level security- Key Problem factors – Core defence mechanisms- Web Application Technologies – HTTP Protocol- Web Functionality- Encoding schemes- web spidering – User Directed spidering- Discovering hidden content. Bypassing Client-Side Controls – Hidden form fields – HTTP cookies – URL parameters – Handling client-side data securely – Attacking authentication – design flaws in authentication mechanisms –securing authentication. Attacking Users: Other Techniques – Client-Side Injection Attacks – Local Privacy Attacks.	11
	INTERNAL TEST 1 (Module 1)	
II	SQL Injection: Attacks and Defence – Introduction: SQL Injection- How it happens - Dynamic string building - Insecure Database Configuration - finding SQL injection – Exploiting SQL injection – Common techniques – identifying the database – Non-Blind fingerprint – UNION statements – Preventing SQL injection. Platform level defences - Using run time protection - web application Firewalls - Using ModSecurity - Intercepting filters- Web server filters - application filters – AOP, IDSs- securing the database – Locking down the application data – Locking down the Database server.	11
	INTERNAL TEST 2 (Module 2)	
III	Mod Security –Virtual Patching- Creating a Virtual Patch- Blocking common attacks – HTTP finger printing– Blocking proxied requests – Cross-site scripting–Cross-site request forgeries – Shell command execution attempts – Null byte attacks – Blog spam – Website defacement – Chroot Jails-ModSecurity to create a Chroot Jail-REMO– rules-Protecting a Web Application.	10

IV	Web server Hacking–Footprinting-Internet Footprinting-Source code disclosure– Canonicalization attacks–DoS – Web application hacking – Web crawling- Database Hacking. Cloud Security–Service Models-IaaS-PaaS-SaaS-Cloud Security Services-Secure Cloud Software Testing-Cloud Penetration Testing.	10
	Case study: Develop a web application and conduct security audit to secure the application- Use any open source Web scanners (Web Scarab, Wapiti, W3af etc.)	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Dafydd Stuttard, Marcus Pinto, The Web Application Hacker's Handbook, 2nd Edition, Wiley Publishing, Inc, 2011.
2. Justin Clarke, SQL Injection Attacks and Defense, Syngress Publication Inc, 2009.
3. Magnus Mischel , ModSecurity 2.5, Packt Publishing, 2009.
4. Stuart McClure Joel, ScambRay, George Kurtz, Hacking Exposed7: Network Security Secrets & Solutions, Seventh Edition, The McGraw-Hill Companies, 2012.
5. Ronald L. Krutz and Russell Dean Vines Cloud Security- A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing, Inc, 2010.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6013	DIGITAL IMAGE PROCESSING	2-1-0-3	2015

COURSE OBJECTIVES:

- To develop a theoretical foundation of fundamental Digital Image Processing concepts.
- To provide mathematical foundations for digital manipulation of images: image acquisition, image enhancement and restoration, Fourier domain processing, compression, segmentation, and representation.
- To gain practical experience to write programs using software tools for digital manipulation of images.

COURSE OUTCOMES:

- Have a clear understanding of the principles of Digital Image Processing terminology used to describe features of images.
- Have a good understanding of the mathematical foundations for digital manipulation of images.
- Be able to use different digital image processing algorithms.
- Be able to design code and test digital image processing applications.
- Ability to recognize a wide range of problems and provide solutions related to the design of image processing systems through suitable algorithms, structures, diagrams, and other appropriate methods.

MODULE	COURSE CONTENT (42hrs)	HRS
I	Introduction to Digital Image Processing, fundamental steps in Digital Image Processing, elements of visual perception, image sensing and acquisition, sampling and quantisation, relationship between pixels, intensity transformations and spatial filtering: basic intensity transformation functions, histogram processing, spatial filtering, smoothing and sharpening filters.	11
INTERNAL TEST 1 (Module 1)		
II	Filtering in frequency domain: preliminary concepts, Fourier transform of sampled functions, Discrete Fourier Transform of one and two variables, Fast Fourier Transform, filtering in the frequency domain: smoothing and sharpening filters, Image restoration: noise models, restoration in the presence of noise only, periodic noise reduction.	11
INTERNAL TEST 2 (Module 2)		
III	Wavelets and multiresolution processing: Image pyramids, subband coding, the Haar transform, multiresolution expansions, wavelet transform in one and two dimensions, fast wavelet transform, wavelet packets. Image compression: fundamentals, compression models and standards, basic compression methods: Huffman coding, Golomb coding, arithmetic coding, LZW coding, run-length coding, wavelet coding.	10

IV	Image segmentation: point, line and edge detection, thresholding, region based segmentation, representation, boundary descriptors, regional descriptors.	10
	Implementation: The students should implement some of the techniques learned in the course with the help of a suitable digital image processing software tool and experiment with different options and choice of parameters.	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Gonzalez R. C. & Woods R. E., Digital Image Processing, 3rd ed, PHI Learning, 2008.
2. Sonka M, Vaclav Hlavac, and Roger Boyle, Image Processing, Analysis and Machine Vision, Brooks Cole, 3rd ed, 2008.
3. Jain A K, Fundamentals of Digital Image Processing, Prentice-Hall India, 2007.
4. Gonzalez R. C., Woods R. E. & Eddins S. L., Digital Image Processing Using MATLAB,Pearson Education India, 2004.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6015	NATURAL LANGUAGE PROCESSING	2-1-0-3	2015

COURSE OBJECTIVES:

- Make aware of different NLP Tasks.
- Familiarize the tools and techniques for NLP Tasks.
- Students get motivated to do something for mother tongue language.

COURSE OUTCOMES:

- Will be confident to do research in the area of NLP.
- Identify the scopes of NLP in Malayalam Language.
- How to write Programs in Python/Java to process the language.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Introduction to NLP: Communication-syntax, semantic and pragmatics-ambiguity-Natural Language Tasks-Syntactic tasks (word segmentation, morphological analysis, POS Tagging, Phrase chunking, syntactic parsing), Semantic tasks (WSD, Semantic Role Labeling, Semantic Parsing, Text entailment), Pragmatics/Discourse Tasks (Anaphora resolution/Co-Reference, Ellipsis Resolution).	11
INTERNAL TEST 1 (Module 1)		
II	N-gram Language Models - The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Part Of Speech Tagging and Sequence Labeling - Lexical syntax. Hidden Markov Models. Maximum Entropy Models, Conditional Random Fields.	11
INTERNAL TEST 2 (Module 2)		
III	Syntactic parsing -Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs), Statistical parsing. Semantics and Pragmatics- Lexical semantics, Computational Lexical Semantics, Computational Discourse	10
IV	Lexical Knowledge Networks, Wordnet Theory, Indian Language Wordnets and Multilingual Dictionaries, challenges in Malayalam computing. Applications of NLP: Information Extraction, Question Answering and Summarization, Machine Translation. Natural Language Processing with Python-Accessing Text corpora and Lexical resources, learning to classify texts.	10
	Case Study: Works in Malayalam Language may be entertained using Python/Java platform.	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
3. S. Bird, E. Klein, E. Loper, Natural Language Processing with Python. Sebastopol, CA: O'Reilly Media, 2009.
4. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6077	RESEARCH METHODOLOGY	1-1-0-2	2015

COURSE OBJECTIVES:

- Aware of the research process.
- Familiarize the tools and skills to investigate a research.
- Preparation of an effective report.

COURSE OUTCOMES:

- Able to do research in a systematic way.
- Effective use of appropriate tools for samples and data collection.
- Write research proposals and reports.

MODULE	COURSE CONTENT (28 hrs)	HRS
I	Introduction- Tools for Planning Research, Finding resources, internet research skills, Evaluating and citing resources, publishing research-literature review– problem definition. Reproducible research-focus on the concepts and tools behind reporting modern data analyses in a reproducible manner. (Students are expected set up a GitHub/Kaggle account and/or take part in collaborative projects such as Mozilla Science Lab, Linux Foundation, Wikis, Technical blogging, Crowd Sourcing)	7
II	Sampling fundamentals- Types of sampling: probability and non-probability sampling. Sampling theory, sampling distribution and sample size determination. Tools and techniques of data collection: Questionnaire and schedule for field surveys, interview, observation, simulation, experimental and case study methods. Collection, recording, editing, coding and scaling of data. Scale classification and types. Measurement of validity, reliability and practicality.	7
III	Descriptive and inferential statistics - Data analysis and interpretation – testing of hypothesis, testing of population mean, variance and proportion –Z test – t test – F test - chi square test.– standard error of the estimate. Testing goodness of fit. Brief introduction to non parametric tests, factor analysis, discriminant analysis and path analysis (description only).	7
IV	Meaning of interpretation and inference: importance and care for interpreting results. Presentation of reports: structure and style. Parts of a research report. Guidelines for writing research papers and reports – Ethics in research. Familiarization with Online tools for computer science researchers	7

	Case Study: Familiarize Latex software for report preparation. Students have to take up a case study on particular samples and conclude with some hypothesis. A report of the same has to be submitted by the student at the end of this course.	

REFERENCES:

1. C. R. Kothari, Research Methodology, Methods and techniques, New Age International Publishers, New Delhi, 2004.
2. R. Panneerselvam, Research Methodology, Prentice Hall of India, New Delhi, 2011.
3. Ranjit Kumar, Research Methodology, A step by step approach, Pearson Publishers, New Delhi, 2005.
4. K. N. Krishnaswami, Appa Iyer and M Mathirajan, Management Research Methodology, Pearson Education, Delhi, 2010
5. M N Borse, Hand Book of Research Methodology, Shree Niwas Publications, Jaipur, 2004.
6. William G Zikmund, Business Research Methods,South – Western Ltd, 2003.
7. P K Majumdar, Research Methods in Social Science, Viva Books Pvt Ltd, New Delhi, 2005.
8. Norman Blaikie, Analyzing Quantitative Data, SAGE Publications, London, 2003.

WEB REFERENCES:

Module I

http://help.library.ubc.ca/evaluating-and-citing-sources/evaluating-information-sources/
http://www.vtstutorials.ac.uk/detective/
http://connectedresearchers.com/online-tools-for-researchers/
https://www.ucl.ac.uk/isd/services/research-it/research-software/infrastructure/github/signup
https://www.kaggle.com
https://www.mozillascience.org/training
https://www.ucl.ac.uk/isd/services/research-it
http://researchkit.org/
https://www.cs.ubc.ca/our-department/facilities/reading-room/research-publications/research-tools

Module IV

http://www.i-studentglobal.com/study-programmes/science-engineering-computing-technology/50-essential-online-tools-for-every-computer-science-student

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6091	COMPUTER AIDED SOFTWARE ENGINEERING LAB	0-0-2-1	2015

1. System Requirement Specification (SRS) and related analysis documents as per the guidelines in ANSI/IEEE Std 830-1984.
2. Design documents representing the complete design of the software system.
3. Analysis and design for the same problem should be done using Object Oriented approach.
4. Test documents as per ANSI/IEEE Std. 829/1983 Software Test Documentation.
5. Simple exercises in effort and cost estimation in COCOMO model.
6. Application of COCOMO and Function Point (FP) model for the actual project that has been chosen.
7. Familiarization of UML diagrams.
8. Familiarization of CASE workbenches.
9. Familiarization of some reverse engineering tools available in the public domain.

At the end of the semester, there should be a presentation of the project with demonstration. It is also advisable for the students to present the documents associated with the projects.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6002	MODERN DATABASES	3-1-0-4	2015

COURSE OBJECTIVES:

- Provide an exposure to modern data requirements and their usage.
- Familiarize different techniques and tools for modern data management.
- Provide a basic understanding of advanced concepts and research directions in the field of databases.
- Provide an insight into the implementation aspects of modern databases.
- Introduce data models and systems used for semi structured data, distributed data, spatial data, multimedia data, mobile data and big data.

COURSE OUTCOMES:

- Familiarity with the support for distributed data, multimedia data, spatial data, semi structured data and big data.
- Demonstrate basic knowledge and awareness about various modern database architectures.
- Ability to apply modern database tools and techniques in real environment.

MODULE	COURSE CONTENT (56 hrs)	HRS
I	Modern trends in databases: In - memory databases – VoltDB - Embedded Databases – SQLite internal architecture and data types , Semi - structured data management with XML, DTD – Drawbacks - XML Schema, Querying XML documents with XPath and XQuery - FLWOR expression - JSON format - Examples - BSON format.	12
	INTERNAL TEST 1 (Module 1)	
II	Advanced databases: Spatial Data Management: Types Of Spatial Data And Queries- Point and Region Data-Queries-Spatial Indexes-indexing using Space Filling Curves- Z ordering- Hilbert's curve-Region Quad Trees with Z Ordering – Index Structures - Grid Files, R-Trees. Distributed databases- Types of fragmentation and replication- distributed query processing.	18
	INTERNAL TEST 2 (Module 2)	
III	NoSQL Databases –CAP theorem- BASE transactions and eventual consistency- Properties of NOSQL databases, consistent hashing, object versioning, Hinted handoff, Snapshots-Key-Value data-stores – Column Stores- Document data-stores - Architecture and data management with DynamoDB, BigTable, HBase, Cassandra and MongoDB.	14
IV	Graph databases - Neo4j – Example graphs, Cypher queries. Mobile Databases- Mobile Database Systems-Issues and Applications- Effect of mobility on management of data- Types of Query – Transaction Execution in MDS.	12

	Implementation: A micro project using any one of the above modern database technologies should be implemented and evaluated.	

END SEMESTER EXAM (ALL Modules)

REFERENCES:

1. Elmasri R., Navathe S.B., "Fundamentals of Database Systems", Pearson Education/Addison Wesley, Fifth Edition, 2007.
2. Shashi Shekhar, Sanjay Chawla, Spatial databases A Tour,Perason Education, Indian Edition, First Impression 2009.
3. SQLite, FromWikipedia,the free encyclopedia, http://en.wikipedia.org/wiki/SQLite
4. VoltDB The NewSQL database for high velocity applications http://odbms.org/download/VoltDBTechnicalOverview.pdf
5. Mainak Adhikari , Sukhendu Kar, Nosql Databases,Handbook of Research on Securing Cloud-Based Databases with Biometric Applications, pp 109-156-available in safaribooksonline,2014.
6. Vijay Kumar, "Mobile Database Systems", A John Wiley & Sons, Inc., Publication,2006.
7. Chanda Ray, Distributed database systems, Pearson,2011.
8. Henry F Korth, Abraham Silberschatz, Sudharshan S., "Database System Concepts", McGraw Hill, Fifth Edition, 2005.
9. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition, 2004.
10. Nosql - https://class.coursera.org/datasci-001/lecture/preview
11. Ian Robinson, Jim Webber, Emil Eifrem, Graph databases- , O'Reilly, 2013.
12. Manoj V, comparative study of NOSQL Document, Column store databases and evaluation of Cassandra, International Journal of Database Management Systems (IJDMS) Vol.6, No.4, August 2014.
13. NoSQL For Dummies By Adam Fowler, John Wiley and sons Inc., 2015
14. An Introduction to XML and Web Technologies, Anders Moller, Michael Schwartzbach, Pearson,2006.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6004	ADVANCED COMPUTER NETWORKS	2-1-0-3	2015

COURSE OBJECTIVES:

- Familiarize the basics of Computer Networks.
- To understand various Network architectures.
- Concepts of fundamental protocols.
- To understand the network traffic, congestion, controlling and resource allocation.

COURSE OUTCOMES:

- Capable of listing and classifying network services, protocols and architectures, explain why they are layered.
- Enables to choose key Internet applications and their protocols, and to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.
- Develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery etc. Explain various congestion control techniques.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Physical Layer: Data Transmission- Analog and Digital Transmission, Transmission Impairments, Transmission Media- Wired Transmission, Wireless Transmission, Signal Encoding Techniques. Data link layer: TCP/IP Protocol Architecture, Framing, Reliable Transmission, Ethernet (802.3) and Token Ring (802.5).	11
	INTERNAL TEST 1 (Module 1)	
II	Network Layer: Connecting Devices. ARP, RARP. IP Address – Sub netting / Super netting, Packet Forwarding with Classful / Classless Addressing, Datagram Fragmentation, Components in IP software, Private IP and NAT. ICMP messages. Routing Protocols -Distance Vector Routing-RIP, Link-State Routing-OSPF	11
	INTERNAL TEST 2 (Module 2)	
III	Transport Layer: UDP- Port Addressing, UDP datagram, UDP services. TCP- TCP services and features, TCP segment, TCP connection, TCP state transitions, Windows in TCP, Flow and Error control, Congestion control, TCP Timers. SCTP- SCTP services and features, Packet format, SCTP association, State Transitions, Flow and Error control.	10
IV	Application Layer**:** DNS- Name Space, Name Resolution, DNS messages, HTTP-Architecture, HTTP Transaction, DHCP operation, SNMP- SMI, MIB, SNMP PDUs, Real Time Data Transfer- RTP, RTCP, Voice over IP- Session Initiation Protocol.	10

	Implementation: Simulation of different network topologies using NS2. Eg: Simulate a 3 node point to point network with duplex links between them. Set the Queue size and vary the bandwidth and find the number of packets dropped.	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. William Stallings, Data and Computer Communications, Pearson Education, 2008.
2. Behrouz A Forouzan, TCP/IP Protocol Suite, Tata McGraw-Hill, 2010.
3. Peterson and Davie, Computer Networks A systems approach, Elsevier, 2011.
4. Kurose and Ross, Computer Networks A systems approach, Pearson Education, 2009.
5. Behurouz A Forouzan, Data Communications & Networking, 4th edition, McGraw-Hill, 2007.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6006	OPERATING SYSTEM DESIGN CONCEPTS	2-1-0-3	2015

COURSE OBJECTIVES:

- To understand the design of the UNIX operating system.
- To become familiar with the various data structures used.
- To learn the various low-level algorithms used in UNIX.

COURSE OUTCOMES:

- Understand how the basic operating concepts are implemented in UNIX.
- Implement various low-level algorithms used in UNIX.
- Design some new low-level algorithms that can run in UNIX.
- Study the behavior of processes running on a UNIX system.
- Analyze the different methods used for inter-process communications.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Overview of the System - Characteristics of modern operating system – Operating system services –Introduction to the Kernel – Architecture of the UNIX operating system. Introduction to system concepts: Overview of the File Subsystem, Processes – System administration. The Buffer Cache: Buffer headers – Structure of the buffer pool.	11
	INTERNAL TEST 1 (Module 1)	
II	File Subsystems - Inode – Structure of a 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 file system: Open - Read - Write – Adjusting the position of file I/O - lseek – close – File creation – Changing directory, root, owner, mode - stat and fstat – Pipes.	11
	INTERNAL TEST 2 (Module 2)	
III	Processes - 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 - Shell - System boot and the INIT process- Process Scheduling.	10
IV	Memory Management – Swapping: Allocation of swap space – Swapping processes in and out – Demand paging: Data structures – The page-stealer process – Page faults – Hybrid System – I/O Subsystem – Driver Interface – Inter process communication - System V IPC: Messages – Shared Memory – Semaphores	10

	Case Study: 1. Implementation of a new system call, process creation, exchange of messages between parent and child using pipes, process termination etc has to be conducted and evaluated. 2. Implementation of Inter process communication has to be conducted and evaluated. 3. Other algorithms discussed in the subject can be implemented**.**	
END SEMESTER EXAM (ALL Modules)		

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, 2005.
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 and Implementation of the 4.3BSD Unix Operating System",Addison Wesley,1998.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6022	REAL TIME SYSTEMS	2-1-0-3	2015

COURSE OBJECTIVES:

- Real-time scheduling and schedulability analysis.
- Formal specification and verification of timing constraints and properties.
- Design methods for real-time systems.
- Development and implementation of new techniques to advance the state-of-the-art real-time systems research.

COURSE OUTCOMES:

- Enables to identify multi tasking techniques in real time systems.
- Capable of evaluating the performance of soft and hard real time systems.
- Ability to analyze multi task scheduling algorithms for periodic, aperiodic and sporadic tasks.
- Design real time operating systems.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Introduction: Hard versus Soft Real time Systems: Jobs and Processors – Real times, Deadlines and Timing constraints – Hard and Soft timing constraints – Hard Real time systems – Soft Real time systems – A reference model of Real time systems: Processors and resources – Temporal parameters of Real time workload – Periodic task model – Precedence constraints and data dependency – Other types of dependencies – Functional Parameters – Resource Parameters of Jobs and Parameters of resources – Scheduling hierarchy.	11
	INTERNAL TEST 1 (Module 1)	
II	Commonly used approaches to Real time scheduling: Clock driven approach – Weighted round robin approach – Priority Driven approach – Dynamic versus Static systems –Effective Release times and Deadlines – Optimality of EDF and LST – Challenges in validating timing constraints in Priority driven systems – Offline versus Online scheduling – Clock driven scheduling: Notations and assumptions – Static Timer driven scheduler –General structure of Cyclic schedules – Cyclic executives – Improving average response time of aperiodic jobs – Scheduling Sporadic jobs .	11
	INTERNAL TEST 2 (Module 2)	
III	Priority driven scheduling of Periodic jobs: Static assumptions – Fixed priority versus Dynamic priority algorithms – Maximum schedulable utilization – Optimality of RM and DM algorithms – Schedulability test for fixed priority tasks with Short response times – Schedulability Test for Fixed priority tasks with arbitrary response times – Sufficient Schedulability conditions for RM and DM algorithms.	10

IV	Scheduling Aperiodic and Sporadic Jobs in Priority Driven Systems: Assumptions and Approaches – Deferrable servers – Sporadic servers – Constant Utilization, Resources and Resource Access Control: Assumptions on resources and their usage – Effects of resource contention and resource access control – Non preemptive Critical Sections – Basic Priority Inheritance Protocol – Basic Priority Ceiling Protocol - Stack Based Priority ceiling Protocol – Preemption Ceiling Protocol.	10
	Case Study: • Implement fair scheduling algorithms on a multiprocessor system and conduct experiments to assess the degree of fairness ensured in practice. • Build a simulator environment that can generate random task sets and simulate task executions under a variety of scheduling algorithms. • Similar implementations based on the syllabus could be included.	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Jane W.S. Liu, "Real-Time Systems", Pearson Education, ISBN NO: 81–7758–575-4, 2000.
2. Phillip A. Laplante, "Real-Time Systems Design and Analysis", Prentice Hall of India, Second Edition, 2001, ISBN NO: 81-203-1684-3.
3. Krishna C. M., Kang G. Shin, "Real-Time Systems", McGraw-Hill International Edition. ISBN: 0-07-114243-6,2006.
4. Williams,"Real Time Systems Development", Elsevier India Pvt. Ltd., New Delhi, First edition, 2008.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6024	BIO COMPUTING	2-1-0-3	2015

COURSE OBJECTIVES:

- To understand the different methods of storing, retrieving and analyzing of biological information
- The course aims to provide students with an awareness of common bioinformatics tools and databases
- To provide the basic understanding of how computers can be used to solve biological problems and establishing the connection between phosphorylation and cancer

COURSE OUTCOMES:

- Will be able to use many heuristic tools including FASTA and BLAST
- Familiarize with many algorithms for Local Alignment and Global Alignment of Biosequences
- Use of Hidden Markov Model to find the distance between DNA sequences
- Basic understanding of microarray technology used to determine the expression level of genes
- Learn how to classify proteins on the basis of protein characteristics
- Familiarize with many Bioinformatics Tools and Databases

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Molecular Biology and Biological Chemistry - The Genetic Material, Gene Structure and Information Content, Protein Structure and Function, The Nature of Chemical Bonds, Molecular Biology Tools, Genomic Information Content, Major Databases in Bioinformatics, Information Search and Data Retrieval- Tools for Web Search, Data Retrieval Tools, Data Mining of Biological Databases. Gene Analysis and Gene Mapping- Genome Analysis, Genome Mapping, Physical Maps, Cloning The Entire Genome, Genome Sequencing, The Human Genome Project (HGP).	11
INTERNAL TEST 1 (Module 1)		
II	Alignment of Pairs of Sequences - Methods of Sequence Alignments, Using Scoring Matrices, Measuring Sequence Detection Efficiency, Methods of Multiple Sequence Alignment, Evaluating Multiple Alignments, Phylogenetic Analysis, Tree Evaluation. Tools for Similarity Search and Sequence Alignment – Working with FASTA, BLAST, FASTA and BLAST Algorithms Comparison.	11
INTERNAL TEST 2 (Module 2)		
III	Profiles and Hidden Markov Models - Using Profiles, Hidden Markov Models. Gene Identification and Prediction – Basis of Gene Prediction, Pattern Recognition, Gene Prediction Methods. Gene Expression and Microarrays – Working with DNA Microarrays, Clustering Gene Expression Profiles, Data Sources and Tools for Microarray Analysis, Applications of Microarray Technology.	10

IV	Protein Classification and Structure Visualization **-** Protein Structure Visualization, Protein Structure Databases, Protein Structure Alignment, Domain Architecture Databases, Protein Classification Approaches, Protein Identification and Characterization, Primary and Secondary Structure Analysis and Prediction, Patterns and Fingerprints Search, Methods of 2D Structure Prediction, Protein Prediction from a DNA Sequence. Proteomics – Tools and Techniques in Proteomics, Protein-Protein Interactions, Methods of Gene Family Identification. Computational Methods for Pathways and Systems Biology – Analysis of Pathways, Metabolic Control Analysis, Simulation of Cellular Activities, Biological Markup Languages.	10
	Case Study: Implementation of FASTA, BLAST, Needleman-Wunsch and Smith-Waterman Algorithms.	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

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

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6026	ADVANCED COMPUTER ARCHITECTURE	2-1-0-3	2015

COURSE OBJECTIVES:

- To provide in-depth knowledge of current and emerging trends in computer architectures, focusing on performance and the hardware/software interface
- The course emphasis on analyzing fundamental issues in architecture design and their impact on application performance

COURSE OUTCOMES:

- Understand advanced issues in design of computer processors, caches and memory
- Analyze performance trade-offs in computer design
- Apply knowledge of processor design to improve performance in algorithms and software systems

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Design and Analysis- Principles of computer design, Fallacies and Pitfalls, Instruction Set Principles- Classifying instruction set architecture, Memory addressing, Type and size of operands, Operations in the instruction set, Instruction for control flow, Encoding an instruction set, Role of compiler, Fallacies and Pitfalls.	11
	INTERNAL TEST 1 (Module 1)	
II	Memory Hierarchy- Introduction , Cache performance reviews, cache performance , Basic cache optimizations, Virtual memory –Techniques for fast address translation, Protection via virtual memory, Fallacies and Pitfalls, Case study of Pentium/Linux memory system-Pentium address translation, Linux Virtual memory system.	11
	INTERNAL TEST 2 (Module 2)	
III	Pipelining- Introduction, Pipeline hazards, Static branch prediction and dynamic branch prediction, Implementation of MITS, Basic pipeline of MITS, Implementing the control in MITS pipeline, Dealing with branches in pipeline, Dealing with exceptions, Handling of multi-cycle operations, Maintaining precise exceptions, Case study of MITS R4000 pipeline, Dynamic scheduled pipelines.	10
IV	Data Level Parallelism- Vector architecture, SIMD instruction set, Extension for multimedia, Graphic Processing Units, Case study Envida GPU instruction set architecture, conditional branching in GPU, GPU memory structure, Innovations in GPU architecture, Comparisons between vector architecture and GPUs, comparisons between multimedia SIMD computers and GPUs, Loop level parallelism, Finding dependencies, Eliminating dependencies.	10

	Case Study: Implementation of pipelining and various level parallelisms has to be done using the various tools like OPENMP.	
END SEMESTER EXAM (ALL Modules)		

REFERENCES:

1. Hennessy J.L and David A. Patterson "Computer Architecture- A Quantitative Approach" Morgan Kaufmann Publication, Fifth edition,2002.
2. Randal E Bryant and David O'Hallaron "Computer Systems A programmer's perspective" Pearson Education,2nd edition 2010 .
3. Kaihwang and Naresh Jotwani, "Advanced Computer Architecture" 2nd edition Tata Mcgraw-Hill, 2010.
4. Sima D,Fountain T and Kacsuk P "Advanced Computer Architecture: A Design Space Apporach"Pearson Education, 1st edition 1997.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6032	SOCIAL NETWORK ANALYTICS	2-1-0-3	2015

COURSE OBJECTIVES:

- Visual and a mathematical analysis of human relationships.
- To gain knowledge about the current Web development and emergence of Social Web.
- To study about the modelling, aggregating and knowledge representation of Semantic Web.
- To learn about the extraction and mining tools for Social networks.

COURSE OUTCOMES:

- Mapping and measuring of relationships and flows between people, groups, organizations, computers, URLs, and other connected information/knowledge entities.
- Mining and extraction of data from social network using different tools.
- Study different methods for visualization of data produced by Social Network Analysis.
- Gain knowledge on Web personalization and Web Visualization of Social networks.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Social Media Defined – Social media design framework – social media examples – The Network perspective – types of networks.	11
	INTERNAL TEST 1 (Module 1)	
II	Web Analytics 2.0 paradigm – Click - stream Analysis – Eight critical web matrices – Bounce rate – Exit rate – Conversion rate – Engagement – Attributes of great metrics – A Web Analytics Primer Understanding Visitor Acquisition Strengths – Click Density Analysis – Measuring Visits to Purchase – Search Engine Optimization (SEO) Analysis – Direct Traffic Analysis.	11
	INTERNAL TEST 2 (Module 2)	
III	Measuring outcome – Key Performance Indicators (KPIs) – Moving beyond Conversion Rates – Measuring Macro and Micro Conversions – Measuring Success for a Non-ecommerce Website – Lab Usability tests – Surveys – Types of Surveys.	10
IV	A/B Testing – Multivariate Testing – Competitive Intelligence Data Sources, Types, and Secrets – Website Traffic Analysis – Search and Keyword Analysis – Audience Identification and Segmentation Analysis.	10
	Case Study: Conduct analysis on different websites, including popular social network sites using the techniques covered in the subject.	
	END SEMESTER EXAM (All Modules)	

REFERENCES:

1. Derek L. Hansen,Ben Sheiderman, ,Marc A. Smith, .Analyzing SocialMedia Networks with NodeXL, Morgan Kaufmann, 2011.
2. Avinash Kaushik. 2009. Web Analytics 2.0, Wiley Publishing, Inc, 2010.
3. David Easley and Jon Kleinberg. Networks, Crowds, and Markets: Reasoning About a Highly Connected World. Cambridge University Press, 2010.
4. Peter Mika, Social networks and the Semantic Web, Springer, 1st edition 2007.
5. Borko Furht, Handbook of Social Network Technologies and Applications, Springer, 1st edition, 2010.
6. Guandong Xu, Yanchun Zhang and Lin Li, Web Mining and Social Networking Techniques and applications, Springer, 1st edition, 2011.
7. Dion Goh and Schubert Foo, Social information retrieval systems: emerging technologies and applications for searching the Web effectively, IGI Global snippet, 2008.
8. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and social information retrieval and access: techniques for improved user modelling, IGI Global snippet, 2009.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6034	EMBEDDED SYSTEMS	2-1-0-3	2015

COURSE OBJECTIVES:

- Introduce students to the embedded system, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To explain the memory management in the embedded system.
- Familiarize students with embedded operating system.

COURSE OUTCOMES:

- The students will be familiarized with the embedded system.
- They are able to do project in embedded area.
- Memory management of embedded system will be clearly studied.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Introduction to embedded systems and embedded hardware: A system engineering approach to embedded systems - Introduction and definition of embedded system, embedded system design, Introduction and importance of embedded systems architecture, The embedded systems model, Basics of computer architecture and binary number system. Introduction to embedded systems-application domain, Features and general characteristics of embedded systems, Microprocessor vs. Microcontroller, Figure of merits, Classification of MCUs.	11
INTERNAL TEST 1 (Module 1)		
II	Embedded systems-The hardware point of view – MCU, Memory, Low power design, Pull up and pull down resistors, sensors, ADC and actuators. Building blocks and the embedded board – Importance of reading a schematic, major component of an embedded board, factors that allow an embedded device to work, the Embedded Board and the Von Neumann model, powering the hardware.	11
INTERNAL TEST 2 (Module 2)		
III	Embedded Operating System: Process, Multitasking and Process management- Process implementation - Process scheduling-Inter task communication and synchronization using Embedded Linux as example RTOS-Middleware: definition, middle ware examples-Networking Middleware driver Examples-Internet layer middleware (Internet Protocol)- Transport Layer Middleware(User Datagram Protocol)	10

IV	Memory management-User memory space-Kernel memory space- cache overview, external memory, and direct memory access, Board memory-memory management of external memory, board memory and performance. I/O and File system management, OS standards-POSIX(Portable Operating Systems Interface)-OS performance Guidelines- OSes and Board Support Packages (BSPs) with Embedded Linux as example of RTOS.	10
	Case Study: Embedded system programming using pic/c language.	
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Tammy noregaard, "Embedded System Architecture: a comprehensive for Engineers and Programmers", Elsevier "2/e,2010".
2. Lyla b das ,"Embedded Systems –An integrated approach" Pearson education 2013.
3. P Ragavan, Amol Lad & Sriram Neelakandan ,"Embedded Linux system design and Development", Aauerbach publications 2005.
4. Wayne Wolf, "Computers as Components-principles of Embedded computer system design", Elseveir, 2005.
5. Peter Barry & Patrick Crowley, "Modern Embedded Computing", Morgan Kauffman, 2012.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6036	CYBER FORENSICS	2-1-0-3	2015

COURSE OBJECTIVES:

- Define digital forensics from electronic media.
- Describe how to prepare for digital evidence investigations and explain the differences between law enforcement agency and corporate investigations.
- Explain the importance of maintaining professional conduct

COURSE OUTCOMES:

- Utilize a systematic approach to computer investigations.
- Utilize various forensic tools to collect digital evidence.
- Perform digital forensics analysis upon networks and network devices.
- Perform web based investigations.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Cyber forensics-Introduction to Cyber forensics, Type of Computer Forensics Technology- Type of Vendor and Computer Forensics Services. Information Security Investigations, Corporate Cyber Forensics, Scientific method in forensic analysis, investigating large scale Data breach cases, Analyzing Malicious software.	11
	INTERNAL TEST 1 (Module 1)	
II	Digital Evidence in Criminal Investigations. The Analog and Digital World, Training and Education in digital evidence, the digital crime scene, Investigating Cybercrime, Duties Support Functions and Competencies. Computer Forensics Evidence and Capture- Data Recovery-Evidence collection and Data Seizure-Duplication and preservation of Digital Evidence-Computer image verification and Authentication	11
	INTERNAL TEST 2 (Module 2)	
III	Investigating Network Intrusions and Cyber Crime, Network Forensics and Investigating logs, Investigating network Traffic, Investigating Web attacks, Router Forensics. Computer Forensics Analysis- Discovery of Electronic Evidence- Identification of data- Reconstructing Past events-networks	10
IV	Countermeasure: Information warfare- Surveillance tool for Information warfare of the future-Advanced Computer Forensics.	10
	Case Study: Study of Cyber forensics tools.	
	END SEMESTER EXAM (All Modules)	

REFERENCES:

1 Christof paar, Jan Pelzl, Understanding Cryptography: A Textbook for Students and Practitioners, 2010.

2 Ali Jahangiri, Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, 1st edition 2009.

3 John J. Barbara, Handbook of Digital and Multimedia Forensic Evidence, 2008 edition.

4 Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 1st edition 2009.

5 Jennifer Bayuk, Cyber Forensics: Understanding Information Security Investigations, Springer's Forensic Laboratory Science Series, 2010 edition.

6 Daniel Ventre, Information warfare: Information warfare and security: (ACM Press) by Cyberwar and Information Warfare: Springer, 1st edition 2011.

7 John R. Vacca, Computer forensics: computer crime scene investigation, Volume 1 Charles River Media, 2008.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6066	**SEMINAR - I**	**0-0-2-2**	**2015**

Each student shall present a seminar on any topic related to the core/elective courses offered in the first/second semester of the M. Tech. Programme. The selected topic should be based on the papers published in reputed international journals preferably IEEE/ACM.

Students should get the paper approved by the Program Co-ordinator/Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. They should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6088	MINI PROJECT	0-0-4-2	2015

The mini project is designed to develop practical ability and knowledge in tools/techniques to solve problems related to the industry, academic institutions and computer science research. Students can take up any application level/system level project pertaining to a relevant domain, preferably based on papers from IEEE/ACM journals. Projects can be chosen either from the list provided by the faculty or in the field of interest of the student. The topic should be approved by the Programme Co-ordinator / Faculty member before carrying out the work. For external projects, students should obtain prior permission after submitting the details of the guide and synopsis of the work. The project guide should have a minimum qualification of ME/M.Tech in Computer Science or related fields. 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 for end semester assessment. Marks will be awarded based on the report and their performance during presentations and demonstrations. Publishing the work in Conference Proceedings/Journals with National/International status with the consent of the guide will carry an additional weightage in the evaluation process.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 6092	NETWORK SYSTEMS LAB	0-0-2-1	2015

List of Experiments using NS2 / NS3

Part I

1. Familiarization using suitable examples.
2. Simulate a wired network consisting of TCP and UDP Traffic and then calculate their respective throughput using AWK script.
3. Performance evaluation of different routing protocols in wired network environment
4. Performance evaluation of different queues and effect of queues and buffers in wired network environment.
5. Compare the behavior of different variants of TCP (Tahoe, Reno, Vegas….) in wired network. Comparison can be done on the congestion window behavior by plotting graph.
6. Evaluate the End to end delay, Propagation delay, Packet loss, jitter, Number of packets received in a connection by analyzing the trace file.
7. Simulation of wireless Ad hoc networks.
8. Simulate a wireless network consisting of TCP and UDP Traffic and then calculate their respective throughput using AWK script.
9. Performance evaluation of different ad-hoc wireless routing protocols (DSDV, DSR, AODV …).

Part II

1. Develop a web application and conduct security audit to secure the application. Use any open source Web scanners like Web Scarab, Wapiti, W3af, Paros proxy or Skip fish.
2. Examine how sniffing works (tools available in ethereal.com can be used).
3. Perform an experiment for port scanning with NMAP, Superscan or any other software.
4. Perform an experiment on active and passive finger printing using xprobe2 and NMAP.
5. Perform an experiment to demonstrate how to sniff for router traffic by using the tool Wireshark.
6. Examine how PGP works (Go to site GnuPGP.org)
7. Study of an Intrusion Detection System: Snort

Note: At least 5 experiments from part I and 3 experiments from part II should be conducted.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7041	BIG DATA PROCESSING	2-1-0-3	2015

COURSE OBJECTIVES:

- Explore the open source software for distributed storage and processing of large data sets.
- Achieving massive scalability in processing the large data sets.
- Scheduling workflows and achieve high performance in distributed environment.

COURSE OUTCOMES:

- Able to perform the distributed processing of large data sets across clusters of computers using simple programming models.
- Perform parallel computations across clusters using Pig and achieve data summarization and ad hoc querying using Hive.
- Perform workflow scheduling using Oozie and fast scheduling using Spark.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Big Data and Hadoop: Hadoop Ecosystem- Core Components - Hadoop Distributions -Developing Enterprise Applications. HDFS: Architecture - Using HDFS Files - Hadoop Specific File Types - HDFS Federation and High Availability. HBase: HBase Architecture - HBase Schema Design - New HBase Features -Combining HDFS and HBase for Effective Data Storage -Using Apache Avro - Managing Metadata with HCATALOG.	11
	INTERNAL TEST 1 (Module 1)	
II	MapReduce- Processing data with MapReduce: Execution pipeline - Runtime Coordination and Task Management in MapReduce - Designing MapReduce implementations: Using MapReduce as a framework for parallel processing - Face Recognition Example - Simple Data Processing with MapReduce - Inverted Indexes Example - Building joins with MapReduce - Road Enrichment Example - Link Elevation Example - Building iterative MapReduce Applications -Solving Linear Equation Example -To MapReduce or not to MapReduce? - Common MapReduce Design Gotchas.	11
	INTERNAL TEST 2 (Module 2)	
III	Hive-Features –Hive in the hadoop ecosysytem – Datatypes and file formats –primitive and collection datatypes – HiveQL – Databases in Hive – Creating tables –Partitioned, Managed Tables – Dropping Tables- Alter table. Pig - Installing and Running Pig: Execution Types- Running Pig Programs- Grunt- Comparison with Databases - Pig Latin: Structure – Statements – Functions – User Defined Functions: A Filter UDF - An Eval UDF- A Load UDF - Data Processing Operators: Loading and Storing Data - Filtering Data - Grouping and Joining Data - Sorting Data - Combining and Splitting Data.	10

IV	Oozie- Components - Oozie Workflow - Oozie Coordinator - Oozie Bundle - Oozie Job Execution Model- Accessing Oozie - Oozie SLA - Scheduling workflows using Oozie coordinator: Oozie Coordinator System--Oozie coordinator components and variables**.** Spark-Spark Architecture-Spark Streaming-Streaming Operator-Spark SQL-Resilient Distribution Dataset (RDD). Reference 1: Module 1, Module 2, Oozie Reference 2: Pig Reference 3: Hive Reference 4: Scheduling Workflows using Oozie	10
	Implementation: Students may implement simple programs using MapReduce, PigLatin, Hive, Spark or Oozie.	
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich ,PROFESSIONAL Hadoop® Solutions ,Wrox,2013.
2. Tom White ,Hadoop: The Definitive Guide, O'Reilly Media 3rd Edition,May6, 2012.
3. Jason Rutherglen, Dean Wampler, Edward Capriolo, Programming Hive, O'Reilly,2012.
4. Snehalatha, Scheduling Workflows using Oozie Coordinator, DeveloperIQ Magazine, August 28, http://developeriq.in/articles/2013/aug/28/scheduling-workflows-using-oozie-coordinator.
5. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia, Learning Spark, O'Reilly, February 2015.
6. https://spark.apache.org/docs/latest/programming-guide.html.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7043	CLOUD COMPUTING	2-1-0-3	2015

COURSE OBJECTIVES:

- To explore the basics of cloud computing architecture and services.
- To understand the various web services and virtualization technologies involved in cloud computing.
- To provide the student a clear understanding of the various privacy and security issues in cloud computing.
- To learn how the management and migration aspects works in the cloud.

COURSE OUTCOMES :

- Students will be able to comprehend different cloud services.
- Students will be able to utilize the various tools for the development of web services.
- Students will be able to illustrate various issues related to security, management and migration.
- Students will be able to explain and develop sample application on cloud.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Understanding cloud computing-Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Cloud Services Understanding cloud services: Web-Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service –Infrastructure as a service, Case studies – Amazon Ec2 – Google Apps Engine –Microsoft Azure-IBM Clouds.	11
INTERNAL TEST 1 (Module 1)		
II	Web services, AJAX, Mash-ups and Virtualization-Web services: SOAP and REST, SOAP versus REST, AJAX: asynchronous 'rich' interfaces, Mashups: user interface services ,Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization, Implementation levels of virtualization, Multitenant software: Multi-entity support, Multi-schema approach, Multitenance using cloud data stores, Data access control for enterprise applications	11
INTERNAL TEST 2 (Module 2)		
III	Cloud Security-Cloud security fundamentals, Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Privacy in cloud, Identity Management and Access control: Identity management- Access control, Autonomic Security, Cloud computing security challenges: Virtualization security management-virtual threats, VM Security Recommendations, VM-Specific Security techniques.	10

IV	Communication and Migration-Communicating with the cloud, media and streaming, Cloud management standards, Monitoring the cloud .Migrating to the cloud: cloud services for individuals, enterprise class cloud offerings, migration: Broad Approaches to Migrating into the Cloud-The Seven Step Model of Migration into a Cloud, Mobile clouds, mobile web services, best practices, Enterprise cloud computing ecosystem.	10
	Implementation: Implement load balancing on firewall applications using Java.	
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
2. Sosinsky B., Cloud Computing Bible, Wiley India, 2010.
3. Gautam Shroff ,Enterprise Cloud Computing,Cambridge university press, 2010.
4. Kai Hwang,Geoffrey C. Fox,Jack J. Dogarra, Distributed and cloud computing:From parallel processing to the Internet of Things ,Morgan Kaufman, 2012.
5. Ronald Krutz and Russell Dean Vines, Cloud Security-a comprehensive guide to secure cloud computing, Wiley-India, 2010.
6. TimMalhar, S.Kumaraswammy, S.Latif, CloudSecurity&Privacy, (SPD,O'REILLY),2009.
7. Antohy T Velte, et.al, Cloud Computing : A Practical Approach, McGraw Hill, 2009
8. Buyya R., Broberg J., Goscinski A., Cloud Computing : Principles and Paradigm, John Wiley & Sons, 2010.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7045	ONTOLOGICAL ENGINEERING	2-1-0-3	2015

COURSE OBJECTIVES:

- Students shall understand the basic concepts and major issues of Ontological Engineering.
- To make ontologies more understandable to those computer science engineers that integrates ontologies into their information systems.

COURSE OUTCOMES:

- Able to understand basic concepts of ontological Engineering.
- Learn various methods, tools and languages, as well as the most outstanding ontologies used in web.
- Capable of performing knowledge management in semantic web.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Introduction : Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background -Sample - Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need –Foundation – Layers – Architecture.	11
	INTERNAL TEST 1 (Module 1)	
II	Languages for semantic web ontologies : Web Documents in XML – RDF - Schema – Web Resource Description using RDF- RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics - Traditional Ontology Languages – LOOM- OKBC – OCML – Flogic Ontology Markup Languages – SHOE – OIL - DAML + OIL- OWL	11
	INTERNAL TEST 2 (Module 2)	
III	Ontology learning for semantic web : Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning – Importing and Processing Ontologies and Documents – Ontology Learning Algorithms – Evaluation.	10
IV	Ontology management and tools : Overview – need for management – development process – target ontology – ontology mapping – skills management system – ontological class – constraints – issues. Evolution– Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools.	10
	Case Study: Categorize the issues in ontology engineering methodologies and demonstrate it with real-world examples.	

END SEMESTER EXAM (All Modules)

REFERENCES:

1. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez,Ontological Engineering: with examples from the areas of Knowledge Management, e- Commerce and the Semantic Web, Springer, 2004.
2. Grigoris Antoniou, Frank van Harmelen, A Semantic Web Primer (Cooperative Information Systems) , The MIT Press, 2004.
3. Alexander Maedche, Ontology Learning for the Semantic Web, Springer, First Edition, 2002.
4. John Davies, Dieter Fensel, Frank Van Harmelen, Towards the Semantic Web: Ontology – Driven Knowledge Management, John Wiley & Sons Ltd., 2003.
5. John Davies (Editor), Rudi Studer (Co-Editor), Paul Warren (Co-Editor) Semantic Web Technologies: Trends and Research in Ontology-based Systems,Wiley Publications, Jul 2005.
6. Dieter Fensel (Editor), Wolfgang Wahlster, Henry Lieberman, James Hendler, Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potential, The MIT Press, 2002.
7. Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Elsevier, Morgan Kaufmann publishers, 2002.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7051	WEB SERVICES	2-1-0-3	2015

COURSE OBJECTIVES:

- Learn basic concepts in distributed systems necessary to appreciate and make use of Web Services specifications.
- Programmatic techniques to build web services.
- Identify the key characteristics of the Web Services architecture.
- Discuss notions that underpin the Web service architectures, such as SOAP, WSDL, UDDI and also the various APIs used.
- Appreciate the programming styles involved in building web services.

COURSE OUTCOMES:

- Ability to develop Web Service enabled applications.
- Will be able use SOAP, WSDL, UDDI.
- Familiarized with various useful Java APIs for developing Web Services

MODULE	COURSE CONTENT (42 hrs)	HRS
I	XML-Review of Extensible Markup Language basics**,** XML document, Namespaces, XML Schema basics. Web Services – Introduction to Web Services, Web Services Architecture, Web Services Communication Models.	11
	INTERNAL TEST 1 (Module 1)	
II	SOAP- Anatomy of a SOAP Message, SOAP Encoding, SOAP Message Exchange Model, SOAP Communication, SOAP Messaging, SOAP Bindings for Transport Protocols, SOAP Security, Building SOAP Web Services, Developing SOAP Web Services Using Java.	11
	INTERNAL TEST 2 (Module 2)	
III	WSDL- Anatomy of a WSDL Definition Document, WSDL Bindings, WSDL Tools UDDI- UDDI Registries, Programming with UDDI, Implementations of UDDI, Registering as a Systinet, UDDI Registry User, Publishing Information to a UDDI Registry, Searching Information in a UDDI Registry, Deleting Information from a UDDI Registry.	10
IV	XMLProcessing and Data Binding with Java APIs - Java API for XML Processing (JAXP), Java Architecture for XML Binding (JAXB). XML Messaging Using JAXM and SAAJ - The Role of JAXM in Web Services, JAXM API Programming Model, Basic Programming Steps for Using JAXM, JAXM Deployment Model, Developing JAXM-Based Web Services.	10

	Implementation: Implementing a Web service with Apache Axis.	
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Ramesh Nagappan, Robert Skoczylas,Rima Patel Sriganesh, Developing Java Web Services, Wiley Publishing Inc.,2003.
2. Richard Monson Haefel, J2EE Web Services, Pearson Education, 2004.
3. Travis Vandersypen, Jason Bloomberg, Madhu Siddalingaiah, Sam Hunting, Michael D Qualls, David Houlding, Chad Darby, Diane Kennedy, XML and Web Services Unleashed, Pearson Education, 2002.
4. Frank P Coyle, XML Web Services and Data Revolution, Pearson Education, 2002.
5. Mark Hansen, SOA Using Java Web Services, Pearson Education, 2007.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7053	INFORMATION RETRIEVAL	2-1-0-3	2015

COURSE OBJECTIVES:

- The prime objective of this course is to present the scientific underpinnings of the field of Information Search and Retrieval for organizing and analyzing information and its content for the purpose of providing intellectual access to textual and non-textual information resources and more advanced techniques for information filtering and decision support.

COURSE OUTCOMES:

- With the completion of the course the students will be able to apply the techniques to quickly find information that is both relevant and comprehensive for their needs from a massive information source such as World Wide Web.
- The information search and discovery processes are highly eased and thereby increasing customer fidelity and conversion rates.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Introduction – Retrieval Process – Modeling – Classic Information Retrieval – Set Theoretic, Vector and Probabilistic Models – Structured Text Retrieval Models – Retrieval Evaluation.	11
	INTERNAL TEST 1 (Module 1)	
II	~~Languages~~ – Key Word based Querying – Pattern Matching – Structural Queries – ~~Query Operations~~ – User Relevance Feedback – Local and Global Analysis – Text and Multimedia languages-Word Sense Disambiguation.	11
	INTERNAL TEST 2 (Module 2)	
III	Document Preprocessing – Clustering – Text Compression - Indexing and Searching – Inverted files – Boolean Queries – Sequential searching –User Interface and Visualization – Human Computer Interaction – Access Process – Starting Points –Query Specification - Context – User relevance Judgment – Interface for Search.	10
IV	Data Models – Query Languages – Spatial Access Models – Generic Approach – One Dimensional Time Series – Two Dimensional Color Images –Searching the Web – Challenges – Characterizing the Web – Search Engines – Browsing – Meta-searchers.	10
	Case Study: Information retrieval systems used in Libraries and Digital libraries.	
	END SEMESTER EXAM (All Modules)	

REFERENCES:

1. Ricardo Baeza-Yates, Berthier Ribeiro-Neto, Modern Information Retrieval, Pearson Education Asia, First Edition, 2005.
2. Daniel Jurafsky and James H. Martin, Speech and Language Processing, Pearson Education, 2000.
3. G.G. Chowdhury, Introduction to Modern Information Retrieval, Neal- Schuman Publishers, Second Edition, 2003.
4. David A. Grossman, Ophir Frieder, Information Retrieval: Algorithms, and Heuristics, Academic Press, 2000.
5. Charles T. Meadow, Bert R. Boyce, Donald H. Kraft, Text Information Retrieval Systems, Academic Press, 2000.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7055	DISTRIBUTED ALGORITHMS	2-1-0-3	2015

COURSE OBJECTIVES:

- Introduction to distributed algorithm with emphasis on principles and theory.
- To solve algorithmic problems with background on logic and discrete structures.
- Provide solutions to algorithm that arise design problems.

COURSE OUTCOMES:

- Students would develop a working of the problem domain.
- Good idea regarding various system models and their capabilities, which will help to design new algorithms.

MODULE	COURSE CONTENT (42 hrs)	HRS
I	Introduction to model of synchronous distributed computing system, Leader election in a General Network - Simple Flooding Algorithm, Basic Breadth- First Search Algorithm, Bellman-Ford algorithm.	11
	INTERNAL TEST 1 (Module 1)	
II	Algorithms in Synchronous Network, Minimum Spanning Tree, Leader Election in a Synchronous Ring , LCR algorithm, HS algorithm, Time Slice Algorithm, Variable Speeds Algorithm, Lower Bound for Comparison-Based Algorithms. Maximal Independent Set, LubyMIS algorithm. Distributed Consensus with Link Failures and Process Failures – Basics.	11
	INTERNAL TEST 2 (Module 2)	
III	Introduction to model of asynchronous distributed computing system, Send/Receive systems, Broadcast systems, Multicast systems, Basic algorithms, Peterson Leader-Election Algorithm, Local Synchronizer, Safe Synchronizer.	10
IV	Asynchronous System Model. Shared Memory Systems, Environment Model, Shared Variable Types, Mutual Exclusion - Asynchronous Shared Memory Model, Dijkstra's Mutual Exclusion Algorithm. Resource Allocation - Nonexistence of Symmetric Dining Philosophers Algorithms, Right-Left Dining Philosophers Algorithm, mutual exclusion and consensus, relationship between shared memory and network models, asynchronous networks with failures.	10
	Implementation: Implementations using Java have to be conducted and evaluated for different synchronous and asynchronous distributed algorithms.	

END SEMESTER EXAM (All Modules)

REFERENCES

1. Nancy A. Lynch, Distributed Algorithms, Morgan Kaufmann Publishers, Inc,1996.
2. Wolfgang Reisig, W. Reisig, Elements Of Distributed Algorithms: Modeling And Analysis With Petri Nets, Springer-verlag, First Edition, 1998.
3. Tel Gerard , Introduction To Distributed Algorithms, Second Edition, Cambridge University Press,2000.
4. Sukumar Ghosh, Distributed Systems: An Algorithmic Approach (Hardcover), Chapman & Hall/crc, 2015.
5. Valmir C. Barbosa, An Introduction To Distributed Algorithms, Mit Press,1996.
6. Randy Chow, Theodore Johnson, Distributed Operating Systems and Algorithm Analysis, Pearson Education,2009.
7. Nicola Santoro, Design And Analysis Of Distributed Algorithms, Wiley-interscience, First Edition, October 2006.
8. Fionnuala O'Donnell, VDM Verlag Dr. Muller, A Simulated Framework For The Teaching Of Distributed Algorithms, Aktiengesellschaft & Co. Kg, January 2009.
9. Ajay D. Kshemkalyani, Mukesh Singhal, Distributed Computing - Principles, Algorithms And Systems, Cambridge University Press, First Edition, 2008.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7067	**SEMINAR – II**	**0-0-2-2**	**2015**

Each student shall present a seminar on any topic related to their mini project or thesis work of the M. Tech. Programme. The selected topic should be based on the papers published in reputed international journals preferably IEEE/ACM.

Students should get the paper approved by the Program Co-ordinator/Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. They should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7087	PROJECT (PHASE-I)	0-0-8-6	2015

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. A detailed design should be prepared based on the study, comparison, analysis and review of the research work and recent developments in the area. Recent National/International Conference Proceedings/Journals, preferably IEEE/ACM, should be referred for the selection of the 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. Emphasis should be given for literature survey, scope and design of the proposed work along with the details of the preliminary work carried out on the thesis topic.

The candidate should present the current status of the thesis work and the assessment will be made on the basis of the work and the presentation, by a panel of examiners. This panel can be a committee headed by the head of the department with two other faculty members in the area of the project, of which one shall be the project supervisor .If the project is done outside the college, the external supervisor associated with the student will also be a member of the committee. The examiners should give their suggestions in writing to the students so that it should be incorporated in the Phase–II of the thesis.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CS 7088	PROJECT PHASE II	0-0-21-12	2015

In the fourth semester, the thesis work approved and evaluated in third semester should be continued and carried out to successful completion. A detailed thesis report should be submitted at the end of phase II. 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.

Final evaluation of the project will be taken up only on completion of the project. This shall be done by a committee constituted by the principal of the college for the purpose. The concerned head of the department shall be the chairman of this committee. It shall have two senior faculty members from the same department, project supervisor and external supervisor of the student, if any and an external expert either from an academic/R&D organization or from industry as members.