

B-Tech Computer Science & Engineering

Sixth Semester

Course Syllabus & Course Plan

S6 - CORE COURSES

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS302	Design and Analysis of Algorithms	3-1-0-4	2015
Course Objectives <ol style="list-style-type: none"> 1. To introduce the concepts of Algorithm Analysis, Time Complexity, Space Complexity. 2. To discuss various Algorithm Design Strategies with proper illustrative examples. 3. To introduce Complexity Theory. 			
Syllabus <p>Introduction to Algorithm Analysis, Notions of Time and Space Complexity, Asymptotic Notations, Recurrence Equations and their solutions, Master's Theorem, Divide and Conquer and illustrative examples, AVL trees, Red-Black Trees, Union-find algorithms, Graph algorithms, Divide and Conquer, Dynamic Programming, Greedy Strategy, Back Tracking and Branch and Bound, Complexity classes</p>			
Expected outcome <p>Student is able to</p> <ol style="list-style-type: none"> 1. Analyze a given algorithm and express its time and space complexities in asymptotic notations. 2. Solve recurrence equations using Iteration Method, Recurrence Tree Method and Master's Theorem. 3. Design algorithms using Divide and Conquer Strategy. 4. Compare Dynamic Programming and Divide and Conquer Strategies. 5. Solve Optimization problems using Greedy strategy. 6. Design efficient algorithms using Back Tracking and Branch Bound Techniques for solving problems. 7. Classify computational problems into P, NP, NP-Hard and NP-Complete. 			
Text Books <ol style="list-style-type: none"> 1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press [Modules 1,2,6] 2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Computer Algorithms, Universities Press, 2007 [Modules 3,4,5] 			

References			
1. AnanyLevitin, Introduction to the Design and Analysis of Algorithms, Pearson, 3rd Edition. 2. Richard E. Neapolitan,KumarssNaimipour, Foundations of Algorithms using C++ Psuedocode, Second Edition. 3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Pearson Education, 1999. 4. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, Pearson Education.			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks %
I	<i>Introduction to Algorithm Analysis</i> Time and Space Complexity- Elementary operations and Computation of Time Complexity- Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms	04	15 %
	<i>Recurrence Equations</i> :Solution of Recurrence Equations - Iteration Method and Recursion Tree Methods,	04	
II	<i>Master's Theorem</i> (Proof not required) - examples, Asymptotic Notations and their properties- Application of Asymptotic Notations in Algorithm Analysis- Common Complexity Functions	04	15%
	<i>AVL Trees</i> - rotations, Red-Black Trees insertion and deletion (Techniques only; algorithms not expected). B-Trees - insertion and deletion operations. Sets- Union and find operations on disjoint sets.	05	
FIRST INTERNAL EXAM			
III	<i>Graphs</i> - DFS and BFS traversals, complexity, Spanning trees - Minimum Cost Spanning Trees, single source shortest path algorithms, Topological sorting, strongly connected components.	07	15%

IV	<i>Divide and Conquer</i> :The Control Abstraction, 2 way Merge sort, Strassen’s Matrix Multiplication, Analysis	04	15%
	<i>Dynamic Programming</i> : The control Abstraction- The Optimality Principle- Optimal matrix multiplication, Bellman-Ford Algorithm	04	
SECOND INTERNAL EXAM			
V	Analysis, Comparison of Divide and Conquer and Dynamic Programming strategies	02	20%
	<i>Greedy Strategy</i> : - The Control Abstraction- the Fractional Knapsack Problem,	04	
	Minimal Cost Spanning Tree Computation- Prim’s Algorithm – Kruskal’s Algorithm.	03	
VI	<i>Back Tracking</i> : -The Control Abstraction – The N Queen’s Problem, 0/1 Knapsack Problem	03	20%
	<i>Branch and Bound</i> :Travelling Salesman Problem.	03	
	<i>Introduction to Complexity Theory</i> :-Tractable and Intractable Problems- The P and NP Classes- Polynomial Time Reductions - The NP- Hard and NP- Complete Classes	03	
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
 - a. Total marks : 12
 - b. Four questions each having 3 marks, uniformly covering modules I and II; Allfour questions have to be answered.
3. Part B
 - a. Total marks : 18

- b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
 - a. Total marks : 12
 - b. Four questions each having 3 marks, uniformly covering modules III and IV; Allfour questions have to be answered.
5. Part D
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
 - a. Total Marks: 40
 - b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
 - c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS304	COMPILER DESIGN	3-0-0-3	2015
Course Objectives <i>To provide a thorough understanding of the internals of Compiler Design.</i>			
Syllabus Phases of compilation, Lexical analysis, Token Recognition, Syntax analysis, Bottom Up and Top Down Parsers, Syntax directed translation schemes, Intermediate Code Generation, Triples and Quadruples, Code Optimization, Code Generation.			
Expected Outcome Student is able to <ol style="list-style-type: none"> 1. <i>Explain the concepts and different phases of compilation with compile time error handling.</i> 2. <i>Represent language tokens using regular expressions, context free grammar and finite automata and design lexical analyzer for a language.</i> 3. <i>Compare top down with bottom up parsers, and develop appropriate parser to produce parse tree representation of the input.</i> 4. <i>Generate intermediate code for statements in high level language.</i> 5. <i>Design syntax directed translation schemes for a given context free grammar.</i> 6. <i>Apply optimization techniques to intermediate code and generate machine code for high level language program.</i> 			
Text Books <ol style="list-style-type: none"> 1. Aho A. Ravi Sethi and D Ullman. Compilers - Principles Techniques and Tools, Addison Wesley. 2. D. M.Dhamdhare, System Programming and Operating Systems, Tata McGraw Hill & Company. 			
References <ol style="list-style-type: none"> 1. Kenneth C. Loudon, Compiler Construction - Principles and Practice, Cengage Learning Indian Edition. 2. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company. 			

Course Plan			
Module	Contents	Hours	Sem. Exam Marks %
I	Introduction to compilers - Analysis of the source program, Phases of a compiler, Grouping of phases, compiler writing tools - bootstrapping Lexical Analysis: The role of Lexical Analyzer, Input Buffering, Specification of Tokens using Regular Expressions, Review of Finite Automata, Recognition of Tokens.	07	15%
II	Syntax Analysis: Review of Context-Free Grammars - Derivation trees and Parse Trees, Ambiguity. Top-Down Parsing: Recursive Descent parsing, Predictive parsing, LL(1) Grammars.	06	15%
FIRST INTERNAL EXAM			
III	Bottom-Up Parsing: Shift Reduce parsing - Operator precedence parsing (Concepts only) LR parsing - Constructing SLR parsing tables, Constructing, Canonical LR parsing tables and Constructing LALR parsing tables.	07	15%
IV	Syntax directed translation: Syntax directed definitions, Bottom- up evaluation of S-attributed definitions, L- attributed definitions, Top-down translation, Bottom-up evaluation of inherited attributes. Type Checking : Type systems, Specification of a simple type checker.	08	15%
SECOND INTERNAL EXAM			
V	Run-Time Environments: Source Language issues, Storage organization, Storage-		

	allocation strategies. Intermediate Code Generation (ICG): Intermediate languages - Graphical representations, Three-Address code, Quadruples, Triples. Assignment statements, Boolean expressions.	07	20%
VI	Code Optimization: Principal sources of optimization, Optimization of Basic blocks Code generation: Issues in the design of a code generator. The target machine, A simple code generator.	07	20%
END SEMESTER EXAM			

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3. Part B
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
 - a. Total marks : 12
 - b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
5. Part D
 - a. Total marks : 18

- b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
 - a. Total Marks: 40
 - b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
 - c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CS306	Computer Networks	3-0-0-3	2015
Course Objectives <ol style="list-style-type: none"> 1. To build an understanding of the fundamental concepts of computer networking. 2. To introduce the basic taxonomy and terminology of computer networking. 3. To introduce advanced networking concepts. 			
Syllabus <p>Concept of layering, LAN technologies (Ethernet), Flow and error control techniques, switching, IPv4/IPv6, routers and routing algorithms (distance vector, link state), TCP/UDP and sockets, congestion control, Application layer protocols.</p>			
Expected Outcome <p>Student is able to</p> <ol style="list-style-type: none"> 1. Describe the different aspects of networks, protocols and network design models. 2. Examine various Data Link layer design issues and Data Link protocols. 3. Analyse and compare different LAN protocols. 4. Compare and select appropriate routing algorithms for a network. 5. Examine the important aspects and functions of network layer, transport layer and application layer in internetworking. 			
Text Books <ol style="list-style-type: none"> 1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI. 2. Larry L. Peterson & Bruce S. Dave, Computer Networks-A Systems Approach, 5/e, Morgan Kaufmann, 2011. 3. Behrouz A. Forouzan, Data Communications and Networking, 4/e, Tata McGraw Hill. 			
References <ol style="list-style-type: none"> 1. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e. 2. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998. 3. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004. 4. W. Richard Stevens. TCP/IP Illustrated volume 1, Addison-Wesley. 5. Fred Halsall, Computer Networking and the Internet, 5/e. 6. Request for Comments (RFC) Pages - IETF -https://www.ietf.org/rfc.html 			

Course Plan			
Module	Contents	Hours	Sem. Exam Marks
I	Introduction - Uses - Network Hardware - LAN -MAN - WAN, Internetworks - Network Software - Protocol hierarchies - Design issues for the layers - Interface & Service - Service Primitives. Reference models - OSI - TCP/IP.	07	15%
II	Data Link layer Design Issues - Flow Control and ARQ techniques. Data link Protocols - HDLC. DLL in Internet. MAC Sub layer - IEEE 802 FOR LANs & MANs, IEEE 802.3, 802.4, 802.5. Bridges - Switches - High Speed LANs - Gigabit Ethernet. Wireless LANs - 802.11 a/b/g/n, 802.15.PPP	08	15%
FIRST INTERNAL EXAMINATION			
III	Network layer - Routing - Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, RIP, OSPF, Routing for mobile hosts.	07	15%
IV	Congestion control algorithms - QoS. Internetworking - Network layer in internet. IPv4 - IP Addressing - Classless and Classfull Addressing. Sub-netting.	07	15%
SECOND INTERNAL EXAMINATION			
V	Internet Control Protocols - ICMP, ARP, RARP, BOOTP. Internet Multicasting - IGMP, Exterior Routing Protocols - BGP. IPv6 - Addressing - Issues, ICMPv6.	07	20%
VI	Transport Layer - TCP & UDP. Application layer -FTP, DNS, Electronic mail, MIME, SNMP. Introduction to World Wide Web.	07	20%
END SEMESTER EXAM			

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5. Part D
 - a. Total marks : 18
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 - a. Total Marks: 40
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7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS308	Software Engineering and Project Management	3-0-0-3	2015
Pre-requisite:			
Course Objectives			
<ol style="list-style-type: none"> 1. To introduce the fundamental concepts of software engineering. 2. To build an understanding on various phases of software development. 3. To introduce various software process models. 			
Syllabus			
Introduction to software engineering, Software process models, Software development phases, Requirement analysis, Planning, Design, Coding, Testing, Maintenance.			
Expected Outcome			
Student is able to			
<ol style="list-style-type: none"> 1. Identify suitable life cycle models to be used. 2. Analyze a problem and identify and define the computing requirements to the problem. 3. Translate a requirement specification to a design using an appropriate software engineering methodology. 4. Formulate appropriate testing strategy for the given software system. 5. Develop software projects based on current technology, by managing resources economically and keeping ethical values. 			
References			
<ol style="list-style-type: none"> 1. Roger S. Pressman, Software Engineering : A practitioner's approach, McGraw Hill publication, Eighth edition, 2014 2. Walker Royce, Software Project Management : A unified frame work, Pearson Education, 1998 3. Ian Sommerville, Software Engineering, University of Lancaster, Pearson Education, Seventh edition, 2004. 			

4. K. K. Aggarwal and Yogesh Singh, Software Engineering, New age International Publishers, Second edition, 2005.
5. S.A. Kelkar, Software Project Management: A concise study, PHI, Third edition, 2012.

COURSE PLAN

Module	Contents	Hours	Sem. Exam Marks%
I	Introduction to software engineering- scope of software engineering - historical aspects, economic aspects, maintenance aspects, specification and design aspects, team programming aspects. Software engineering a layered technology - processes, methods and tools. Software process models - prototyping models, incremental models, spiral model, waterfall model.	07	15%
II	Process Framework Models: Capability maturity model (CMM), ISO 9000. Phases in Software development - requirement analysis- requirements elicitation for software, analysis principles, software prototyping, specification.	06	15%
FIRST INTERNAL EXAM			
III	Planning phase - project planning objective, software scope, empirical estimation models- COCOMO, single variable model, staffing and personal planning. Design phase - design process, principles, concepts, effective modular design, top down, bottom up strategies, stepwise	07	15%

	refinement.		
IV	Coding - programming practice, verification, size measures, complexity analysis, coding standards. Testing - fundamentals, white box testing, control structure testing, black box testing, basis path testing, code walk-throughs and inspection, testing strategies-Issues, Unit testing, integration testing, Validation testing, System testing.	07	15%
SECOND INTERNAL EXAM			
V	Maintenance-Overview of maintenance process, types of maintenance. Risk management: software risks - risk identification-risk monitoring and management. Project Management concept: People - Product-Process-Project.	07	20%
VI	Project scheduling and tracking: Basic concepts-relation between people and effort-defining task set for the software project-selecting software engineering task Software configuration management: Basics and standards User interface design - rules. Computer aided software engineering tools - CASE building blocks, taxonomy of CASE tools, integrated CASE environment.	08	20%
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6. Part E
 - a. Total Marks: 40
 - b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
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S6 - ELECTIVES

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS362	Computer Vision	3-0-0-3	2015
Pre-requisite NIL			
Course Objectives <ol style="list-style-type: none"> 1. To build an understanding on detailed models of image formation. 2. To expose the students to image feature detection and matching. 3. To introduce fundamental algorithms for pattern recognition. 4. To introduce various classification techniques. 5. To expose the students to various structural pattern recognition and feature extraction techniques. 			
Syllabus Image formation and Image model with Components of a vision system, Multiple images and the Geometry of multiple views, High level vision, Basics of pattern recognition, Linear discriminant based classifiers and tree classifiers, Unsupervised Methods, Recent Advances in Pattern Recognition.			
Expected Outcome Student is able to <ol style="list-style-type: none"> 1. Appreciate the detailed models of image formation. 2. Analyse the techniques for image feature detection and matching. 3. Apply various algorithms for pattern recognition. 4. Examine various clustering algorithms. 5. Analyze structural pattern recognition and feature extraction techniques. 			
Text Books: <ol style="list-style-type: none"> 1. David A. Forsyth & Jean Ponce, Computer vision – A Modern Approach, Prentice Hall, 2002. 			

2. Bernd Jahne and Horst HauBecker, Computer vision and Applications, Academic press, 2000.

References

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, 2004.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, John Wiley, 2001.
3. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
4. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

COURSE PLAN

Module	Contents	Hours	Sem. ExamMarks%
I	Image formation and Image model- Components of a vision system- Cameras- camera model and camera calibration- Radiometry- Light in space- Light in surface - Sources, shadows and shading.	06	15%
II	Multiple images-The Geometry of multiple views- Stereopsis- Affine structure from motion- Elements of Affine Geometry Affine structure and motion from two images- Affine structure and motion from multiple images- From Affine to Euclidean images.	07	15%
FIRST INTERNAL EXAM			
III	High level vision- Geometric methods- Model based vision- Obtaining hypothesis by pose consistency, pose clustering and using Invariants, Verification.	07	15%

IV	Introduction to pattern and classification, supervised and unsupervised learning, Clustering Vs classification, Bayesian Decision Theory- Minimum error rate classification Classifiers, discriminant functions, decision surfaces- The normal density and discriminant-functions for the Normal density.	07	15%
SECOND INTERNAL EXAM			
V	Linear discriminant based classifiers and tree classifiers Linear discriminant function based classifiers- Perceptron- Minimum Mean Squared Error (MME) method, Support Vector machine, Decision Trees: CART, ID3.	07	20%
VI	Unsupervised Methods Basics of Clustering; similarity / dissimilarity measures; clustering criteria. Different distance functions and similarity measures, K-means algorithm. Recent Advances in Pattern Recognition Neural network structures for pattern recognition, Pattern classification using Genetic Algorithms.	08	20%
END SEMESTER EXAM			

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 - a. Total Marks: 40
 - b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
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7. There should be at least 60% analytical/numerical questions.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS364	Mobile Computing	3-0-0-3	2015
Pre-requisite			
1. CS307 Data Communication			
Course Objectives			
1. To impart basic understanding of the wireless communication systems.			
2. To expose students to various aspects of mobile and ad-hoc networks.			
Syllabus			
Mobile Computing Application and Services, Mobile Computing Architecture, Emerging Technologies, Intelligent Networks and Internet, Wireless LAN, MAC layer routing, Mobile transport layer Security Issues in mobile computing.			
Expected Outcome			
Student is able to			
1. Explain various Mobile Computing application, services and architecture.			
2. Understand various technology trends for next generation cellular wireless networks.			
3. Describe protocol architecture of WLAN technology.			
4. Understand Security Issues in mobile computing.			
Text Books			
1. Asoke K. Talukder, Hasan Ahmad, Mobile Computing Technology- Application and Service Creation, 2 nd Edition, McGraw Hill Education.			
2. Jochen Schiller, Mobile Communications, Pearson Education Asia, 2008.			
3. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.			
4. Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, Wiley Publishers, 2015			
References			
1. Andrew S. Tanenbaum, Computer Networks, PHI, Third edition, 2003.			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks %
I	Introduction to mobile computing, Middleware and Gateways, Application and services, Internet-Ubiquitous networks, Architecture and three-tier architecture for Mobile Computing, Design	06	15%

	consideration for Mobile Computing.		
II	Spread spectrum - Direct sequence, Frequency hopping. Medium Access Control - SDMA, FDMA, TDMA, CDMA, Cellular concepts- channel assignment strategy- hand off strategy interface and system capacity- improving coverage and capacity in cellular system, Satellite Systems-GEO, LEO, MEO. Wireless Communication Systems- Telecommunication Systems- GSM- GSM services & features, architecture -DECT features & characteristics, architecture.	06	15%
FIRST INTERNAL EXAM			
III	Wireless LANS: Wireless LAN Standards - IEEE 802 Protocol Architecture, IEEE 802.11 System Architecture, Protocol Architecture & Services, Cellular Networks: Channel allocation, multiple access, location management, Handoffs. MAC Layer & Management, Routing - Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, Mobile Agents, Service Discovery.	07	15%
IV	Mobile internet-mobile network layer-mobile IP-dynamic host configuration protocol-, mobile transport layer-implications of TCP on mobility-indirect TCP-snooping TCP- mobile TCP transmission-selective retransmission, Transaction oriented TCP- Support for mobility-file systems-WAP.	07	15%
SECOND INTERNAL EXAM			
V	Mobile Transport Layer - Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks. Protocols and Platforms for Mobile Computing - WAP, Bluetooth, XML, J2ME, JavaCard, PalmOS, Linux for Mobile Devices, Android.	08	20%

VI	Security issues in mobile computing, Information Security, Components of Information Security, Next Generation Networks- LTE - Architecture & Interface - LTE radio planning and tools, 5G architecture, MIMO, Super core concept, Features and Application Case Study - Setting up an adhoc network system, LiFi.	08	20%
END SEMESTER EXAM			

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5. Part D
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
 - a. Total Marks: 40

- b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
- c. A question can have a maximum of three sub-parts.

Course No.	Course Name	L-T-P Credits	Year of Introduction
CS366	Natural language processing	3-0-0-3	2015
Course Objectives			
<ol style="list-style-type: none"> To introduce the fundamentals of Language processing from the algorithmic viewpoint. To discuss various issues those make natural language processing a hard task. To discuss some applications of Natural Language Processing (NLP). 			
Syllabus			
Levels of Language Analysis, Syntax, Semantics and Pragmatics of Natural Language, Language Processing, Issues and approaches to solutions, Applications of Natural Language Processing (NLP).			
Expected Outcome			
Student is able to			
<ol style="list-style-type: none"> appreciate the fundamental concepts of Natural Language Processing. design algorithms for NLP tasks. develop useful systems for language processing and related tasks involving text processing. 			
Text Books			
<ol style="list-style-type: none"> James Allen, Natural Language Understanding, The Benjamin/Cummings Publishing Company Inc., Redwood City, CA. D. Jurafsky and J. H. Martin, Speech and Language Processing, Prentice Hall India. 			
References			
<ol style="list-style-type: none"> Charniak, Eugene, Introduction to Artificial intelligence, Addison-Wesley. Ricardo Baeza-Yates and BerthierRibeiro-Neto, Modern Information Retrieval, Addison-Wesley,1999. U. S. Tiwary and TanveerSiddiqui, Natural Language Processing and Information Retrieval, Oxford University Press. 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks %
I	Introduction to Natural Language Understanding- Levels of language analysis- Syntax, Semantics, Pragmatics. Linguistic Background- An Outline of English Syntax.	10	15%
II	Lexicons, POS Tagging, Word Senses.	10	15%

	Grammars and Parsing- Features, Agreement and Augmented Grammars.		
FIRST INTERNAL EXAM			
III	Grammars for Natural Language, Parsing methods and Efficient Parsing. Ambiguity Resolution- Statistical Methods. Probabilistic Context Free Grammar.	12	15%
IV	Semantics and Logical Form: Linking Syntax and Semantics- Ambiguity Resolution- other Strategies for Semantic Interpretation- Scoping and the Interpretation of Noun Phrases.	08	15%
SECOND INTERNAL EXAM			
V	Knowledge Representation and Reasoning- Local Discourse Context and Reference- Using World Knowledge- Discourse Structure- Defining a Conversational Agent.	10	20%
VI	Applications- Machine Translation, Information Retrieval and Extraction, Text Categorization and Summarization.	06	20%
END SEMESTER EXAM			

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 - a. Total marks : 12

- b. Four questions each having 3 marks, uniformly covering modules III and IV; All four questions have to be answered.
5. Part D
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts.
6. Part E
 - a. Total Marks: 40
 - b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
 - c. A question can have a maximum of three sub-parts.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS368	Web Technologies	3-0-0-3	2015
Course Objectives			
<ol style="list-style-type: none"> 1. To impart the design, development and implementation of Dynamic Web Pages. 2. To develop programs for Web using Scripting Languages. 3. To give an introduction to Data Interchange formats in Web. 			
Syllabus			
Basics of Internet and World Wide Web, HTML and XHTML, Cascading Style Sheets, Frameworks, Basics of JavaScript, JQuery, Introduction to XML and JSON, Overview of PHP			
Expected Outcome			
Student is able to			
<ol style="list-style-type: none"> 1. Understand different components in web technology and to know about CGI and CMS. 2. Develop interactive Web pages using HTML/XHTML. 3. Present a professional document using Cascaded Style Sheets. 4. Construct websites for user interactions using JavaScript and JQuery. 5. Know the different information interchange formats like XML and JSON. 6. Develop Web applications using PHP. 			
Text Books			
<ol style="list-style-type: none"> 1. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc., 2014. 2. P. J. Deitel, H.M. Deitel, Internet & World Wide Web How To Program, 4/e, Pearson International Edition 2010. 			
References			
<ol style="list-style-type: none"> 1. Bob Boiko, Content Management Bible, 2nd Edition, Wiley Publishers. [Chapter 1, 2] 2. Matthew MacDonald, WordPress: The Missing Manual, 2nd Edition, O'Reilly Media. [Chapter 1] 3. Bear Bibeault and Yehuda Katz, jQuery in Action, Second Edition, Manning Publications. [Chapter 1] 4. Lindsay Bassett, Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON 1st Edition, O'Reilly. [Chapter 1,2,3,4] 5. DreamTech, Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX, 			

<p>Black Book, Kogent Learning Solutions Inc. 2009.</p> <p>6. Chris Bates, Web Programming Building Internet Applications, 3/e, Wiley India Edition 2009.</p> <p>7. Jeffrey C Jackson, Web Technologies A Computer Science Perspective, Pearson Education Inc. 2009.</p>			
<p>Web Resources</p> <ol style="list-style-type: none"> 1. www.w3.org/CGI/ 2. old.tree.ro/en/strategy-white-papers/content-management-systems.pdf 3. httpd.apache.org/download.cgi 4. https://alistapart.com/article/frameworks 5. http://getbootstrap.com/css/ 6. https://www.w3.org/TR/WD-DOM/introduction.html 			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks %
I	<p>Introduction to the Internet: The World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol. Common Gateway Interface(CGI), Content Management System – Basics</p> <p><i>Case Study:</i> Apache Server, WordPress.</p>	06	15%
II	<p>Introduction to HTML/XHTML : Origins and Evolution of HTML and XHTML, Basic Syntax of HTML, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5, Syntactic Differences between HTML and XHTML.</p>	07	15%
FIRST INTERNAL EXAM			
III	<p>Introduction to Styles sheets and Frameworks</p> <p>Cascading Style Sheets: Levels of Style Sheets - Style Specification Formats, Selector Forms, Property-Value Forms, Font Properties, List Properties, Alignment of Text, Color, The Box Model, Background</p>	06	15%

	Images, The span and div Tags. Frameworks: Overview and Basics of Responsive CSS Frameworks - Bootstrap.		
IV	Introduction to JavaScript and jQuery The Basics of JavaScript: Overview of JavaScript, Object Orientation and JavaScript, General Syntactic Characteristics- Primitives, Operations, and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions. Callback Functions, Java Script HTML DOM. Introduction to jQuery: Overview and Basics.	07	15%
SECOND INTERNAL EXAMINATION			
V	Introduction to Data Interchange Formats XML: The Syntax of XML, XML Document Structure, Namespaces, XML Schemas, Displaying Raw XML Documents, Displaying XML Documents with CSS, XSLT Style Sheets, XML Applications. JSON(Basics Only): Overview, Syntax, Datatypes, Objects, Schema, Comparison with XML.	08	20%
VI	Introduction to PHP: Origins and Uses of PHP, Overview of PHP - General Syntactic Characteristics - Primitives, Operations, and Expressions - Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Cookies, Session Tracking.	08	20%
END SEMESTER EXAM			

Assignment:

It is highly recommended to give assignment based on:

1. JavaScript Frameworks (like AngularJS or/and NodeJS)
2. Any PHP web app based on frameworks (like Laravel, CodeIgniter, CakePHP, Zend etc.)

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
 - a. Total marks : 12
 - b. Four questions each having 3 marks, uniformly covering modules I and II; Allfour questions have to be answered.
3. Part B
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
 - a. Total marks : 12
 - b. Four questions each having 3 marks, uniformly covering modules III and IV; Allfour questions have to be answered.
5. Part D
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
 - a. Total Marks: 40
 - b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
 - c. A question can have a maximum of three sub-parts.

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS372	HIGH PERFORMANCE COMPUTING	3-0-0-3	2015
Pre-requisites			
<ol style="list-style-type: none"> 1. BE101-05 Introduction to Computing & Problem Solving 2. CS203 Switching Theory and Logic Design 3. CS202 Computer Organization and Architecture 			
Course Objectives			
<ol style="list-style-type: none"> 1. <i>To introduce the concepts of Modern Processors.</i> 2. <i>To introduce Optimization techniques for serial code.</i> 3. <i>To introduce Parallel Computing Paradigms.</i> 4. <i>To introduce Parallel Programming using OpenMP and MPI.</i> 			
Syllabus			
<p>Modern processors - pipelining-superscalarity-multicore processors- Mutithreaded processors- vector processors- basic optimization techniques for serial code - taxonomy of parallel computing paradigms- shared memory computers- distributed-memory computers- Hierarchical Systems- networks- basics of parallelization - data parallelism - function parallelism- Parallel scalability- shared memory parallel programming with OpenMp - Distributed-memory parallel programming with MPI.</p>			
Expected Outcome			
<p>Student is able to</p> <ol style="list-style-type: none"> 1. <i>appreciate the concepts used in Modern Processors for increasing the performance.</i> 2. <i>appreciate Optimization techniques for serial code.</i> 3. <i>appreciate Parallel Computing Paradigms.</i> 4. <i>identify the performance issues in Parallel Programming using OpenMP and MPI.</i> 			
Text Book			
<ol style="list-style-type: none"> 1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series, 2011. 			

References			
1. Charles Severance, Kevin Dowd, High Performance Computing, O'Reilly Media, 2nd Edition, 1998. 2. Kai Hwang, Faye Alaye Briggs, Computer Architecture and Parallel Processing, McGraw Hill, 1984.			
Course Plan			
Module	Contents	Hours	Sem. Exam Marks %
I	Modern Processors : Stored Program Computer Architecture- General purpose cache- based microprocessor-Performance based metrics and benchmarks- Moore's Law- Pipelining- Superscalarity- SIMD- Memory Hierarchies Cache- mapping- prefetch- Multicore processors- Mutithreaded processors- Vector Processors- Design Principles- Maximum performance estimates- Programming for vector architecture.	07	15%
II	Basic optimization techniques for serial code : scalar profiling- function and line based runtime profiling- hardware performance counters- common sense optimizations- simple measures, large impact- elimination of common subexpressions- avoiding branches- using simd instruction sets- the role of compilers - general optimization options- inlining - aliasing- computational accuracy- register optimizations- using compiler logs- c++ optimizations - temporaries- dynamic memory management- loop kernels and iterators data access optimization: balance analysis and lightspeed estimates- storage order- case study: jacobi algorithm and dense matrix transpose.	07	15%
FIRST INTERNAL EXAM			

III	Parallel Computers : Taxonomy of parallel computing paradigms- Shared memory computers- Cache coherence- UMA - ccNUMA- Distributed-memory computers- Hierarchical systems- Networks- Basic performance characteristics- Buses- Switched and fat-tree networks- Mesh networks- Hybrids - Basics of parallelization - Why parallelize - Data Parallelism - Function Parallelism- Parallel Scalability- Factors that limit parallel execution- Scalability metrics- Simple scalability laws- parallel efficiency - serial performance Vs Strong scalability- Refined performance models- Choosing the right scaling baseline- Case Study: Can slow processors compute faster- Load balance.	07	15%
IV	Distributed memory parallel programming with MPI : message passing - introduction to MPI - example - messages and point-to-point communication - collective communication - nonblocking point-to-point communication- virtual topologies - MPI parallelization of Jacobi solver- MPI implementation - performance properties	08	15%
SECOND INTERNAL EXAM			
V	Shared memory parallel programming with OpenMp : introduction to OpenMp - parallel execution - data scoping- OpenMp work sharing for loops- synchronization - reductions - loop scheduling - tasking - case study: OpenMp- parallel jacobi algorithm- advanced OpenMpwavefront parallelization- Efficient OpenMP programming: Profiling OpenMP programs - Performance pitfalls- Case study: Parallel Sparse matrix-vector multiply.	08	20%

VI	Efficient MPI programming : MPI performance tools-communication parameters- Synchronization, serialization, contention- Reducing communication overhead- optimal domain decomposition- Aggregating messages - Nonblocking Vs Asynchronous communication- Collective communication- Understanding intra-node point-to-point communication.	08	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper - A, B, C, D, E
2. Part A
 - a. Total marks : 12
 - b. Four questions each having 3 marks, uniformly covering modules I and II; Allfour questions have to be answered.
3. Part B
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
 - a. Total marks : 12
 - b. Four questions each having 3 marks, uniformly covering modules III and IV; Allfour questions have to be answered.
5. Part D
 - a. Total marks : 18
 - b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
6. Part E
 - a. Total Marks: 40

- b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
 - c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

S6 - LABORATORY COURSES

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS332	MICROPROCESSOR LAB	0-0-3-1	2015
Pre-requisite			
1. CS305 Microprocessors and Microcontrollers			
Course Objectives			
<ol style="list-style-type: none"> 1. To practice assembly language programming on 8086. 2. To practice fundamentals of interfacing/programming various peripheral devices with microprocessor/microcontroller. 			
List of Exercises/ Experiments: (Minimum 12 Exercises/ Experiments are mandatory. Exercises/ Experiments marked with * are mandatory)			
I. Assembly Language Programming Exercises/Experiments using 8086 Trainer kit			
<ol style="list-style-type: none"> 1. Implementation of simple decimal arithmetic and bit manipulation operations.* 2. Implementation of code conversion between BCD, Binary, Hexadecimal and ASCII. 3. Implementation of searching and sorting of 16-bit numbers. 4. Programming exercises using stack and subroutines.* 			
II. Exercises/Experiments using MASM (PC Required)			
<ol style="list-style-type: none"> 5. Study of Assembler and Debugging commands. 6. Implementation of decimal arithmetic(16 and 32 bit) operations.* 7. Implementation of String manipulations.* 8. Implementation of searching and sorting of 16-bit numbers. 9. Implementation of Matrix operations like addition, transpose, multiplication etc. 			
III. Interfacing Exercises/Experiments with 8086 trainer kit through Assembly Language Programming			
<ol style="list-style-type: none"> 10. Interfacing with stepper motor - Rotate through any given sequence.* 11. Interfacing with 8255 (mode0 and mode1 only).* 12. Interfacing with 8279 (Rolling message, 2 key lock out and N-key roll over implementation).* 13. Interfacing with 8253/54 Timer/Counter. 			

14. Interfacing with Digital-to-Analog Converter.*

15. Interfacing with Analog-to-Digital Converter.

16. Interfacing with 8259 Interrupt Controller.

IV. Exercises/Experiments using 8051 trainer kit

17. Familiarization of 8051 trainer kit by executing simple Assembly Language programs such as decimal arithmetic and bit manipulation.*

18. Implementation of Timer programming (in mode1).

19. Implementation of stepper motor interfacing, ADC/DAC interfacing and sensor interfacing with 8251 through Assembly Language programming.

Expected Outcome

Student is able to

- 1. Develop assembly language programs for problem solving using software interrupts and various assembler directives.*
- 2. Implement interfacing of various I/O devices to the microprocessor/microcontroller through assembly language programming.*

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS334	Network Programming Lab	0-0-3-1	2015
Pre-requisite			
<ol style="list-style-type: none"> 1. CS307 Data Communication 2. CS306 Computer Networks 			
Course Objectives			
<ol style="list-style-type: none"> 1. To introduce Network related commands and configuration files in Linux Operating System. 2. To introduce tools for Network Traffic Analysis and Network Monitoring. 3. To practice Network Programming using Linux System Calls. 4. To design and deploy Computer Networks. 			
List of Exercises/ Experiments (12 Exercises/ Experiments are to be completed . Exercises/ Experiments marked with * are mandatory)			
<ol style="list-style-type: none"> 1. Getting started with Basics of Network configurations files and Networking Commands in Linux. 2. To familiarize and understand the use and functioning of System Calls used for Operating system and network programming in Linux. 3. <u>Familiarization and implementation of programs related to Process and thread.</u> 4. <u>Implement the First Readers-Writers Problem.</u> 5. <u>Implement the Second Readers-Writers problem.</u> 6. <u>Implement programs for Inter Process Communication using PIPE, Message Queue and Shared Memory.</u> 7. Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.* 8. Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.* 9. Implement a multi user chat server using TCP as transport layer protocol.* 10. Implement Concurrent Time Server application using UDP to execute the program at remoteserver. Client sends a time request to the server, server sends its system time back to the client. Client displays the result.* 11. Implement and simulate algorithm for Distance vector routing protocol. 12. Implement and simulate algorithm for Link state routing protocol. 			

13. Implement Simple Mail Transfer Protocol.*
14. Develop concurrent file server which will provide the file requested by client if it exists. If not server sends appropriate message to the client. Server should also send its process ID (PID) to clients for display along with file or the message.*
15. Using Wireshark observe data transferred in client server communication using UDP and identify the UDP datagram.
16. Using Wireshark observe Three Way Handshaking Connection Establishment, Data Transfer and Three Way Handshaking Connection Termination in client server communication using TCP.
17. Develop a packet capturing and filtering application using raw sockets.
18. Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.*
19. Install network simulator NS-2 in any of the Linux operating system and simulate wired and wireless scenarios.

Expected Outcome

Student is able to

1. *Use network related commands and configuration files in Linux Operating System.*
2. *Develop operating system and network application programs.*
3. *Analyze network traffic using network monitoring tools.*