KERALA TECHNOLOGICAL UNIVERSITY

(THRISSUR CLUSTER - 07)

SCHEME AND SYLLABI

of

M. TECH.

in

COMPUTER SCIENCE AND ENGINEERING

OFFERING DEPARTMENT

COMPUTER SCIENCE AND ENGINEERING

CLUSTER LEVEL GRADUATE PROGRAM COMMITTEE

1.	Dr Devdas Menon, Professor, IIT Madras, Chennai	Chairman
2	Principal, Government Engineering College Trichur, Thrissur	Convener
3	Principal, AXIS College of Engineering & Technology, East Kodaly, Murikkingal, Thrissur	Member
4	Principal, IES College of Engineering, Chittilapilly, Thrissur	Member
5	Principal, MET'S School of Engineering, Mala, Thrissur	Member
6	Principal, Royal College of Engineering & Technology, Akkikkavu, Thrissur	Member
7	Principal, Vidya Academy of Science & Technology, Thalakkottukara, Thrissur	Member
8	Principal, Thejus Engineering College, Vellarakkad, Erumappetty, Thrissur	Member
9	Principal, Universal Engineering College, Vallivattom, Konathakunnu, Thrissur	Member
10	Principal, Sahrdaya College of Engineering & Technology, Kodakara, Thrissur	Member

CERTIFICATE

This is to certify that

1. The scheme and syllabi are prepared in accordance with the regulation and guidelines issued by the KTU from time to time and also as per the decisions made in the CGPC meetings.
2. The suggestions/modifications suggested while presenting the scheme and syllabi before CGPC on 25.6.2015 have been incorporated.
3. There is no discrepancy among the soft copy in MS word format, PDF and hard copy of the syllabi submitted to the CGPC.
4. The document has been verified by all the constituent colleges.

Coordinator in charge of syllabus revision of the programme

(Name, designation and College Name)

Principal of the lead college

(Name and College Name)

Principals of the colleges in which the programme is offered

No	Name of the college	Principal's Name	Signature
1	Government Engineering College Thrissur		
2	IES College of Engineering, Chittilapilly, Thrissur		
3	MET'S School of Engineering, Mala, Thrissur		
4	Royal College of Engineering & Technology, Akkikkavu, Thrissur		
5	Vidya Academy of Science & Technology, Thalakkottukara, Thrissur		
6	Thejus Engineering College, Vellarakkad, Erumappetty, Thrissur		
7	Sahrdaya College of Engineering & Technology, Kodakara, Thrissur		

Date: Chairman
Place:

VISION and MISSION of the Programme

VISION

To become a center of excellence in the field of computer science and to be the cradle of pioneering research in this field.

MISSION

To provide quality education and training to the students, through rigorous academic and research oriented activities in the field of computer science, which may bring innovation in daily endeavours for the betterment of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To enable graduates to be proficient in identifying and solving computing problems by applying their knowledge in mathematics and computer science using modern computing tools.

2. To enable graduates to develop a research attitude in the field of computer science and to utilize it in their higher education endeavours and lifelong teaching-learning process.

3. To enable students to acquire verbal skill to communicate effectively with team members, constituents, and the public which enable them to collaborate as team members and team leaders.

4. To enable graduates to maintain professional work ethics and obligation with the prevalent cyber laws.

5. To inculcate awareness of professional and social responsibility so that they can contribute to society through active engagement with professional societies, schools, civic organizations or other community activities.

PROGRAM OUTCOMES (POs)

A. Graduates get an ability to analyze and apply fundamental principles of computing and mathematics as appropriate to the discipline of computer science and engineering.

B. Graduates will demonstrate the proficiency in understanding of various computer programming languages and knowledge of various technologies in computer system

C. Graduates will demonstrate an ability to apply mathematical foundations, algorithmic principles and computer science theory, in the modeling and design of computer based system.

D. Graduates will demonstrate an ability to use techniques, skills to analyze and investigate complex problems through research and effectively utilize appropriate modern engineering tools to solve it.

E. Graduates will possess sustainable, inclusive technology for societal and environmental contexts.

F. Graduates will be able to communicate effectively and develop confidence in self and life-long learning.

G. Graduates will possess leadership, project management and financial skills with professional ethics.

Scheme of M.Tech Programme in Computer Science and Engineering

Semester 1

Exam Slot	Course Code	Subject	Hours/Week			Marks		Total Marks	Sem end exam duration (Hours)	Credits
			L	T	P/D	Internal	Sem-end			
A	07MA 6011	Mathematical Foundations of Computer Science	4	0	0	40	60	100	3	4
B	07CS 6101	Advanced Software Engineering	4	0	0	40	60	100	3	4
C	07CS 6103	Algorithms and Complexity	4	0	0	40	60	100	3	4
D	07CS 6105	Topics in Database Systems and Design	3	0	0	40	60	100	3	3
E		Elective - 1	3	0	0	40	60	100	3	3
	07GN 6001	Research Methodology	0	2	0	100	0	100	-	2
	07CS 6115	Advanced Programming Lab	0	0	2	100	0	100	-	1
	07CS 6117	Introduction to Seminar	0	1	0	-	-	-	-	-
	TOTAL		18	2	2	400	300	700		21

Elective – 1

07CS 6107 Artificial Intelligence
07CS 6109 Advanced Networking Technologies
07CS 6111 Distributed and Mobile Operating Systems
07CS 6113 Digital Image Processing

Semester 2

Exam. Slot	Course Code	Subject	Hours/Week			Marks		Total Marks	Sem end exam duration (Hours)	Credits
			L	T	P/D	Internal	Sem-end			
A	07CS 6102	Advanced Compiler Design	4	0	0	40	60	100	3	4
B	07CS 6104	Advanced Parallel Computing	3	0	0	40	60	100	3	3
C	07CS 6106	Machine Learning and Language Processing	3	0	0	40	60	100	3	3
D		Elective - 2	3	0	0	40	60	100	3	3
E		Elective - 3	3	0	0	40	60	100	3	3
	07CS 6124	Seminar-1	0	0	2	100	0	100	-	2
	07CS 6126	Mini Project	0	0	4	100	0	100	-	2
	07CS 6128	Advanced Research lab	0	0	2	100	0	100	-	1
	TOTAL		16	0	8	500	300	800		21

Elective – 2

07CS 6108 **Data Compression**
07CS 6110 **Advanced Topics in Information Security**
07CS 6112 **Software Quality Assurance and Reliability**
07CS 6114 **Cloud Computing**

Elective – 3

07CS 6116 **High Performance and Secure Networks**
07CS 6118 **Bio Informatics**
07CS 6120 **Soft Computing**
07CS 6122 **Lambda Calculus**

Semester 3

Exam. Slot	Course Code	Subject	Hours/Week			Marks		Total Marks	Sem end exam duration (Hours)	Credits
			L	T	P/D	Internal	Sem-end			
A		Elective - 4	3	0	0	40	60	100	3	3
B		Elective - 5	3	0	0	40	60	100	3	3
	07CS 7117	Seminar - 2	0	0	2	100	0	100	-	2
	07CS 7119	Master Research Project Phase I	0	0	12	Guide: 20 / EC: 30	0	50	-	6
	TOTAL		6	0	14	230	120	350		14

Elective – 4

07CS 7101 Wireless Communication Techniques
07CS 7103 Advanced Machine Learning
07CS 7105 Computer Vision
07CS 7107 Optimization Techniques

Elective – 5

07CS 7109 Ad-hoc Wireless Networks
07CS 7111 Advanced Cryptography
07CS 7113 Combinatorial Algorithms
07CS 7115 Big-data Analytics

Semester 4

Course Code	Subject	Hours/Week			Marks		Sem end exam	Total Marks	Credits
		L	T	P/D	Guide	Evaluation Committee	External Examiner		
07CS 7102	Master Research Project Phase II	0	0	21	30	40	30	100	12
TOTAL		0	0	21	30	40	30	100	12

L- Lecture T-Tutorial P-Practical

Note: The student has to undertake the departmental work assigned by HOD

Total credits for all semesters: 68

SEMESTER -1

07MA 6011 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Credits: 4-0-0: 4 **Year:** 2015

Pre-requisites: Vector spaces and Probability distributions.

Course Objectives: To familiarize the students with certain concepts in mathematical structures *viz*. vector spaces, linear transformations, wavelets, groups, rings, fields, probability inequalities, limit theorems, Markov models, queuing networks, *etc*.

Syllabus: Linear transformations, matrix of linear transformations, orthogonality of functions, discrete wavelet transform, groups, co-sets, rings, fields, conditional probability, probability inequalities, law of large numbers, central limit theorem, classification of stochastic processes, Markov processes, stationary processes, Poisson process, birth and death processes, queuing models and open networks.

Course Outcomes: These concepts will help the students to appreciate (*i*) algebraic structures applied as a tool in signal and image processing, coding and algorithms and (*ii*) probabilistic methods in assessing the performance measures of various computer network configurations. Consequently, they will demonstrate an ability to integrate mathematical structures, algorithmic principles and computer science theory in the modelling and design of computer based systems. Thus this course empowers students with problem analysis skills and imbibes interest in investigating possible applications of certain mathematical structures in their field of study.

References:

1. Chee-Hock, Ng and Boon-Hee, Soong (2008), *Queuing Modelling Fundamentals with Applications in Communication Networks*, 2nd Edn., Wiley.
2. Gubner J A (2006), *Probability and Random Processes for Electrical and Computer Engineers*, Cambridge University Press, Cambridge, New York
3. Klima, R E; Sigmon, N and Stitzinger, E (1999), *Applications of Abstract Algebra with Maple*, CRC Press, Boca Raton.
4. Medhi, J (2009), *Stochastic Processes*, 3rd Edn., New Age International (P) Ltd., New Delhi.
5. Soman, K P; Ramachandran, K I and Resmi, N G (2013), *Insight into Wavelets, from Theory to Practice*, 3rd Edn., PHI Learning, Delhi.
6. Strang, G (2008), *Introduction to Linear Algebra*, 4th Edn., Wellesley-Cambridge Press, MA, USA.

Course Plan

COURSE NO: 07MA 6011 **COURSE TITLE: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE** **(L-T-P : 4-0-0) CREDITS: 4**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Linear algebra (8 hours)** Linear transformations Matrix of linear transformations Diagonalization	 4 2 2	 15
MODULE : 2 **Discrete wavelet transform (8 hours)** Discrete wavelet transform Haar scaling function, Haar wavelet function and their orthogonality Haar bases	 3 3 2	 15
FIRST INTERNAL TEST		
MODULE : 3 **Abstract Algebra (8 hours)** Groups, permutations groups Cosets, quotient groups Rings, Euclidean domains Finite fields	 2 2 2 2	 15
MODULE : 4 **Probability (8 hours)** Conditional probability, independence Probability inequalities (Markov, Chebychev & Chernoff) Chebychev's & Khintchin's weak law of large numbers Lindeberg-Levy central limit theorem	 2 2 2 2	 15
SECOND INTERNAL TEST		
MODULE : 5 **Stochastic processes (12 hours)** Specification/ classification of processes Brief description of Markov processes/ chains & renewal processes Strict and wide sense stationary processes Poisson process Birth and death processes	 2 2 3 3 2	 20
MODULE : 6 **Queuing models (12 hours)** M/M/1 M/M/s M/M/s/k Tandem queues Jackson open queuing networks.	 3 2 2 2 3	 20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6101 ADVANCED SOFTWARE ENGINEERING

Credits: 4-0-0: 4 **Year:** 2015

Pre-requisite: Software Engineering

Course Objectives

- To understand various phases and life-cycle models
- Learn the importance of Analysis and Design
- To understand and apply software metrics in analysis and estimation

Syllabus

Basic Concepts, Software life-cycle models, Metrics for Project size Estimation. Project Estimation Techniques, Staffing Level Estimation, Software Requirements Specification, function oriented design using SA/SD, Software quality and maintenance, Models for automated Analysis of programs, Computer-Aided Software Engineering (CASE).

Course Outcomes

- Students will be familiar with software industry processes.
- They learn importance and various techniques for estimation.
- Students get to know the different metrics and its use in estimation.
- Students get a practical experience using and familiarizing software engineering tools.

References:

1. Rajib Mall, *Fundamentals of Software Engineering*, Prentice Hall India.
2. Pankaj Jalote, *An integrated approach to Software Engineering*, Springer/Narosa.
3. Roger S. Pressman, *Software Engineering: A practitioner's approach*, McGraw Hill.
4. Ian Sommerville, Software *Engineering*, Addison-Wesley.
5. KK Aggarwal and Yogesh Singh, *Software Engineering*, New Age

Course Plan

COURSE NO: 07CS 6101 COURSE TITLE: ADVANCED SOFTWARE ENGINEERING (L-T-P : 4-0-0) CREDITS: 4		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Basic Concepts (8 hours)**		15
Software life-cycle models – Waterfall model and its extensions, Rapid Application Development(RAD),	3	
Agile Development Models, Spiral Models,	3	
Comparison of different models,	1	
Software Project Management-Project Planning, Metrics for Project size Estimation,	2	
MODULE : 2 **Project Estimation Techniques (8 hours)**		15
Basic COCOMO Model, Intermediate COCOMO, Complete COCOMO, COCOMO2,	3	
Halstead's Technique, Staffing Level Estimation, Scheduling, Organization and Team Structure,	3	
Risk Management,	1	
Software Configuration Management	1	
FIRST INTERNAL TEST		
MODULE : 3 **Software Requirements Specification, Formal Requirements Specification and Verification (16 hours)**		15
Axiomatic and Algebraic specifications,	6	
Software Design, function oriented design using SA/SD, object-oriented design using UML, Design Patterns, OOAD Methodology, User Interface Design, Coding, Unit Testing, Integration Testing and Systems Testing, Debugging Techniques.	10	
MODULE : 4 **Software quality (9 hours)**		15
SEI CMM and ISO-9000.	3	
Software Reliability and Fault-Tolerance,	3	
Software Maintenance, Software Metrics	3	
SECOND INTERNAL TEST		
MODULE : 5 **Models for automated Analysis of programs (6 hours)**		20
Control flow graphs,	2	
System Dependence Graphs for procedural programs,	2	
System Dependence Graphs for OOP (ClDG)	2	
MODULE : 6 **Computer-Aided Software Engineering (CASE) (9 hours)**		20
Software Reuse,	2	
Component-Based Software Development,	2	
Extreme Programming.	2	
Familiarization of PlantUML, MAKE, Cobertura, Selenium.	3	

Internal continuous assessment: 40 marks

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07CS 6103 ALGORITHMS AND COMPLEXITY

Credits: 4-0-0: 4 **Year:** 2015

Pre-requisite: Design and Analysis of Algorithms

Course Objective:

To provide an introduction to the different complex algorithms in computer programming such as graph algorithms randomized algorithms etc. and the complexity classes such as NP-Hard and NP-Complete problems.

Syllabus:

RAM model – Asymptotic notation, standard notations and common functions, Recurrences, Proof of master theorem. Amortized analysis, Dynamic tables, Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, Disjoint Sets, Union by Rank and Path Compression. Graph Algorithms and complexity, Single source shortest paths, All-Pairs Shortest Paths, Johnson's algorithm for sparse graphs. Maximum flow, Maximum bipartite matching, Greedy algorithms and Matroid theory. Randomized Algorithms - Finger printing, Pattern matching, Interactive proof systems. Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions. Polynomial Time and Fully Polynomial time Approximation Schemes. Introduction to probabilistic complexity classes.

Course Outcomes:

This course empowers students with problem analysis skills, students also gain expertise for the design and development of algorithm for computing problems, and enables the students to model a complex problem using mathematical techniques.

References

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, *Introduction to Algorithms*, Prentice Hall India, 1990.
2. V. Aho, J. E. Hopcraft, J. D. Ullman, *The design and Analysis of Computer Algorithms*, Addison Wesley, 1974.
3. S. Basse, *Computer Algorithms: Introduction to Design and Analysis*, Addison Wesley, 1998.
4. Dexter Kozen, *The Design and Analysis of Algorithms*, Springer, 1992.
5. U. Manber, *Introduction to Algorithms: A creative approach*, Addison Wesley, 1989.
6. R. Motwani and P. Raghavan, *Randomized Algorithms*, Cambrdige University Press, 1995.
7. C. H. Papadimitriou, *Computational Complexity*, Addison Wesley, 1994.
8. Leonard Adleman. *Two theorems on random polynomial time*. In Proceedings of the 19th IEEE Symposium on Foundations of Computer Science, pages 75–83, 1978.
9. Markus Hoffmann and Leland R. Beaumont, *Content Networking: Architecture, Protocols, and Practice*, Morgan Kauffman, 2005.

Course Plan

COURSE NO: 07CS 6103 (L-T-P : 4-0-0)	COURSE TITLE: ALGORITHMS AND COMPLEXITY CREDITS:4	
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 – Recurrences (8 hours)		15
RAM model	1	
Asymptotic notation, standard notations and common functions	2	
Recurrences	1	
The substitution method, The recursion tree method	2	
The master method	1	
Proof of master theorem	1	
MODULE : 2 – Amortized analysis and advanced data structures (10 hours)	1	15
Amortized analysis – Aggregate analysis	1	
The accounting method	1	
The potential method	1	
Dynamic tables	1	
Advanced data structures – B-trees, Binomial heaps	2	
Fibonacci heaps	1	
Disjoint sets	1	
Union by rank and path compression	1	
FIRST INTERNAL TEST		
MODULE : 3 – Graph algorithms and complexity (7 hours)		15
Depth first search, Breadth first search	1	
Single source shortest paths	2	
All pairs shortest paths algorithm	1	
Floyd-warshal algorithm	2	
Johnson's algorithm for sparse graphs	1	
MODULE : 4 – Maximum flow (8 hours)		15
Flow networks	1	
Ford-Fulkerson method	2	
Maximum bipartite matching	2	
Greedy algorithms, Elements of greedy algorithms	1	
Theoretical foundations of greedy algorithms – matroid theory	2	
SECOND INTERNAL TEST		
MODULE : 5 – Randomized algorithms (11 hours)		20
Introduction to randomized algorithms	1	
Finger printing and Freivald's technique	2	
Verifying polynomial identities	1	
Matching in graphs, Perfect matching	2	
Verifying equality of strings	2	
Pattern matching	2	
Interactive proof systems	1	
MODULE : 6 – Complexity classes (12 hours)		20
Complexity classes – introduction	1	
P and NP classes	1	
NP hard and NP complete problems	2	
Cook's theorem and its proof	2	
NP completeness and reductions	3	
Polynomial time and fully polynomial time approximation schemes	2	
Introduction to probabilistic complexity classes	1	

Internal continuous assessment: 40 marks

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07CS 6105 TOPICS IN DATABASE SYSTEMS AND DESIGN

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisite: Fundamentals of Database Management Systems

Course Objectives:
To provide the learner

- The concept of database system and design.
- The concepts of emerging technologies in the field of database management systems

Syllabus
Data Modelling using ER, Relational Model, Relational Algebra, Database Design using normalization , SQL, Object Oriented Database, Data mining and data warehousing, Structure of Oracle, Programming in Oracle using PL/SQL.

Course Outcomes:
The learners will be able to:

- Design database system using ER modelling
- Understand the relational model by relational algebra
- Able to apply principle of database design for creating good databases
- Understand the significance of data mining for doing research in that area
- Extract information from relational database using SQL
- Able to develop simple programs in PL/SQL

References:

1. Ramez Elmasri, Shamkanth B Navathe: *Database Systems- Models, Languages, Design and Application Programming* 6th Edition Pearson India
2. Thomas M Connolly, Carolyn E Begg: Database Systems – *A practical approach to Design, Implementation and Management* 4th Edition – Pearson India
3. Abraham Silberschatz, Henry F Korth: *Database System Concepts* 6th Edition Mc. Graw Hill Education
4. C J Date, A Kannan, S. Swamynathan: *An introduction to database systems* 8th Edition Pearson India
5. Alexis Leon and Mathews Leon : *Database Management Systems* – Vikas Publishing House, New Delhi
6. J. Han and M. Kamber, *Data mining: Concepts and Techniques*, Elsevier Science, 2007
7. Coronel, Moris, Rob : *Database Systems Design, Implementation and Management Course Technology*, Cengage Learning

Course Plan

COURSE NO: 07CS 6105 COURSE TITLE: TOPICS IN DATABASE SYSTEMS AND DESIGN (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction (7 hours)**		
Conceptual data modelling using ER modelling	1	15
Relational Model Concepts	1	
Relational Model constraints and Relational Databases schemas	1	
Formal relational languages: Relational Algebra operations	1	
Queries in relational algebra, The Tuple relational calculus, The domain relational calculus	2	
Mapping of relational database design using ER to relational mapping	1	
MODULE : 2 **Database Design (6 hours)**		
Relational Database Design algorithms	1	15
Functional dependencies, Normal forms based on functional dependencies and keys	2	
1NF, 2 NF, 3NF, BCNF Normalization	1	
Multi valued dependencies and fourth normal form	1	
Join dependencies and fifth normal form	1	
FIRST INTERNAL TEST		
MODULE : 3 **SQL (6 hours)**		
Data definition, constraints and basic queries and updates, embedded sql, stored procedures	3	15
Triggers, Types of Triggers, Disabling and enabling triggers, Replacing and dropping triggers	3	
MODULE : 4 **Object Oriented Databases (7 hours)**		
Overview of object oriented database concepts	1	15
Object relational features	2	
The ODMG object data model	2	
ODL and OQL	2	
SECOND INTERNAL TEST		
MODULE : 5 **Data Mining Technology (8 hours)**		
Overview of data mining technology, Association rules, Classifications, Clustering	3	20
Data warehousing and OLAP: Characteristics of data warehouses, Architecture of data warehouse, data modelling for data warehouses, building a data warehouse, functionalities of data warehouse	5	
MODULE : 6 **Oracle Database (8 hours)**		
Overview Oracle Database System,	2	20
Storage Organization,	2	
Programming basics in Oracle using PL/SQL	4	

Internal continuous assessment: 40 marks

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07CS 6107 ARTIFICIAL INTELLIGENCE

Credits: 3-0-0 : 3 **Year:** 2015

Prerequisites: Nil

Course Objectives:
To provide the students, the concepts of artificial intelligence in computing, to familiarize heuristic search techniques, knowledge representation etc. To enable students to understand the fundamentals of robotics.

Syllabus

AI concepts, search techniques, basic search BFS, DFS, heuristic search techniques, simulated anealing,. Hill Climbing, Agent based techniques, knowledge representation, propositional, predicate calculus, semantic representation, Concepts of Robotics.

Course Outcomes:
Students successfully completing this course will be able to:

- Comprehend advanced AI related literature more clarity.
- Apply suitable AI techniques to solve real life problems.
- Justify selection of techniques with proper theoretical arguments.

References:

1. George.F.Luger, *Artificial Intelligence- Structures and Strategies for Complex Problem Solving*, 4/e, 2002, Pearson Education.
2. Stuart Jonathan Russell, Peter Norvig, *Artificial intelligence, A modern approach*,3rd edition, pearson,2010
3. E. Rich, k.knight, *Artificial Intelligence*, 2/e, Tata McGraw Hill.

Course Plan

COURSE NO: 07CS 6107 COURSE TITLE: ARTIFICIAL INTELLIGENCE (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Artificial Intelligence (6 hours)** History and Applications, Production Systems, Structures and Strategies for state space search Data driven and goal driven search Depth First and Breadth First Search	 1 2 1 2	 15
MODULE : 2 **Heuristic Search (6 hours)** DFS with Iterative Deepening, Heuristic Search Best First Search, A* Algorithm, AO* Algorithm, Constraint Satisfaction, Using heuristics in games Minimax Search, Alpha Beta Procedure .	 1 1 2 1 1	 15
FIRST INTERNAL TEST		
MODULE : 3 **Beyond classical search (5 hours)** Local search and optimization problems, Hill climbing search, Simulated annealing, Local search in continuous spaces	 1 2 1 1	 15
MODULE : 4 **Agents (5 hours)** Searching with nondeterministic actions, Searching with partial observations, Intelligent agents, online search agents and unknown environments.	 1 1 1 2	 15
SECOND INTERNAL TEST		
MODULE : 5 **Knowledge representation (10 hours)** Propositional calculus, Predicate Calculus, Theorem proving by Resolution, Answer Extraction, AI Representational Schemes Semantic Nets, Conceptual Dependency, Scripts, Frames	 6 4	 20
MODULE : 6 **Introduction to Robotics (10 hours)** Robot Hardware , Sensors, Effectors , Robotic Perception Planning to Move, Planning Uncertain Movements , Moving, Robotic Software Architectures, Application Domains.	 5 5	 20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6109 ADVANCED NETWORKING TECHNOLOGIES

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Undergraduate Computer Networks course

Course Objectives:

To introduce the concepts in network performance, Switching, Router Architecture, to familiarize with IP Next generation, IPv6 concepts. To understand the concepts of content transport and instant messaging.

Syllabus

Packet switching techniques, factors limiting the performance of switches and its mitigation measures. Functions of a Router and router architecture and introduction to IP address lookup algorithms. Next Generation Ipv6 addressing support for QoS and security. TCP Congestion Control mechanisms proactive and reactive measures to alleviate the problem. Random Early Detection (RED) its variants and feedback mechanisms. Content transport over Internet; the concept of peer-to-peer network and instant content delivery.

Course Outcomes:

The students attains the knowledge of internal working of large packet switched networks, familiarizes with the usage and study of modern tools to analyze the network performance, students also gain expertise for the design and development of solutions, and enhances engineering knowledge.

References

1. Deepankar Medhi , Karthikeyan Ramasamy, *Network Routing Algorithms, Protocols, and Architectures*, Elsevier Inc, 2007
2. Larry L. Peterson and Bruce S. Davie, *Computer Networks: A Systems Approach*, Fourth Ed., Morgan Kaufmann, 2007
3. Doug Lowe, *Networking All-in-One For Dummies*, 5th Edition , Wiely Publications, 2014
4. Silvano gai, *Internetworking IPV6 with CISCO Routers*, McGraw– Hill computer communication series.
5. Markus Hoffmann and Leland R. Beaumont, *Content Networking: Architecture, Protocols, and Practice*, Morgan Kauffman, 2005.

Course Plan

COURSE NO: 07CS 6109 (L-T-P : 3-0-0)	**COURSE TITLE: ADVANCED NETWORKING TECHNOLOGIES CREDITS:3**	
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Packet switching (6 hours)**		15
Switching techniques :Generic Switch Architecture: Shared Bus, Shared Memory, Crossbar;	2	
Factors That Limit Performance: Head-of-Line Blocking, Output Queuing, Virtual Output Queuing.	2	
Network Performance measures in packet switched networks: bandwidth , delay , throughput.	1	
Case study : Network Performance analysis using wire shark	1	
MODULE : 2 **IP address lookup (7 hours)**		15
Router Architectures Functions of a Router	1	
Types of Routers , Elements of a Router , Packet Flow ,Packet Processing:	2	
IP address lookup algorithms : Impact of Addressing on Lookup Address Aggregation, Longest Prefix Matching	2	
Binary Tries : Search and Update Operations , Path Compression	2	
FIRST INTERNAL TEST		
MODULE : 3 **TCP Congestion Control (6 Hours)**		15
Effects of Congestion-TCP Congestion Control, Slow Start, Additive Increase, Multiplicative Decrease ,	2	
Fast Retransmit and Fast Recovery ,	2	
Implicit Feedback Schemes ,Drop Position , Proactive versus Reactive Dropping.	2	
MODULE : 5 **Random Early Detection (RED) (6 Hours)**		15
Random Early Detection (RED),	1	
Computing Average Length of Queue , Computing Drop Probability	2	
Variations of RED , Weighted Random Early Detection , Adaptive Random Early Detection ,	1	
Explicit Feedback Schemes , Choke Packets , Explicit Congestion Notification	2	
SECOND INTERNAL TEST		
MODULE : 5 **IP Next Generation (9 Hours)**		20
Why IPv6, basic protocol comparison of header structure,	1	
unicast, multicast and anycast addressing, extension headers and options,		
Support for QoS, security, neighbour discovery, auto-configuration, routing.	1	
Application Programming Interface for IPv6.	2	
Case Study: 6bone	2	
MODULE : 6 **Content Transport (9 Hours)**		20
Content Transport: Protocol Architecture and Design Paradigms of the Internet	2	
Multicast Transport, Peer-to-Peer Content Networks ,9	2	
Technical Challenges in Peer-to-Peer Networks ,	2	
Interactive Content Delivery—Instant Messaging,	2	
Case Studies: Building Content Networks	1	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6111 DISTRIBUTED AND MOBILE OEPRATING SYSTEMS

Credits: 3-0-0: 3 **Year:** 2015
Pre-requisite: Operating system

Course Objectives:
The course familiarize the students with design and development of distributed systems and and also gain expertise in the development of light weight operating systems

Syllabus
Introduction to distributed operating system, synchronization, processes and threads- scheduling of processes, distributed file systems, distributed shared memory, Mobile operating systems- Overview of Android kernel.

Course Outcome
The students attain the knowledge of the distributed operating system, to apply that knowledge in the development of operating systems for multiprocessor environment. Students also get knowledge in the working of light weight kernels like android.

References:

1. Andrew S.Tanenbaum *Distributed Systems*, Third Edition, Pearson Education
2. Marko Gargenda *Learning Android*, Orielly Publications.
3. Karim Yaghmour *Embedded Android*, Orielly Publications.
4. Abraham Silberschatz, Peterson B. Galvin, G. Gagne, *Operating System Concepts*, Sixth Edition, Addison Wesley Publishing Co., 2003.
5. Randy Chow and Theodore Johnson, *Distributed Operating Systems and Algorithms*, Adison-Wesley

Course Plan

COURSE NO: 07CS 6111 COURSE TITLE: DISTRIBUTED AND MOBILE OPERATING SYSTEMS **(L-T-P : 3-0-0) CREDITS:3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Distributed OS (6 hours)** Distributed Operating Systems - Introduction – Goals-Hardware and Software Concepts Design Issues , Communication Client Server Model Remote Procedure Call-Group Communication .	 1 1 2 2	 15
MODULE : 2 **Synchronization (7 hours)** Synchronization- Clock Synchronization Exclusion-Election Algorithms Atomic Transactions Distributed Deadlock Detection and Prevention.	 2 2 2 1	 15
FIRST INTERNAL TEST		
MODULE : 3 **Process and Threads (7 hours)** Processes and Processors in Distributed Systems-Threads System Models Processor Allocation- Scheduling in Distributed Systems Fault Tolerance Real Time Distributed Systems Distributed File Systems Design-Implementation.	 1 1 1 1 1 2	 15
MODULE : 4 **Shared Memory Concepts (6 hours)** Distributed Shared Memory-Introduction-Consistency models Page Based Distributed Shared Memory-Shared Variable Distributed Shared Memory Object Based Distributed Shared Memory	 2 2 2	 15
SECOND INTERNAL TEST		
MODULE : 5 **Mobile OS (8 hours)** Mobile OS- Introduction of Android Main Building Block Services	 2 3 3	 20
MODULE : 6 **Design of Light-weight OS (8 hours)** Internals Primer AOSP Jumpstart Build System	 2 3 3	 20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6113 DIGITAL IMAGE PROCESSING

Credits: 3-0-0: 3 **Year:** 2015
Pre-requisite: Nil

Course Objectives:
To introduce the students the concepts of digital image processing fundamentals, image enhancement techniques, segmentation, feature analysis and their applications.

Syllabus:
Steps in Image Processing Systems, Pixel Relationships Colour Fundamentals and Models. Image Operations , Spatial Domain Gray Level Transformations, Histogram Processing. Spatial Filtering, Smoothing and Sharpening, Frequency Domain, Filtering in Frequency Domain. Smoothing and Sharpening filters. Edge Operators, Thresholding , Region Based Segmentation. Feature Analysis and Extraction,
Image Compression: Fundamentals Compression Standards. Image Classification, Image Recognition – Image Understanding , Video Motion Analysis, Steganography.

Course Outcomes:
This course imparts an investigative mentality for solving complex problems. Familiarizes with the usage and study of modern tools for image processing, and students also gain expertise to suggest solutions for image processing problems.

References:
1. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing” Second Edition, Pearson Education, 2003.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Second Edition, Thomson Learning, 2001
3. Anil K.Jain, “Fundamentals of Digital Image Processing”, Person Education, 2003.

Course Plan

COURSE NO: 07CS 6113 **COURSE TITLE: DIGITAL IMAGE PROCESSING** **(L-T-P : 3-1-0)** **CREDITS:3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Fundamentals of image processing (6 hours)**		15
Introduction, Steps in Image Processing Systems	1	
Image Acquisition, Sampling and Quantization	2	
Pixel Relationships	1	
Colour Image Processing: Colour Fundamentals and Models, File Formats.	2	
MODULE : 2 **Image operations and enhancement (7 hours)**		15
Image Operations – Arithmetic, Geometric &Morphological	1	
Image Enhancement – Transformations – Negative, Logarithmic, Gamma, Contrast Stretching, Grey level & Bit Plane Slicing.	3	
Histogram Processing – Equalization & Matching.	3	
FIRST INTERNAL TEST		
MODULE : 3 **Image filtering (7 hours)**		15
Spatial Filtering – Smoothing and Sharpening	1	
Frequency Domain – Filtering in Frequency Domain – DFT, FFT, DCT	3	
Smoothing and Sharpening filters	2	
Homomorphic Filtering.	1	
MODULE : 4 **Image Segmentation (6 hours)**		
Detection of Discontinuities.	1	
Edge Operators – Edge Linking and Boundary Detection.	1	15
Thresholding – Region Based Segmentation.	2	
Morphological Watersheds	1	
Motion Segmentation.	1	
SECOND INTERNAL TEST		
MODULE : 5 **Feature Extraction (8 hours)**		
Feature Analysis and Extraction.	1	
Multi Resolution Analysis: Image Pyramids – Multi resolution expansion.	2	20
Wavelet Transforms.	2	
Image Compression – Fundamentals – Models – Elements of Information Theory – Error Free Compression – Lossy Compression – Compression Standards.	3	
MODULE : 6 **Application of Image processing (8 hours)**		20
Image Classification – Image Recognition & Understanding	2	
Video Motion Analysis.	2	
Image Fusion.	2	
Steganography.	1	
Digital Composting – Mosaics.	1	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07GN 6001 : RESEARCH METHODOLOGY

Credits: 0-2-0: 2 **Year:** 2015
Pre-requisites: Nil

Course Objectives

The main objective of the course is to provide a familiarization with research methodology and to induct the student into the overall research process and methodologies. This course addresses:

- The scientific research process and the various steps involved
- Formulation of research problem and research design
- Thesis preparation and presentation.
- Research proposals, publications and ethics
- Important research methods in engineering

As a tutorial type course, this course is expected to be more learner centric and active involvement from the learners are expected which encourages self study and group discussions. The faculty mainly performs a facilitator's role.

Syllabus

Overview of research methodology - Research process, scientific method, research design process.
Research Problem and Design - Formulation of research task, literature review, web as a source, problem solving approaches, experimental research, and ex post facto research.
Thesis writing, reporting and presentation -Interpretation and report writing, principles of thesis writing-format of reporting, oral presentation.
Research proposals, publications and ethics - Research proposals, research paper writing, considerations in publishing, citation, plagiarism and intellectual property rights.
Research methods – Modelling and Simulation, mathematical modeling, graphs, heuristic optimization, simulation modelling, measurement design, validity, reliability, scaling, sample design, data collection methods and data analysis

Course Outcomes:

At the end of course, the student will be able to:

- Discuss research methodology concepts, research problems, research designs, thesis preparations, publications and research methods.
- Analyze and evaluate research works and to formulate a research problem to pursue research
- Prepare a thesis or a technical paper, and present or publish them
- Apply the various research methods followed in engineering research for formulation and design of own research problems and to utilize them in their research project.

References:

1. C. R. Kothari, *Research Methodology, Methods and Techniques*, New Age International Publishers
2. K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan, *Management Research Methodology, Integration of principles, Methods and Techniques*, Pearson Education
3. R. Panneerselvam, *Research Methodology*, PHI Learning
4. Deepak Chawla, Meena Sondhi, *Research Methodology–concepts & cases*, Vikas Publg House
5. J.W Bames, *Statistical Analysis for Engineers and Scientists*, McGraw Hill, N.York
6. Schank Fr., *Theories of Engineering Experiments*, Tata Mc Graw Hill Publication.
7. Willktnsion K. L, Bhandarkar P. L, *Formulation of Hypothesis*, Himalaya Publication.
8. Fred M Kerlinger , *Research Methodology*

9. Ranjit Kumar, *Research Methodology – A step by step guide for beginners*, Pearson Education
10. John W Best, James V Kahan – *Research in Education* , PHI Learning
11. Donald R. Cooper, Pamela S. Schindler, *Business Research Methods*, 8/e, Tata McGraw-Hill Co Ltd
12. Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, Ess Ess Publications. 2 volumes
13. Trochim, W.M.K., 2005. *Research Methods: the concise knowledge base*, Atomic Dog Publishing. 270p.
14. Coley, S.M. and Scheinberg, C. A., 1990, "*Proposal Writing*", Sage Publications.
15. Day, R.A., 1992. *How to Write and Publish a Scientific Paper*, Cambridge University Press.
16. Fink, A., 2009. *Conducting Research Literature Reviews: From the Internet to Paper*. Sage Publications
17. Donald H.McBurney, *Research Methods*, 5th Edition, Thomson Learning, ISBN:81-315-0047-0,2006
18. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers..
19. Wadehra, B.L. 2000. *Law relating to patents, trademarks, copyright designs and geographical indications*. Universal Law Publishing
20. Carlos, C.M., 2000. *Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options*. Zed Books, New York.
21. Additional suitable web resources
22. Guidelines related to conference and journal publications

Course Plan

COURSE NO: 07GN 6001 (L-T-P : 0-2-0)	COURSE TITLE: _RESEARCH METHODOLOGY CREDITS:2	
MODULES	**Contact hours**	**Sem.Exam Marks;%**
Module 1 Overview of Research Methodology Research concepts – meaning – objectives – motivation - types of research – research process – criteria for good research – problems encountered by Indian researchers - scientific method - research design process – decisional research	5	10
Module 2 Research Problem and Design Formulation of research task – literature review – methods – primary and secondary sources – web as a source – browsing tools -formulation of research problems – exploration - hypothesis generation - problem solving approaches-introduction to TRIZ(TIPS)- experimental research – principles -Laboratory experiment - experimental designs - ex post facto research - qualitative research	5	10
FIRST INTERNAL TEST		
Module 3 Thesis writing, reporting and presentation Interpretation and report writing – techniques of interpretation – precautions in interpretation – significance of report writing – principles of thesis writing-format of reporting - different steps in report writing – layout and mechanics of research report - references – tables – figures – conclusions. oral presentation – preparation - making presentation – use of visual aids - effective communication	4	10
Module 4 Research proposals, publications, ethics and IPR Research proposals - development and evaluation – research paper writing – layout of a research paper - journals in engineering – considerations in publishing – scientometry-impact factor- other indexing like h-index – citations - open access publication -ethical issues - plagiarism –software for plagiarism checking- intellectual property right- patenting case studies	5	10
SECOND INTERNAL TEST		
Module 5 Research methods – Modelling and Simulation Modelling and Simulation – concepts of modelling – mathematical modelling - composite modelling – modelling with – ordinary differential equations – partial differential equations – graphs heuristics and heuristic optimization - simulation modelling	5	10
Module 6 – Research Methods – Measurement, sampling and Data acquisition Measurement design – errors -validity and reliability in measurement - scaling and scale construction - sample design - sample size determination - sampling errors - data collection procedures - sources of data - data collection methods - data preparation and data analysis	4	10

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are three tests for the course (3 x 20 = 60 marks) and assignments (40 marks). The assignments can be in the form of seminar, group tasks, case studies, research work or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6115 ADVANCED PROGRAMMING LAB

Credits: 0-2-0: 1 **Year :** 2015

Pre-requisite: Data structures and Network programming lab in UG

Course Objectives:

To equip students to implement advanced data structure constructs like Binomial heap, Fibonacci heap *and* Disjoint Sets *etc.*

To introduce students the concept of discrete event simulator and other scripting languages like Python, AWK etc.

List of experiments:

1. Implementation of Binomial and Fibonacci heap.
2. Implementation of Disjoint Sets
3. Simulation of Amortized analysis using Dynamic tables
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. Simulate a wireless network consisting of TCP and UDP Traffic and then calculate their respective throughput.

Course outcomes: To enable students for problem analysis skills, create interest in investigations of complex problems and to understand and apply Modern simulation tools.

Note: Students may use the following programming languages or tools for doing the experiments:

- C, C++, java
- Python/awk
- Network Simulating tools

Academic Assessment/Evaluation

1. Practical records/outputs 40%
2. Regular class viva-voce 20%
3. Final test 40%

07CS 6117 INTRODUCTION TO SEMINAR

Credits: 0-1-0: 0 **Year :** 2015
Pre-requisite: Nil

Course Objectives:

To assess the debating capability of the student to present a technical topic. In addition, to impart training to students to face audience and present their ideas and thus creating in them self-esteem and courage that are essential for engineers.

Academic Assessment/Evaluation

Individual students are required to choose a topic of their interest and give a seminar on that topic for about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar. A detailed write up on the topic of seminar is to be prepared in the format prescribed by the department.

Course outcomes: Students shall be able to apply their theoretical knowledge to develop a solution for real time problem.

SEMESTER -2

07CS 6102 ADVANCED COMPILER DESIGN

Credits: 4-0-0: 4 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

- To familiarize students of the basic structure of a typical modern compiler's back end.
- To give a clear understanding of the typical processes in compiler optimization

Syllabus:

Syntax directed translation, automatic tools; Semantic analysis: symbol tables, Intermediate code generation: run-time environments, translation of language constructs; Code generation: flow graphs, register allocation, code generation algorithms; code optimization, instruction scheduling

Course Outcomes:

Students who successfully complete this course will be able to

- Create lexical rules and grammars for a representative programming language.
- Design a compiler for a concise programming language or a small subset of it.
- Implement semantic rules into a parser that performs attribution while parsing.
- Implement simple code optimization techniques in the compiler backend.

References:

1. *Compilers: Principles, Techniques and Tools* (2nd edition), Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffery D. Ullman., Addison Wesley, Boston, MA, 2006
2. *Compilers: Principles, Techniques and Tools*, Aho, A. V, Sethi, R. and Ullman, J. D. Pearson Education, 1986.
3. *Modern Compiler Implementation in Java*, Andrew. W. Appel, Cambridge University Press, 2000.
4. *Advanced Compiler Design and Implementaiton*, Steven S Muchnick, Morgan Kaufmann Publishers

Course Plan

COURSE NO: 07CS 6102 COURSE TITLE: ADVANCED COMPILER DESIGN (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Syntax Directed Translation (8 hours)**		15
Syntax Directed Translation - Syntax directed definitions – Inherited and Synthesized attributes – Evaluating an SDD at the nodes of a parse tree	2	
Evaluation orders for SDDs – Dependency graphs – Ordering the evaluation of attributes – S-attributed definitions – L-attributed definitions – Semantic rules with controlled side effects - Applications of syntax directed translation	2	
Construction of syntax trees – The structure of a type – Syntax directed translation schemes – Postfix translation schemes – Parser-stack implementation of postfix SDTs – SDT's with action inside productions - Eliminating left recursion from SDTs – SDTs for L-attributed definitions	2	
Implementing L-attributed SDDs – Translation during recursive-descent parsing – On-the-fly code generation – L-attributed SDDs and LL Parsing – Bottom up parsing of L-attributed SDDs	2	
MODULE : 2 **Intermediate Code Generation (9 hours)**		15
Intermediate Code Generation - Intermediate Representations – Variants of syntax trees – Directed acyclic graphs for expressions – The value-number method for constructing DAGs – Three-address code – Addresses and instructions – Quadruples – Triples – Static Single-Assignment Form	2	
Types and Declarations – Type Expressions – Type equivalence – Declarations – Storage layout for local names – Sequences of declarations – Fields in records and classes - Translation of expressions	2	
Translation of expressions – Operations within expressions – Incremental translation – Addressing array elements – Translation of array references	2	
Control flow – Boolean expressions – Short-circuit code – flow-of-control statements – Control flow translation of Boolean expressions – Avoiding redundant Gotos – Boolean values and jumping code – Back patching - One-pass code generation using back patching – Back patching for Boolean expressions – Flow-of-control statements – Break, continue and Goto statements	2	
Translation of switch statements – syntax directed translation of switch statements - intermediate code for procedures	1	
FIRST INTERNAL TEST		
MODULE : 3 **Run-Time management (9 hours)**		15
Run-Time Environments - Storage organization – Static versus dynamic storage allocation – stack allocation of space – Activation trees – Activation records – Calling sequences – Variable length data on the stack	2	
Access to nonlocal data on the stack – Data access without nested procedures – Issues with nested procedures – Access links – Manipulating access links – Access links for procedure parameters – Displays	3	
Heap management – The memory manager – Locality in programs – Reducing fragmentation – Manual deallocation requests - Garbage collection – Design goals for Garbage collectors – Reference counting garbage collectors	2	
Introduction to trace-based collection – A basic mark-and-sweep collector – Basic abstraction – Optimizing mark-and-sweep – Mark-and-compact garbage collectors – Copying collectors	2	

MODULE : 4 **Code Generation (8 hours)**		15
Code Generation - Issues in the design of a code generator – Instruction selection – Register allocation – Evaluation order - Target language – A simple target machine model – Program and instruction costs - Addresses in the target code – static allocation – stack allocation – run-time addresses for names	2	
Basic Blocks and Flow Graphs – Basic blocks – Next-use information – Flow graphs – Representation of flow graphs – Loops -Optimization of basic blocks – The DAG representation of basic blocks – Finding local common sub expressions – Dead code elimination – Use of algebraic identities – Representation of array references – Pointer assignments and procedure calls – Resembling basic blocks from DAGs	2	
Simple code generator – Register and address descriptors – The code generation algorithm - Peephole optimization – Eliminating redundant loads and stores – Eliminating unreachable code – Flow-of-control optimizations – Algebraic simplification and reduction I strength – Use of machine identities	2	
Register allocation and assignment – Global register allocation – Usage counts – Register Assignment for outer loops – Register allocation for graph colouring - Instruction selection by tree rewriting – Tree-translation schemes – Code generation by tiling an input tree – Pattern matching by parsing – Routines for semantic checking – General tree matching - Optimal code generation for expressions – Ershove numbers – Generating code from Labelled Expression trees	2	
SECOND INTERNAL TEST		
MODULE : 5 **Code Optimization (11 hours)**		20
Code optimization - Principal sources of optimization – causes of redundancy – Semantics-preserving transformations – Global common sub expressions – Copy propagation – Dead code elimination – Code motion	2	
Induction variables and reduction in strength – Introduction to data flow analysis –The data-flow abstraction – The data-flow analysis schema – Data-flow schemas on Basic blocks – Reaching definitions	2	
Live variable analysis – Available expressions	1	
Partial redundancy elimination – The sources of redundancy – The lazy-code-motion problem – Anticipation of expressions	2	
The lazy-code-motion algorithm - Loops in Flowgraphs – Dominators – Depth-first ordering – Edges in Depth-first spanning tree – Back edges and reducibility – Depth of a flow graph – Natural loops – Convergence of Iterative data-flow algorithms	2	
Region based analysis – Regions – Region hierarchies for reducible flow graphs – Algorithm for region based analysis – Handling non-reducible flow graphs	2	
MODULE : 6 **Code Scheduling (11 hours)**		20
Instruction scheduling - Instruction-level parallelism – instruction pipelines and branch delays – pipelined execution – multiple instruction issue	2	
Code scheduling constraints – data dependence - dependencies among memory accesses – Trade off between register usage and parallelism	2	
Phase ordering between register allocation and code scheduling – control dependence – speculative execution support	1	
Basic-Block Scheduling – Data dependence graphs – List scheduling of basic blocks – Prioritized topological orders	2	
Global Code Scheduling – Primitive code motion – Upward code motion – Downward code motion – Updating data dependencies	2	
Global scheduling algorithms – Advanced code motion techniques – Interaction with dynamic schedulers	2	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6104 ADVANCED PARALLEL COMPUTING

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisite: Computer Architecture and Parallel Processing.

Course Objectives

Equip students to select both suitable parallel programming paradigm and parallel programming environment for solving heavy computational tasks.

Syllabus

Theoretical aspects of parallel programming paradigms, physical organisation of parallel computing platforms, parallel algorithm models. detailed study of selected and popular parallel programming like MPI, Detailed study of CUDA, Selected popular parallel programming problems in different domains, parallel algorithm implementation and case studies.

Course Outcomes

Students who successfully complete this course will be able to:

- Select the suitable parallel programming paradigm and justify using proper theoretical background.
- Apply suitable parallel programming environment for large scale tasks.
- Design and develop solutions for complex large scale tasks using parallel programming concepts

References:

1. *An Introduction to Parallel Computing : Design and Analysis of Algorithms* (English) 2nd Edition,: Vipin Kumar , Ananth Grama , Anshul Gupta , George Karypis,Pearson India ,2007.
2. *Programming Massively Parallel Processors: A Hands-on Approach (Applications of GPU Computing Series)* -2nd Edition, David Kirk and Wen-mei Hwu, Morgan Kaufmann (Elsevier), 2013.
3. *Hennesy J.L. & Pattersen D.A., Computer Architecture: A Quantitative approach*,Fifth Edition, Harcourt Asia P Ltd. (Morgan Kaufman),2011.
4. *Programming on parallel machines* by Norm matloff available at http://heather.cs.ucdavis.edu/~matloff/158/PLN/ParProcBook.pdf (open book under creative common license).
5. *Parallel Programming in C with MPI and OpenMP* by M J Quinn, Mc-Grawhill Education, 2008.
6. *Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes*, F Thomas Leighton,2002

Course Plan

COURSE NO: 07CS 6104 COURSE TITLE: ADVANCED PARALLEL COMPUTING (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Motivation and Scope of Parallel Computing (5 hours)** Trends in Microprocessor Architecture, Physical Organisation of Parallel Computing Platforms. Communications Costs In Parallel Machines.	 1 2 2	15
MODULE : 2 **Basic Communication Operations (4 hours)** One-To-All Broadcast And All-To-One Reduction, All-To-All Broadcast And Reduction, All-Reduce And Prefix-Sum Operations, Scatter And Gather, Circular Shift, All-To-All Personalized Communication, Improving The Speed Of Some Communication Operations.	 3 1	15
FIRST INTERNAL TEST		
MODULE : 3 **Principles of Parallel Algorithm Design Decomposition Techniques (5 hours)** Principles of Parallel Algorithm Design Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing,	 1 2 2	15
MODULE : 4 **Parallel Algorithm Models (4 hours)** Methods for Containing Interaction Overheads, Parallel Algorithm Models, Analytical Modelling of Parallel Programs, Sources of Overhead in Parallel Programs.	 1 1 1 1	15
SECOND INTERNAL TEST		
MODULE : 5 **MPI, OpenMP ans CUDA(14 hours)** Programming Using the Message-Passing(MPI),Paradigm, Programming Shared Address Space Platforms(open MP), Combining MPI and Open MP, History Of GPU Computing, Introduction to CUDA,CUDA threads, CUDA Memories, Performance Considerations, Floating Point Considerations	 3 3 2 1 3 2	20
MODULE : 6 **Parallel Algorithms and Implementations (10 hours)** Solving System of Linear Equation: Gaussian Elimination, Finding Power of Matrices, Matrix Multiplication, Parallel Sorting Methods, Parallelising Apriori Algorithm, Clustering Algorithms, Parallel Random Number Generators, Graph Algorithms, Case Studies of CUDA Implementation	 2 2 2 2 2	20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6106 MACHINE LEARNING AND LANGUAGE PROCESSING

Credits: 3-0-0: 3 **Year:** 2015
Pre-requisite: Nil

Course Objectives:

To impart basic knowledge of natural language processing with more clarity by including adequate machine learning concepts

Syllabus:

Selected supervised learning techniques and unsupervised learning techniques, sequence classifier technique like Hidden Markov Models, Discussion of popular problems of NLP like Pos tagging, Word sense disambiguation, information extraction and Machine translation.

Course Outcomes :

Students successfully complete this course will be able to:

- Comprehend Natural language processing concepts with more clarity.
- Apply Suitable machine learning algorithms to solve NLP problems.
- Justify selection of learning algorithms with proper theoretical arguments.

References:

1. *Introduction to Machine Learning*, third edition, Ethem Alpaydin, PHI learning pvt Ltd, 2015
2. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*, second edition, Daniel jurafsky and James H martin, Pearson – 2014.
3. *Foundations of Statistical Natural Language Processing*, Christopher Manning and Hinrich Schiitze, MIT press, 1999
4. *Pattern Recognition and Machine Learning (Information Science and Statistics)*, Christopher bishop, springer, 2011.
5. *Machine Learning: An Algorithmic Perspective*, Stephen Marsland, CRC Press, 2009.
6. *Data Mining: Concepts and Techniques*, Third edition, Jiawei Han , Micheline Kamber and Jian Pei , Morgan Kaufmann publishers,2012.
7. *Probabilistic Graphical Models: Principles and Techniques*, Daphne Koller and Nir Friedman, MIT Press, 2009.
8. *Machine Learning: A Probabilistic Perspective*, Kevin P. Murphy, MIT Press, 2012.
9. *Building Machine Learning Systems with Python*, Willi Richert et.al, Packt Publishing Limited, 2013.

Course Plan

COURSE NO: 07CS 6106 (L-T-P : 3-0-0)	**COURSE TITLE: MACHINE LEARNING AND LANGUAGE PROCESSING CREDITS:3**	
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Classifiers (6 hours)** Naive Bayes classifier KNN classifier Decision tree methods Support vector machines	 2 2 1 1	 15
MODULE : 2 **Classification and Regression (6 hours)** Multi class classification, Multi label classification Linear regression, logistic regression.	 3 3	 15
FIRST INTERNAL TEST		
MODULE : 3 **Clustering and Sequence classifier (5 hours)** K means clustering. Expectation Maximization algorithm, Sequence classifier: Hidden markov models.	 1 2 2	 15
MODULE : 4 **HMM (5 hours)** Three basic problems associated with HMM, solution of three problems Maximum entropy models.	 2 3	 15
SECOND INTERNAL TEST		
MODULE : 5 **Natural Language Problems - 1 (10 hours)** N gram language model. POS tagging, Word sense disambiguation, Named entity recognition, Probabilistic Context Free Grammar Syntactic parsing, statistical parsing.	 2 2 2 1 1 2	 20
MODULE : 6 **Natural Language Problems - 2 (10 hours)** Automatic Speech recognition, Information Extraction. Question answering and summarization, Machine translation.	 2 3 2 3	 20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6108 DATA COMPRESSION

Credits: 3-0-0: 3 **Year:** 2015
Pre-requisite: Coding theory.

Course Objectives:
To familiarize the students with different compression techniques. The different types of compression are text, image, video formats. Finally the different compression algorithm performance is analyzed.

Syllabus:
Introduction about Compression Techniques, Mathematical modeling of compression techniques – lossless and lossy compression. Different types and methods of Compression Techniques, Dictionary methods, Image compression, JPEG, Wavelet methods, Progressive Image compression, Video Compression

Course Outcomes:
Students shall be able to apply the knowledge of compression algorithm for different application areas and identify the features.

References:

1. David Solomon, *Data compression: the complete reference*, 2nd edition, Springer verlag, New York.
2. Stephen Welstead, *Fractal and wavelet Image Compression techniques*, PHI, NewDelhi-1, 1999.
3. Khalid Sayood, *Introduction to data compression*, Morgan Kaufmann Publishers, 2003 reprint.
4. *The Data compression Book*, Mark Nelson and Jean-Loup Gailly, Mark Nelson and Jean-Loup ‘Gailly,BPB publications (2nd Edition),1995

Course Plan

COURSE NO: 07CS 6108 COURSE TITLE: DATA COMPRESSION **(L-T-P : 3-0-0) CREDITS: 3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction about Compression Techniques (6 hours)**		15
Lossy compression & Lossless compression,	2	
Modelling and compression Mathematical modelling for Lossless compression- Physical models probability models, Markov Models and composite source models.	2	
Mathematical modelling for Lossy compression - physical models, Probability models and linear systems models.	2	
MODULE : 2 **Compression Techniques (7 hours)**		15
Run length encoding, RLE Text compression, RLE image compression and scalar quantization.	2	
Statistical Methods: Information theory concepts, Huffman coding, Adaptive Huffman coding, facsimile compression	3	
Arithmetic coding and Adaptive, Arithmetic coding and Text compression.	2	
FIRST INTERNAL TEST		
MODULE : 3 **Dictionary methods** (7 **hours)**		15
String compression,	1	
LZ 77, LZSS, LZ78,LZW,	2	
Unix compression,	1	
GIF image, ARC and PKZIP,	2	
Data compression patterns.	1	
MODULE : 4 **Image Compression (6 hours)**		15
Wavelet methods: Fourier Image compression, Multi Resolution decomposition and JPEG 2000,	3	
Image Compression: Intuitive Methods, Image Transforms, JPEG	3	
SECOND INTERNAL TEST		
MODULE : 5 **Progressive Image compression (8 hours)**		20
Progressive Image compression,	1	
Vector quantization, Adaptive Vector Quantization,	2	
Block Matching, Block Truncation coding.	1	
Context Tree weighting,	1	
Block Decomposition,	1	
Binary Tree predictive coding,	1	
Quad Trees and Finite Automata Methods.	1	
MODULE : 6 **Video Compression (8 hours)**		20
Video Compression Analog Video,	1	
Composite and Components Video,	1	
Digital Video compression, MPEG and H.261.	1	
Audio Compression Sound,	1	
Digital Audio,	1	
The Human Auditory System,	1	
μ -Law and A-Law companding,	1	
A Wide band codec DPCM Audio compression and MPEPG-1 Audio Layers.	1	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6110 ADVANCED TOPICS IN INFORMATION SECURITY

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisite: Information Security

Course Objectives:

- To introduce advanced topics in information security which deals with protecting information and information systems
- To analyze and familiarize the various threats to storage of secure information, the security principles and practices of information systems.
- To understand Security Risk Assessment and Security Auditing

Syllabus

Introduction to computer security, Security Trends, User Authentication, Access Control Principles, Role based, Multicast, Discretionary Access Control, Database Security, Cloud Security, IT Security Management and Risk Assessment, SISA, HIPAA, Physical Security, Infrastructure Security, Human Resources Security, Legal and Ethical Issues, Security Auditing Architecture, OCTAVE, COBIT, ISO 17799/ISO 27001 Standards.

Course Outcomes:

After completing this course the students will

- Be familiarised with the advanced topics in information systems security.
- Be able to explain and compare the various access control policies and models.
- Be able to analyze the significance of security auditing and risk assessment.

References:

1. W. Stallings, *Computer Security: Principles and Practice*, 2 nd Edition, Prentice Hall, 2011
2. *Computer Forensics: Investigating Network Intrusions and Cyber Crime*, by EC-Council Press 2009
3. Ronald L. Krutz, Russell Dean Vines, *Cloud Security*, Wiley [ISBN: 0470589876], 2010.
4. M. E. Whitman and H. J. Mattord, *Principles of Information Security*, 4th Edition, Course Technology
5. M. Bishop, *Computer Security: Art and Science*, Addison Wesley
6. G. McGraw, *Software Security: Building Security In*, Addison Wesley, 2006
7. *Information Security based on ISO 27001/ISO 27002: A Management Guide*

Course Plan

COURSE NO: 07CS 6110 COURSE TITLE: ADVANCED TOPICS IN INFORMATION SECURITY (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Computer Security (8 hours)**		
Computer security, threats, attacks	2	15
Security architecture and security trends	3	
User authentication and security issues	3	
MODULE : 2 **Access Control (6 hours)**		
Access control principles and access rights	2	15
Database management systems	2	
Database encryption.	2	
FIRST INTERNAL TEST		
MODULE : 3 **Security Management (8 hours)**		15
Cloud security	2	
Security management standards	2	
Security controls	1	
Security threats	1	
Prevention and mitigation measures	2	
MODULE : 4 **Security Risk Assessment (6 hours)**		
IT Security management and risk assessment	1	15
Security risk analysis tools SISA,HIPAA	2	
Security control plans	1	
Security management implementation	2	
SECOND INTERNAL TEST		
MODULE : 5 **Security Auditing (6 hours)**		
Security auditing architecture	1	20
Audit Trail Analysis	1	
OCTAVE,COBIT	2	
Overview of ISO Standards	1	
System security engineering	1	
MODULE : 6 **Network Forensics (8 hours)**		
Network Forensics and Investigating Logs	3	20
Router Forensics	2	
Internet Crimes	2	
Corporate Espionage	1	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6112 SOFTWARE QUALITY ASSURANCE AND RELIABILITY

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Software Engineering

Objective:

- To understand various methods of estimating quality.
- Learn various testing methods
- To understand and apply software metrics in analysis and estimation

Syllabus:

Software quality – challenges, SQA components in project life cycle, Basics of software testing – Test generation from requirements, Testing strategies, Test plan management – Execution and reporting – Software test automation, Hierarchical models of software quality, Project progress control, Software Reliability - Software Reliability and System Reliability, Software Metrics for Reliability.

Course Outcomes:

- Students will be able to analyze the quality of given software.
- To assess Quality standards.
- Estimation and use of reliability using metrics

References

1. Daniel Galin, *Software quality assurance – from theory to implementation*, Pearson education, 2009.
2. Yogesh Singh, *Software Testing*, Cambridge University Press, 2012.
3. Aditya Mathur, *Foundations of software testing*, Pearson Education, 2008
4. Ron Patton, *Software testing* , second edition, Pearson education, 2007
5. Srinivasan Desikan and Gopalaswamy Ramesh, *Software testing – principles and practices* , Pearson education, 2006
6. Alan C Gillies, *Software Quality Theory and Management*, Cengage Learning, Second edition, 2003
7. Robert Furtell, Donald Shafer, and Linda Shafer, *Quality Software Project Management*, Pearson Education Asia, 2002.
8. Thomas Stahl, Markus Voelter, *Model-Driven Software Development: Technology, Engineering*, Management, Wiley, 2006.
9. Anne Kleppe, Jos Warmer and Wim Bast. *MDA Explained. The Model Driven Architecture, Practice and Promise*, Pearson Education, Boston, USA, 2003
10. *Handbook of Software Reliability Engineering*, Michael Lyu (ed.), 1996, IEEE Computer Society Press, ISBN: 0-07-039400-8

Course Plan

COURSE NO: 07CS 6112 COURSE TITLE: SOFTWARE QUALITY ASSURANCE AND RELIABILITY (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction to Software Quality (7 hours)**		15
Introduction to software quality - challenges – objectives – quality factors,	2	
Components of SQA – contract review – development and quality plans	2	
SQA components in project life cycle – SQA defect removal policies – Reviews	3	
MODULE : 2 **Software Testing (7 hours)**		15
Basics of software testing	1	
Test generation from requirements – finite state models – combinatorial designs	2	
Test selection, minimization and prioritization for regression testing	2	
Test adequacy, assessment and enhancement	2	
FIRST INTERNAL TEST		
MODULE : 3 **Testing Strategies (7 hours)**		15
Testing strategies – white box and black box approach – integration testing – system and acceptance testing – performance testing	2	
regression testing - internationalization testing – ad-hoc testing – website testing – usability testing – accessibility testing	2	
Test plan – management – execution and reporting	1	
Software test automation – automated testing tools	2	
MODULE : 4 **Software Quality (7 hours)**		15
Hierarchical models of software quality – software quality metrics –function points	2	
Software product quality – software maintenance quality – effect of case tools	2	
Software quality infrastructure – procedures – certifications – configuration management – documentation control.	3	
SECOND INTERNAL TEST		
MODULE : 5 **Project Quality Management (7 hours)**		20
Project progress control – costs	2	
Quality management standards – project process standards	2	
Management and its role in SQA – SQA unit	3	
MODULE : 6 **Software Reliability (7 hours)**		20
Software Reliability	2	
Software Reliability and System Reliability,	3	
Software Metrics for Reliability	2	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6114 CLOUD COMPUTING

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

- To familiarize the students with the advanced concepts in cloud computing.
- To understand the various issues in cloud computing.

Syllabus:

Basics of cloud computing, System Models for Distributed and Cloud Computing, Cloud Services, Virtualization technique and tools, Cloud architecture, design and development, Parallel and distributed program paradigms – Map reduce, twister, Hadoop, Develop Cloud ap[plication, Cloud security, security as a Service, Data security Application security, VM security.

Course Outcomes:

Students shall be able to apply the knowledge of cloud computing for solving problems in various computing domains.

References:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, *Distributed and Cloud Computing, From Parallel Processing to the Internet of Things*, Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, *Cloud Computing: Implementation, Management, and Security*, CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, *Cloud Computing, A Practical Approach*, TMH, 2009.
4. George Reese, *Cloud Application Architectures: Building Applications and Infrastructure in the Cloud(Theory in Practice)*, O'Reilly Publications, 2009.
5. Michael Miller, *Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online*, Pearson Education, 2009.
6. Kumar Reddy, Victor Moreno, *Network virtualization*, CISCO Press, 2008.
7. James E. Smith, Ravi Nair, *Virtual Machines: Versatile Platforms for Systems and Processes* MorganKaufmann, ELSEVIER Publication, 2006.
8. Alex Amies, Harm Sluiman, QiangGuo Tong, and GuoNing Liu, *Developing and Hosting Applications on the cloud*, IBM Press, 2012.
9. Haley Beard, *Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, applications and Data Centers in the Cloud with SLAs*, Emereo Pty Limited, July 2008
10. Richard N. Katz, *The Tower and The Cloud*, Higher Education in the Age of Cloud Computing, 2008.
11. *Distributed and Cloud Computing*, 1st edition, Morgan Kaufmann, 2011

Course Plan

COURSE NO: 07CS 6114 COURSE TITLE: CLOUD COMPUTING **(L-T-P : 3-0-0) CREDITS:3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction (7 hours)**		15
Evolution of Cloud Computing, Cloud Architecture	1	
System Models for Distributed and Cloud Computing	1	
NIST Cloud Computing Reference Architecture	1	
Cloud Services -IaaS, On-demand Provisioning, Elasticity in Cloud, IaaS Providers	1	
PaaS, PaaS Providers, SaaS, SaaS Providers	1	
Public, Private and Hybrid Clouds.	1	
Companies providing Cloud services, Regularity issues, Government policies	1	
MODULE : 2 **Virtualization (8 hours)**		15
Basics of Virtualization, Types of Virtualization, Implementation Levels of Virtualization, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices	1 2	
Virtual Machine Basics, Taxonomy of Virtual machines, Virtual Machine Monitors	1	
Commercial Hypervisors	1	
Types of Server Virtualization, Physical and Logical Partitioning	2	
Basics of Network Virtualization ,	1	
Storage Virtualization and Desktop Virtualization.		
FIRST INTERNAL TEST		
MODULE : 3 **Cloud Infrastructure (7 hour)**		15
Architectural Design of Compute and Storage Clouds, Layered Cloud Architecture Development, Design Challenges	1	
Inter Cloud Resource Management, Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources.	1 1	
Cloud Management software	1	
Eucalyptus, Open Nebula, Open Stack	2	
Amazon web services	1	
MODULE : 4 **Cloud Programming Models (8 hour)**		15
Parallel and Distributed Programming Paradigms, Map Reduce , Twister and Iterative Map Reduce	1	
Hadoop Architecture, Hadoop Distributed File System, Single and Multi node hadoop clusters	2	
Mapping Applications	1	
Develop and Run a simple map reduce application	1	
Programming Support	1	
Developing python and Java applications with Google App Engine	2	
SECOND INTERNAL TEST		
MODULE : 5 **Security in the Cloud (6 hour)**		20
Security Overview, Cloud Security Challenges	1	
Security -as-a-Service	1	
Security Governance, Risk Management, Security Monitoring	2	
Security Architecture Design, Data Security, Application Security, Virtual Machine Security.	2	
MODULE : 6 **Using Cloud Services (6 hours)**		20
Email Communications, Collaborating on To-Do Lists, Contact Lists, Cloud Computing for the Community	1	
Collaborating on Calendars, Schedules and Task Management, Exploring Online	2	
Scheduling Applications, Exploring Online Planning and Task Management, Collaborating on Event Management, Collaborating on Contact Management, Project Management	2	
Word Processing , Databases, Storing and Sharing Files	1	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6116 HIGH PERFORMANCE AND SECURE NETWORKS

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Computer Networks

Course Objective:

To familiarize the students with the concepts of high speed LANs , high performance optical network and Passive Optical Networks. To impart awareness about protocols for network security.

Syllabus:

Frame Relay Networks – Asynchronous transfer mode, High Speed LAN's , Wired and Wireless Access Technologies , Passive Optical Network architectures and Standards. MPLS and GMPLS, Secure communication using VPN. Network Security Protocols for Electronic Mail Security, IP Security and web security.

Course Outcomes:

Students compare the various methods of providing network services over high speed networks with reference to MPLS, VPN. This course also imparts an investigative mentality for design and development of computer networks with high performance measures.

References

1. Deepankar Medhi , Karthikeyan Ramasamy, *Network Routing Algorithms, Protocols, and Architectures*, Elsevier Inc, 2007
2. Youlu Zheng & Shakil Akhther, *Networks for Computer Scientists and Engineers* Oxford University Press, 2012.
3. Jean Walrand and Pravin Varaiya, *High Performance Communication Networks*, 2nd Ed., Morgan Kauffman, 1999.
4. William Stallings, *HIGH SPEED NETWORKS AND INTERNET*, Pearson Education, Second Edition, 2002.
5. Irvan Pepelnjk, Jim Guichard and Jeff Apcar, *MPLS and VPN architecture*,Cisco Press, Volume 1 and 2, 2003.
6. *Cryptography and Network Security – Principles and Practices* : William Stallings, Pearson Education
7. Leonid G. Kazovsky, Ning Cheng, Wei-Tao Shaw, David Gutierrez, Shing-Wa Wong, *Broadband Optical Access Networks*, John Wiley and Sons, New Jersey, 2011.
8. Uyless D. Black, *Optical Networks: Third Generation Transport Systems*, Prentice Hall ,2007.

Course Plan

COURSE NO: 07CS 6116 (L-T-P : 3-0-0)	**COURSE TITLE: HIGH PERFORMANCE AND SECURE NETWORKS CREDITS:3**	
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **High Speed Networks (6 hours)** Frame Relay Networks Asynchronous transfer mode: ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL. High Speed LAN's: Fast Ethernet, Gigabit Ethernet, IEEE 802.11 WLAN.	 2 2 2	15
MODULE : 2 **Access Technologies (7 hours)** ISDN, DSL standards, Hybrid fibre coax, Cable Modem, Access methods: Wi-MAX / 802.16 , Optical Access Networks , Passive Optical Networks: standards and Development, WDM PON.	 2 2 3	15
FIRST INTERNAL TEST		
MODULE : 3 **Passive Optical Network (7 hours)** Passive Optical Network Components **,** PON Architectures, PON standards development, Broadband PON: architecture, protocol and Service, Bandwidth allocation. Gigabit-Capable PON. Ethernet PON Architecture, 10GEPON PMD Architecture.	 2 2 3	15
MODULE : 4 **MPLS and GMPLS (6 hours)** Multiprotocol Label Switching: Labelled Packets and LSP ,Label Distribution, RSVP-TE for MPLS Generalized MPLS: GMPLS Labels, Label Stacking and Hierarchical LSPs: MPLS/GMPLS, RSVP-TE for GMPLS.	 3 3	15
SECOND INTERNAL TEST		
MODULE : 5 **MPLS and VPN (8 hours)** Multiprotocol Label Switching , MPLS Virtual Private Networks , Layer 2 VPN, Virtual Routing and Traffic Engineering with MPLS , Traffic Engineering of IP/MPLS Networks , MPLS-Based Approach for Traffic Engineering , VPN Traffic Engineering , Layer 3 VPN, Routing/Traffic Engineering for Voice Over MPLS Networks.	 4 4	20
MODULE : 6 **Security Protocols (8 hours)** Electronic Mail Security , IP Security Architecture , Encapsulating Security Payload, Web Security Considerations , Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction DDoS Attack and counter measures in Internet. Case Study: Securing your network using firewall.	 2 2 2 2	20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6118 BIOINFORMATICS

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Nil

Objective:

To give the students an introduction to bio-informatics and various concepts related to bio- informatics such as search engines, data visualization, pattern matching etc.. To build efficient solutions to problems like sequence alignment and to introduce the process of drug discovery.

Syllabus:

Introduction to Molecular biology, Gene structure and information content, Molecular biology tools, Algorithms for sequence alignment, Sequence databases and tools. Molecular Phylogenetics, Phylogenetic trees, Algorithms for Phylogenetic tree construction, Introduction to Perl programming for Bioinformatics. Introduction to Protein structure, Algorithms for Protein structure prediction, Gene expression analysis, Micro Arrays, Pathway analysis. Pattern Matching algorithms, Bio-data analysis, Data Mining in Bioinformatics, Algorithms and data structures for efficient analysis of biological data, Drug Discovery.

Course Outcomes:

This course empowers students with problem analysis skills, imbibes an interest in investigation of bioinformatics problems, and students also gain expertise in programming to solve bioinformatics problems.

References

1. Bryan Bergeron, *Bio Informatics Computing*, Second Edition, Pearson Education, 2003.
2. D. E. Krane and M. L. Raymer, *Fundamental Concepts of Bioinformatics*, Pearson Education, 2003.
3. T. K. Attwood and D. J. Parry-Smith, *Introduction to Bioinformatics*, Pearson Education, 2003.
4. J. H. Zar, *Biostatistical Analysis*, 4/e, Pearson Education, 1999.

Course Plan

COURSE NO: 07CS 6118 COURSE TITLE: BIOINFORMATICS **(L-T-P : 3-0-0) CREDITS:3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction to molecular biology (7 hours)**		15
Introduction to Molecular biology	1	
Gene structure and information content	1	
Molecular biology tools	1	
Algorithms for sequence alignment	2	
Sequence databases and tools	2	
MODULE : 2 **Phylogenetic trees (6 hours)**		15
Molecular Phylogenetics	2	
Phylogenetic trees	2	
Algorithms for Phylogenetic tree construction	2	
FIRST INTERNAL TEST		
MODULE : 3 **Randomized algorithms (6 hours)**		15
Introduction to Perl programming for Bioinformatics	3	
Introduction to Protein structure	1	
Algorithms for Protein structure prediction	2	
MODULE : 4 **Micro Arrays (8 hours)**		15
Gene expression analysis	2	
Micro Arrays	2	
Pathway analysis.	2	
Pattern Matching algorithms	2	
SECOND INTERNAL TEST		
MODULE : 5 **Bio-data analysis (7 hours)**		20
Bio-data analysis	2	
Data Mining in Bioinformatics	2	
Algorithms and data structures for efficient analysis of biological data	3	
MODULE : 6 **Drug discovery (8 hours)**		20
Drug Discovery – components	1	
Perspectives	1	
Numeric considerations	1	
Algorithms	2	
Heuristic methods	2	
Systems Biology Tools	2	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6120 : SOFT COMPUTING

Credits: 3-0-0 : 3 **Year:** 2015

Pre-requisites: Nil

Course Objectives:
To impart concepts of soft computing techniques such as neural Networks, fuzzy systems, genetic algorithms, Ant colony optimization, particle swarm optimization etc.

Syllabus:

Neural networks, different types of neural networks, concepts fuzzy logic, fuzzy expert systems, Evolutionary computing techniques like genetic algorithms, Ant colony optimization and Particle swarm optimization.

Course Outcomes:

Students successfully complete this course will be able to:

- Comprehend soft computing related literature more clarity.
- Apply suitable soft computing techniques to solve optimization problems.
- Justify selection of techniques with proper theoretical arguments.

References

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, *Neuro-Fuzzy and Soft Computing*, Prentice-Hall of India, 2003.
2. James A. Freeman and David M. Skapura, *Neural Networks Algorithms, Applications, and Programming Techniques*, Pearson Edn., 2003.
3. Marco Dorigo, Thomas Stützle, Ant Colony Optimization,2004. George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic-Theory and Applications*, Prentice Hall, 1995.
4. Amit Konar, *Artificial Intelligence and Soft Computing*, First Edition,CRC Press, 2000.
5. Simon Haykin, *Neural Networks: A Comprehensive Foundation*, Second Edition Prentice Hall, 1999.
6. Mitchell Melanie, *An Introduction to Genetic Algorithm*, Prentice Hall, 1998.
7. David E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Addison Wesley, 1997.
8. James F. Kennedy, Russell C. Eberhart, *Swarm intelligence*, Morgan kaufman, 2001
9. Kenneth A. Dejong, *Evolutionary computation a unified approach*, MIT press, 2006
10. Russell C. Eberhart, Yuhui Shi, *Computational Intelligence: Concepts to Implementations*, Morgan kaufman, 2007.

Course Plan

COURSE NO: 07CS 6120 COURSE TITLE: SOFT COMPUTING **(L-T-P : 3-0-0) CREDITS:3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction (6 hours)** Introduction to Soft Computing And Neural Networks Evolution of Computing Soft Computing Constituents From Conventional AI to Computational Intelligence Adaptive Networks, Feed forward Networks	 1 1 2 1 1	 15
MODULE : 2 **Neural Networks (6 hours)** Supervised Learning Neural Networks, Radial Basis Function Networks Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures.	 2 2 2	 15
FIRST INTERNAL TEST		
MODULE : 3 **Fuzzy (5 hours)** Fuzzy Sets, Operations on Fuzzy Sets Fuzzy Relations Fuzzy Rules and Fuzzy Reasoning	 2 1 2	15
MODULE : 4 **Fuzzy – Cont. (5 hours)** Fuzzy Inference Systems, Fuzzy Logic, Fuzzy Expert Systems Fuzzy Decision Making.	 3 2	15
SECOND INTERNAL TEST		
MODULE : 5 **Ant Colony Optimization (10 hours)** Real to Artificial Ants , The Ant Colony Optimization Meta heuristic, Ant Colony Optimization Algorithms for the Traveling Salesman Problem	 3 3 4	 20
MODULE : 6 **Genetic Algorithm and PSO (10 hours)** Genetic Algorithms (GA) , operators in GA, Applications, Particle swarm optimization, Algorithms, applications	 4 6	 20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6122 LAMBDA CALCULUS

Credits: 3-0-0 : 3 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

To familiarize lambda calculus model of computer for enhancing perception of theory of programming languages

Syllabus:

Formal Semantics, Untyped Lambda Calculus, Simply Typed Lambda Calculus, Extensions to Simply Types Lambda Calculus: Basic Types, Derived Forms, Bindings, Pairs, Tuples, Records, Sums, Variants, General Recursion, Sub-typing, Recursive Types, Polymorphism.

Course Outcomes:

Students successfully complete this course will be able to :

- Understand theory of recursive structures like functional programming languages
- Solve complex programming problems.

References

1. Benjamin C Pierce. *Types and Programming Languages*. MIT Press, 2002.
2. Luca Cardelli. *Type Systems*. In Allen B Tucker (Ed.), Handbook of Computer Science and Engineering. CRC Press, 1996.
3. Michael L Scott. *Programming Languages Pragmatics* Elsevier, 2004.

Course Plan

COURSE NO: 07CS 6122 COURSE TITLE: LAMBDA CALCULUS **(L-T-P : 3-0-0) CREDITS:3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Untyped arithmetic expressions (7 hours)** Introduction to Programming Languages Untyped Arithmetic Expressions Syntax and Semantics Properties of the language of Untyped Arithmetic Expressions.	 1 2 2 2	15
MODULE : 2 **Untyped Lambda Calculus (6 hours)** Introduction to Untyped Lambda Calculus Syntax Operational Semantics Evaluation strategies	 1 1 2 2	15
FIRST INTERNAL TEST		
MODULE : 3 **Typed arithmetic expressions (6 hours)** Programming in Lambda Calculus Typed arithmetic Expressions Type safety.	 2 2 2	15
MODULE : 4 **Simply Typed lambda Calculus (9 hours)** Introduction to Simply Typed lambda Calculus Typing relation Properties of the Language Type safety Extensions Basic Types Derived Forms and Let Bindings.	 1 1 1 1 2 1 2	15
SECOND INTERNAL TEST		
MODULE : 5 **Lambda Calculus Extensions (8 hours)** Pairs and Tuples Records Sums and Variants References Exceptions	 2 1 1 2 2	20
MODULE : 6 **Subtyping (6 hours)** Subtyping Recursive Types Polymorphism	 2 2 2	20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 6124 SEMINAR-1

Credits: 0-0-2 : 2 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

To assess the debating capability of the student to present a technical topic. In addition, to impart training to students to face audience and present their ideas and thus creating in them self-esteem and courage that are essential for engineers.

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. A detailed write up on the topic of the seminar is to be prepared in the prescribed format given by the Department. The seminar shall be of 30 minutes duration and a committee with the Head of Department as chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer questions put forward by the committee.

Course Outcomes:

This course empowers students with problem analysis skills, improve effective communication skills, and also inculcate lifelong learning skills.

Internal Continuous Assessment (100 marks):

Presentation : 40 %
Seminar Report : 30%
Ability to answer questions on the topic : 30%

07CS 6126 MINI PROJECT

Credits: 0-0-4 : 2 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical concepts and practical tools/techniques to solve real life problems related to industry and current research.

Assesment Guidelines:

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in computer science related topics. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute, subject to the conditions in M. Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and two experts in the specified area.

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

Course Outcomes:

Students shall be able to apply their theoretical knowledge to develop a solution for real time problem.

This course empowers students with problem analysis skills, improve effective communication skills, and also inculcate lifelong learning skills.

Internal Continuous Assessment (100 marks):

Mini project will have internal marks 50 and semester end examination marks 50. Internal marks will be awarded by respective guides as per the stipulations given below.

Progress achieved and regularity of the student	= 20 marks
Individual evaluation through viva voce/test	= 30 marks
Total	**= 50 marks**

Semester End examination will be conducted by a committee consisting of three faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.

Report	: 25 marks
Concept/Knowledge in the topic	: 15 marks
Presentation	: 10 marks
Total marks	**: 50 marks**

07CS 6128 ADVANCED RESEARCH LAB

Credits: 0-2-0: 1 **Year :** 2015

Pre-requisite: Parallel programming theory and good programming skills

Objective:

To introduce students the concepts of parallel programming using CUDA and MPI
To experience implementation of machine learning techniques.

List of experiments:

Program which invoke CUDA kernel

1. Parallel program to add two integer vectors in O(1) time complexity.
2. Parallel program to multiply two matrices.

MPI Programs

1. Find the largest element in a matrix.
2. Find the transpose of a matrix.

Machine learning with R/Matlab/Python

Invoke following machine learning algorithms with help of any aforementioned execution environment with input of any real dataset (domain can be Natural language processing. Digital Image processing, Bioinformatics, computer vision) and evaluate with appropriate evaluation measures.

1. Support Vector Machines.
2. Naive bayes classifier.
3. Logistic regression.
4. Linear regression.
5. K Means clustering.
6. HMM.

Course outcome: Students will be able to apply advanced tools to implement research papers in machine learning.

Academic Assessment/Evaluation

5. Practical records/outputs 40%
6. Regular class viva-voce 20%
7. Final test 40%

SEMESTER -3

07CS 7101 WIRELESS COMMUNICATION TECHNIQUES

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Digital Communication Techniques

Course Objectives:

- To provide the students with the concepts of wireless communication technologies.
- To impart various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques
- To enhance the understanding of emerging wireless communication technologies.

Syllabus:

Fundamental concepts of wireless networks and wireless communication; wireless channel propagation and models; shadowing and capacity of wireless channels; multiple antennas and space time communications; broadband satellite mobile systems.

Course Outcomes:

Students who successfully complete this course will have an ability to demonstrate the fundamental concepts of wireless communications. Students will also have the ability to design and develop real time wireless networks.

References:

1. C. Siva Ram Murthy, B. S. Manoj , “Ad Hoc Wireless Networks: Architectures and Protocols”, Pearson Education 2004.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2007.
3. Gary Mullett, “Wireless Telecommunications Systems and Networks”, Thomson Learning 2006
4. Jeffrey H Reed, “Software Radio: A Modern Approach to Radio Engineering”, Prentice Hall, May 2002.
5. Theodore S Rappaport, “Wireless Communications”, Pearson Education, Asia , New Delhi, Second Edition, 2002
6. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Prentice Hall, 2003.
7. C Oestges and B Clerckx, “MIMO Wireless Communications”, 1st Edition 2007

Course Plan

COURSE NO: 07CS 7101 COURSE TITLE: WIRELESS COMMUNICATION TECHNIQUES_ (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Overview of Wireless Communications (5 hours)**		
Fundamentals of Wireless Communication Technology, Electromagnetic spectrum, Radio propagation mechanisms, Characteristics of wireless channel	1	15
Modulation techniques, Multiple access techniques, voice coding	2	
IEEE 802.11 standard, HIPERLAN standard	1	
Bluetooth	1	
MODULE : 2 **Overview of Wireless Networks (6 hours)**		
Cellular concept, Cellular architecture	1	
1G, 2G, 3G, 4G,LTE	2	15
IEEE 802.16 standard	1	
Wireless Internet: Mobile IP	1	
Recent advances in wireless networks.	1	
FIRST INTERNAL TEST		
MODULE : 3 **Wireless Channel Propagation and models (7 hours)**		
Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-Small scale fading- channel classification, channel models	1	
Free-Space Path Loss, Two-Ray Model, Simplified Path Loss model	2	15
Empirical Path Loss Models: COST -231, Hata model, Indoor propagation models	2	
Multipath Fading Models: Rayleigh, Rician and Composite	2	
MODULE : 4 **Shadowing and Capacity of Wireless Channels (7 hours)**		
Shadow Fading, Path Loss and Shadowing, Outage Probability under Path Loss and Shadowing, Cell Coverage Area.	1	
Time-Varying Channel Impulse	1	15
Narrowband fading models: Autocorrelation, Cross Correlation, and Power Spectral Density, Envelope and Power Distributions, Level Crossing Rate and Average Fade Duration	3	
Wideband Fading Models: Power Delay Profile, Coherence Bandwidth, Doppler Power Spectrum and Channel Coherence	2	
SECOND INTERNAL TEST		
MODULE : 5 **Multiple Antennas and Space Time Communications (8 hours)**		
MIMO and multicarrier modulation: Narrowband MIMO model-parallel decomposition of MIMO channel, MIMO channel capacity, MIMO diversity gain	3	
Data transmission using multiple carriers-multicarrier modulation with overlapping sub channels-mitigation of subcarrier fading-basic concepts of OFDM.	3	20
Multiuser Channels: Broadcast and Multiple Access, Multiple Access, Broadcast Channel Capacity Region	2	
MODULE : 6 **Broadband Satellite Mobile Systems (9 hours)**		
Broadband Satellite Systems: Introduction, Line-of-sight propagation, Fundamentals of satellite systems, broadband satellite networks	3	
Integration of GEO, LEO, and MEO Satellite and Terrestrial mobile systems.	2	20
Software Defined Radio (SDR), Characteristics and benefits of a Software Radio, Design Principles of Software Radio	3	
Emerging Wireless technologies.	1	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7103 ADVANCED MACHINE LEARNING

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisite: Machine learning and Natural Language processing.

Course Objectives

To enable students to comprehend and practice advanced machine learning literature.

Syllabus

EM algorithm, different models, directed and undirected probabilistic graphical models, Detailed study of popular and emerging machine learning applications like deep learning concepts.

Course Outcomes

Students who successfully complete this course will be able to:

- Comprehend advance machine learning concepts with more clarity.
- Apply Suitable machine learning algorithms to solve real life problems.
- Justify selection of learning algorithms with proper theoretical arguments.

References:

1. *Machine Learning: A Probabilistic Perspective*, Kevin P. Murphy, MIT Press, 2012.
2. *Pattern Recognition and Machine Learning (Information Science and Statistics)*, Christopher bishop, springer, 2011.
3. *Introduction to Machine Learning*, Third edition, Ethem Alpaydin, PHI learning pvt Ltd, 2015
4. *Probabilistic Graphical Models: Principles and Techniques*, Daphne Koller and Nir Friedman, MIT Press, 2009.
5. *Building Machine Learning Systems with Python*, Willi Richert et.al, Packt Publishing Limited, 2013.
6. *Machine Learning With R*, Brett Lantz, Packt Publishing Limited, 2014.
7. *Machine Learning for Hackers*, Drew Conway and John Myles White, OREILLY, 2012

Course Plan

COURSE NO: 07CS 7103 COURSE TITLE: ADVANCED MACHINE LEARNING (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Models (6 hours)** Mixture models , Mixtures of Gaussians , Mixture of multinoullis , Using mixture models for clustering , Mixtures of experts , Parameter estimation for mixture models , Unidentifiability , Computing a MAP estimate is non-convex , The EM algorithm , Basic idea , EM for GMMs , EM for mixture of experts, Latent linear models, PCA Classical PCA: statement of the theorem, Proof, Singular value decomposition (SVD) , Probabilistic PCA, EM algorithm for PCA.	 2 2 2	15
MODULE : 2 **Discrete Data models (6 hours)** Latent variable models for discrete data, LDA (Latent Dirichlet allocation), Basics , Unsupervised discovery of topics , Quantitatively evaluating LDA as a language model , Fitting using (collapsed) Gibbs sampling, extensions of LDA: Correlated topic model , Dynamic topic model , LDA-HMM , Supervised LDA	 1 2 3	15
FIRST INTERNAL TEST		
MODULE : 3 **Directed graphical models (5 hours)** Directed graphical models (Bayes nets), Chain rule, Conditional independence, Graphical models, Graph terminology, Directed graphical models, Examples: Medical diagnosis. Genetic linkage analysis.	 2 2 1	15
MODULE : 4 **Kernels (5 hours)** Kernel functions: RBF kernels, Kernels for comparing documents, Mercer (positive definite) kernels, Linear kernels, Matern kernels, String kernels, Kernel trick: Kernelized nearest neighbor classification Kernelized K-medoids clustering, Kernelized ridge regression, Kernel PCA.	 3 2	15
SECOND INTERNAL TEST		
MODULE : 5 **Undirected graphical models(10 hours)** Undirected graphical models: Markov random fields, Examples of Markov random fields, Conditional Random Fields	 5 5	20
MODULE : 6 **Deep Learning (10 hours)** Deep learning, deep generative models, Deep neural networks, Applications of deep neural networks.	 3 3 3 1	20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7105 COMPUTER VISION

Credits: 3-0-0: 3 **Year:** 2015
Pre-requisite: Linear Algebra, Fundamentals of Image Processing

Course Objectives:

To introduce the student to computer vision algorithms, methods and concepts that will enable the student to implement computer vision systems with emphasis on applications and problem solving.

Syllabus:

Introduction to Computer Vision; Image Formation and Filtering; Edge Detection; Image Analysis; Computational Photography; View; Estimation and Stereo; High Level Computer Vision; Statistical Pattern Recognition.

Course Outcomes:

Students will be able to demonstrate theoretical and experience knowledge on core vision task of scence understanding and recognition. Also will be able to evaluate different vision tasks and apply computer vision algorithms to real world problem solving.

References:

1. *Computer Vision Algorithms and Applications*, Richard Szeliski,Springer 2011
2. *Computer Vision A Modern Approach*, David A Forsyth and Jean Ponce, Prentice Hall 2011
3. *Introductory Techniques for 3D Computer Vision*, E.Trucco and Allessandro Verri,Prentice Hall 1998
4. *Multiple View Geometry in Computer Vision*, Second Edition, Richard Hartley and Andrew Zisserman, Cambridge University Press,2004
5. *Representations and Techniques for 3D Object Recognition and Scene Interpretation*, Synthesis Lecture on Artificial Intelligence and Machine Learning, D. Hoiem and S Savarese, Morgan Claypool Publishers 2011
6. *Learning OpenCV*, Gary Radski and Adrian Kaehler, O'Reilly Media 2008

Course Plan

COURSE NO: 07CS 7105 **(L-T-P : 3-0-0)**	**COURSE TITLE: COMPUTER VISION** **CREDITS:3**	
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction (6 hours)** Image Formation and Filtering, Introduction to Computer Vision, Camera Models, Lenses Euclidean Transformation, Projective Geometry, Optics, Light and Colour, Radiometry- Lighting and shading, Compression, Image Filters, Frequency Domain Processing.	2 2 1 1	15
MODULE : 2 **Edges (6 hours)** Edge Detection, Detection and Localization of Image Edges, Hough Transform and it's variants Interest Points and Corners, Local Image Features-SIFT, SURF Feature Matching, Filling Lines and Curves, RANSAC	2 2 2	15
FIRST INTERNAL TEST		
MODULE : 3 **Advanced Image manipulation (8 hours)** Image Analysis, Object Word and Scene Representation, Scene understanding Methods, Recognition and Registration methods. Computational Photography-High dynamic range imaging, Super Resolution, Alpha Matting, Compositing, Creating Panoramas Image Mosaics, Warping, Stitching	3 4 1	15
MODULE : 4 **Camera (9 hours)** View, Estimation and Stereo ,Dense Motion Estimation, Optical Flow Computation, Application of Optical Flow Camera Calibration, Epipolar Geometry and Structure from motion, Estimation of Depth, Shadows, Contours, Shape from Shading,3d reconstruction, Image based Rendering	4 5	15
SECOND INTERNAL TEST		
MODULE : 5 **Machine learning in CV (6 hours)** High Level Computer Vision-Instance Recognition from Local Features, Scene recognition with bag of words representation Energy minimization segmentation Clustering, Classification	3 3	20
MODULE : 6 **Image Recognition and Applications (8 hours)** Statistical Pattern Recognition, Appearance based Recognition and Model based Recognition Detection with sliding windows, Viola Jones, Internet Scale Vision, Target Tracking, PhotoSynth, Kinect	4 4	20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7107 OPTIMIZATION TECHNIQUES

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Fundamental knowledge of calculus and linear algebra

Course Objectives:

- To introduce to methods of unconstrained optimization
- To provides the student with a collection of optimization modelling and solution tools that can be useful in a variety of industries and functions

Syllabus:

Mathematical Background: Sequences and Subsequences; Vectors and vector spaces- Matrices- Linear transformation; Quadratic forms; linear equations- Solution of a set of linear equations-Basic solution and degeneracy; Linear Programming: Introduction -Optimization model, formulation and applications-Classical optimization techniques; Nonlinear programming: Minimization and maximization of convex functions-Local & Global optimum- Convergence-Speed of convergence. Unconstrained Optimization.

Course Outcomes:

- Translate a verbal or graphical description of a decision problem into a valid optimization model, by identifying variables, constraints, and an objective function.
- Interpret the meaning and assess the validity of a particular optimization model.
- Find solutions to optimization problems using the most appropriate algorithm.
- Perform sensitivity analysis by tracing the effects of varying a parameter on the optimal decision variables and the objective function.

References

1. David G Luenberger, *Linear and Non Linear Programming*, 2nd Ed, Addison-Wesley.
2. S.S.Rao, *Engineering Optimization; Theory and Practice*; Revised 3rd Edition, New Age International Publishers, New Delhi
3. S.M. Sinha, *Mathematical programming: Theory and Methods*, Elsevier.
4. Hillier and Lieberman *Introduction to Operations Research*, McGraw-Hill, 8th edition.
5. Saul I Gass, *Linear programming*, McGraw-Hill, 5th edition.
6. Bazarra M.S., Sherali H.D. & Shetty C.M., *Nonlinear Programming Theory and Algorithms*, John Wiley, New York.
7. Kalyanmoy Deb, *Optimization for Engineering: Design-Algorithms and Examples*, Prentice Hall (India).

Course Plan

COURSE NO: 07CS 7107 COURSE TITLE: OPTIMIZATION TECHNIQUES (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Mathematical Background(9 hours)** Mathematical Background: Sequences and Subsequences, Mapping and functions-Continuous functions- Infimum and Supremum of functions- Minima and maxima of functions- Differentiable functions. Vectors and vector spaces- Matrices- Linear transformation- Quadratic forms- Definite quadratic forms- Gradient and Hessian-Linear equations- Solution of a set of linear equations- Basic solution and degeneracy.	9	15
MODULE : 2 **Convex Sets (9 hours)** Convex sets and Convex cones, Introduction and preliminary definition, Convex sets and properties, Convex Hulls, Extreme point, Separation and support of convex sets, Convex Polytopes and Polyhedra, Convex cones, Convex and concave functions- Basic properties- Differentiable convex functions- Generalization of convex functions.	9	15
FIRST INTERNAL TEST		
MODULE : 3 **Linear Programming (8 hours)** Linear Programming: Introduction, Optimization model, formulation and applications, Classical optimization techniques: Single and multi variable problems, Types of constraints. Linear optimization algorithms: The simplex method, Basic solution and extreme point, Degeneracy, The primal simplex method- Dual linear programs, Primal, dual, and duality theory, The dual simplex method, The primal dual algorithm, Duality applications.	8	15
MODULE : 4 **Post optimization problems (6 hours)** Post optimization problems: Sensitivity analysis and parametric programming, Nonlinear Programming: Minimization and maximization of convex functions- Local & Global optimum- Convergence-Speed of convergence. Unconstrained optimization: One dimensional minimization - Elimination methods: Fibonacci &Golden section search - Gradient methods - Steepest descent method	6	15
SECOND INTERNAL TEST		
MODULE : 5 **Constrained Optimization (5 hours)** Constrained optimization: Constrained optimization with equality and inequality constraints. Kelley′s convex cutting plane algorithm - Gradient projection method, Penalty Function methods.	5	20
MODULE : 6 **Constrained Optimization (5 hours)** Constrained optimization: Lagrangian method , Sufficiency conditions , Kuhn, Tucker optimality conditions, Rate of convergence , Engineering applications, Quadratic programming problems, Convex programming problems	5	20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7109 ADHOC WIRELESS NETWORKS

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Wireless Networks

Course Objectives:
To introduce mobile ad hoc networks, design and implementation issues, security, knowledge of routing mechanisms and knowledge of sensor networks and their characteristics.

Syllabus:
Introduction to Adhoc wireless networks; MAC protocols for adhoc networks; Routing protocols; table driven routing protocols; On demand routing protocols; Hybrid routing protocols; Multicast routing in wireless adhoc networks; transport layer and security protocols; Quality of service in adhoc wireless networks; Energy Management in Adhoc wireless Networks; Wireless sensor Networks

Course Outcomes:

- Students will be able to design and develop mobile ad hoc networks (MANETs)
- Students will have acquired skills to analyse the performance of mobile ad hoc or wireless sensor network using simulation tools.

References

1. C.Sivarama Murthy, B.S Manoj, *Adhoc Wireless Networks (architectures and protocols)*-Prentice Hall- 2012
2. J Schiller, *Mobile Communications*, Addison-Wesley, January 2000
3. Andrew S Tanenbaum, *Computer Networks*, Prentice Hall 2002
4. Sudeep Mishra, lsaacWoungang, *Guide to Wireless Adhoc Networks*, Springer February 2009
5. KavehPahlavan, Prashant Krishnamurthy, *Principles of wireless networks: a unified approach*, Prentice Hall PTR, 2002.
6. Toh, *Ad Hoc Mobile Wireless Networks Protocols and System*, Pearson

Course Plan

COURSE NO: 07CS 7109 COURSE TITLE: ADHOC WIRELESS NETWORKS (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction (8 hours)**		15
Adhoc wireless networks- Types, issues and applications	1	
MAC protocols for wireless adhoc networks-issues and design goals-classification of MAC protocols	1	
Contention based protocols: MACA and MACAW protocols	2	
Contention based protocols with reservation mechanism: Distributed packet reservation multiple access protocol, Five phase reservation protocol	2	
Contention based protocols with Scheduling mechanism: Distributed priority scheduling and medium access in Adhoc networks	1	
Case study: Simulation methods and tools for Wireless Ad-hoc networks	1	
MODULE : 2 **Routing in Adhoc Wireless Networks (7 hours)**		15
Routing protocols in Adhoc wireless networks-Issues, characteristics and classifications	1	
Table Driven Routing Protocols: Destination Sequenced Distance Vector Routing Protocol, Wireless Routing Protocol	1	
On Demand routing protocols: Dynamic Source Routing Protocol, Ad Hoc On-demand Distance Vector Routing Protocol, Location Aided Routing	2	
Hybrid Routing Protocol: Core Extraction Distributed Adhoc Routing Protocol-Optimized Link State Routing Protocol	1	
Hierarchical State Routing Protocol- Power Aware Routing Metrics	1	
Case study: Modeling and Performance Analysis of Adhoc Wireless networks	1	
FIRST INTERNAL TEST		
MODULE : 3 **Multicasting in Adhoc Wireless Networks (6 hours)**		15
Multicast Routing in Adhoc Wireless Networks - Issues, operation, classifications	1	
Tree based multicast routing protocols: Bandwidth efficient multicast routing protocol, Associativity based multicast routing protocol	2	
Mesh based multicast routing protocols: Neighbor supporting Adhoc multicast routing protocol	1	
Energy Efficient Multicasting: Energy efficient reliable broadcast and multicast protocols	1	
Case study: Energy Efficient Routing in MANETs	1	
MODULE : 4 **TCP and security in Adhoc Wireless Networks (9 hours)**		15
Transport Layer and Security Protocols for Adhoc Wireless Networks- Issues and Design goals	1	
TCP over Adhoc Wireless Networks- Adhoc TCP, Split TCP- Application controlled Transport Protocol	2	
Security in Adhoc wireless networks-Requirements, Issues and Attacks	2	
Key Management: Symmetric and asymmetric key algorithms	1	
Secure Routing in Adhoc Wireless Networks: Security-Aware Adhoc Routing Protocol, Security Aware AODV Protocol	2	
Case study: Intrusion Detection in Wireless Adhoc Networks	1	
SECOND INTERNAL TEST		
MODULE : 5 **QoS in Adhoc Wireless Networks (5 hours)**		20
Quality of service in adhoc wireless networks - Issues and challenges	1	
MAC Layer Solutions: IEEE802.11e, Cluster TDMA	1	
Network Layer Solutions: QoS routing protocols, QoS Enabled Adhoc On-demand Distance Vector Routing Protocol	2	
Case study: Improving Quality-of-Service in Ad hoc Wireless Networks	1	

MODULE : 6 **Energy Management (6 hours)**		20
Energy Management in Adhoc wireless Networks- Need and classification	1	
Battery management Schemes, Transmission Power Management and System Power Management Schemes.	2	
Wireless sensor Networks – Applications, Issues, Challenges and architecture	1	
Data dissemination and Data gathering	1	
MAC Protocols for Sensor Networks, Location discovery , Quality of sensor network-	1	
Case study: Middlewares and OS for Wireless Sensor Networks	1	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7111 ADVANCED TOPICS IN CRYPTOGRAPHY

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Number Theory and Cryptography

Course Objective:
To familiarize the concepts in cryptography from a complexity theoretical perspective.

Syllabus:
Basics of Cryptography and Complexity, Non-deterministic computation, Probabilistic computation, Public key cryptography, Digital signatures, Key establishment protocols, Secure encryption, Identification schemes.

Course Outcomes:

After completing this course the students will be

- Familiarized with the applications of complexity theory in cryptography.
- Able to analyse the complexities of various problems in different domains.
- Able to demonstrate how the algorithms are used in different problem domains.

References:

1. *Complexity and Cryptography An Introduction* by John Talbot and Dominic Welsh, Cambridge University Press.
2. *Computational Complexity: A Modern Approach* by Sanjeev Arora , Boaz Barak
3. *Complexity Theory and Cryptology An Introduction to Crypto complexity* by Rothe, Jörg
4. *Cryptography and network security* by William Stallings

Course Plan

COURSE NO: 07CS 7111 COURSE TITLE: ADVANCED TOPICS IN CRYPTOGRAPHY (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction (6 hours)**		15
Cryptographic models, Cryptosystems, Classical and modern cryptography	2	
Complexity theory, deterministic Turing machines, decision problems and languages	2	
Complexity of functions, space complexity.	2	
MODULE : 2 **Probabilistic Analysis (7 hours)**		15
Probabilistic Turing machines and RP primality testing, Zero-error probabilistic polynomial time,	3	
Bounded-error probabilistic polynomial time, Non-uniform polynomial time. Circuits,	2	
Probabilistic circuits, The circuit complexity of most functions, Hardness results	2	
FIRST INTERNAL TEST		
MODULE : 3 **Ciphers (8 hour)**		15
Congruences and residue classes, quadratic residues. Classical Cryptosystems and Their Cryptanalysis	2	
Substitution and Permutation Ciphers, Affine Linear Block Ciphers, Block and Stream Ciphers, Perfect Secrecy. Non- secret encryption, The Cocks–Ellis non-secret cryptosystem,	2	
The RSA cryptosystem, The Elgamal public key cryptosystem,	2	
Public key cryptosystems as trapdoor functions	2	
MODULE : 4 **RSA and Public key Cryptosystems (8 hour)**		15
Insecurities in RSA, Finding the RSA private key and factoring, Rabin's public key cryptosystem.	2	
Public key systems based on NP- hard problems, Problems with trapdoor systems.	3	
Public key-based signature schemes,		
Attacks and security of signature schemes, Signatures with privacy, The importance of hashing, The birthday attack.	3	
SECOND INTERNAL TEST		
MODULE : 5 **Key Sharing and Secret Sharing (6 hour)**		20
The basic problems, Key distribution with secure channels, Diffie–Hellman key establishment, Authenticated key distribution.	2	
Secret sharing, Shamir's secret sharing scheme, Pseudorandom generators, Hard and easy bits of one-way functions.	2	
Pseudorandom generators from hard-core predicates,	1	
Probabilistic encryption, Efficient probabilistic encryption.	1	
MODULE : 6 **Zero Knowledge (6 hours)**		20
Introduction, Interactive proofs, Zero knowledge, Perfect zero-knowledge proofs.	3	
Computational zero knowledge, The Fiat– Shamir identification scheme	3	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7113 COMBINATORIAL ALGORITHMS

Credits: 3-0-0 : 3 **Year:** 2015

Pre-requisites: Algorithms and Complexity

Corse Objectives:

To provide an introduction to the theory and algorithms for integer and combinatorial problems, Familiarizes primal-dual theory of linear programming and its applications in flows, matching, set cover etc, To understand approximation and algorithms and various other combinatorial problems.

Syllabus:

Primal dual theory of linear programming, and application to Max flow / Min cut problem. Application of primal dual theory to matching, bipartite matching, non bipartite matching, set cover, spanning trees and Steiner Forest problems. Introduction to randomized algorithms, probabilistic recurrence, Randomized selection, two point sampling. Randomization techniques, The probabilistic method. Existence proofs. Approximation algorithms. Approximation algorithms for Set Cover - Greedy and using Primal-Dual schema, Steiner Tree and traveling salesman problems. Approximation algorithm for Steiner Forest problem using Primal-Dual schema. Non-approximability. Hardness of approximating MAX-3-SAT.

Course Outcomes :

This empowers students with complex problems analysis skills, gives the mathematical theory behind algorithms for combinatorial problems, helps to formulate a combinatorial problem efficiently and explains how these type of problems can be solved.

References

1. C. H. Papadimitirou and K. Steiglitz, *Combinatorial Optimization: Algorithms and Complexity*, Dover, 1998.
2. G. Ausiello et.al., *Complexity and Approximation: Combinatorial Algorithms and their Approximability Properties*, Springer, 2002.
3. T. H. Cormen, C. E. Leiserson, R. L. Rivest, *Introduction to Algorithms*, Prentice Hall India, 1990.
4. V. Aho, J. E. Hopcraft, J. D. Ullman, *The design and Analysis of Computer Algorithms*, Addison Wesley, 1974.
5. *Approximation Algorithms*, Vijay, Vazirani, Springer, 2001

Course Plan

COURSE NO: 07CS 7113 COURSE TITLE: COMBINATORIAL ALGORITHMS (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Primal-Dual theory of linear programming (7 hours)**		15
Introduction to linear programming	1	
Linear programming duality	1	
Primal-dual theory of linear programming	2	
Flow networks, maximum flow and max flow min cut theorem	1	
Application to max flow min cut theorem	2	
MODULE : 2 **Applications of primal-dual theory(6 hours)**		15
Applications of primal-dual theory to matching	2	
Bipartite matching, Non-bipartite matching	1	
Set cover	1	
Spanning Trees	1	
Steiner-Forest Problems	1	
FIRST INTERNAL TEST		
MODULE : 3 **Randomized algorithms (7 hours)**		15
Introduction to randomized algorithms – Las Vergas and Monte Carlo	1	
Probabilistic Recurrence	2	
Randomized Selection	2	
Two point Sampling	2	
MODULE : 4 **Randomization Techniques (6 hours)**		15
Randomization Techniques	2	
The Probabilistic Method	2	
Existence Proofs	2	
SECOND INTERNAL TEST		
MODULE : 5 **Approximation algorithms (9 hours)**		20
Approximation algorithms – Introduction	1	
Approximation algorithms for Set cover	2	
Greedy method	2	
Primal-dual schema	2	
Steiner tree and Travelling salesman problems	2	
MODULE : 6 **Approximation algorithms for Steiner forest problems (7 hours)**		20
Approximation algorithms for Steiner forest problems using primal-dual schema	3	
Non-approximability	2	
Hardness of approximating MAX-3-SAT	2	

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7115 BIG DATA ANALYTICS

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Data Mining

Course Objectives :
To impart following concepts Big data analytics,Tools and practices for working with big data and Time series and text analytics to students.

Syllabus:
Introduction to big data- features and evolution of big data; big data analytics – data analytics lifecycle overview-case study ; Review of basic data analytics method –exploratory data analysis and methods for evaluation- advanced analytical theory and methods - time series analysis and text analysis; advanced analytics technology and tools- map reduce and hadoop.

Course Outcomes:

The students who successfully complete this course will have the ability to deploy a structured lifecycle approach to data analytics problems and apply appropriate analytic techniques and tools to analyzing big data. Graduates will demonstrate an ability to use techniques to investigate complex problems through research and effectively utilize appropriate modern engineering tools to solve it.

References

1. David Dietrich, Barry Heller, Biebie Yang, *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*, EMC Education Services, John Wiley &Sons, Inc
2. Frank J Ohlhorst, *Big Data Analytics: Turning Big Data into Big Money*, Wiley and SAS Business Series, 2012.
3. Colleen Mccue, *Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis*, Elsevier, 2007
4. Anand Rajaraman and Jeffrey David Ullman, *Mining of Massive Datasets*, Cambridge University Press, 2012.
5. Bill Franks, *Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics*, Wiley and SAS Business Series, 2012.
6. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, *Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data*, McGraw Hill, 2011.
7. Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan, *Harness the Power of Big data – The big data platform*, McGraw Hill, 2012.
8. Pete Warden, *Big Data Glossary*, O'Reilly, 2011.
9. M Sudheep Elayidom, *Datamining and Warehousing*, 1st Edition, Cengage Learning India Pvt Ltd
10. Jiawei Han, Micheline Kamber *Data Mining Concepts and Techniques*, Second Edition, Elsevier, Reprinted 2008.

Course Plan

COURSE NO: 07CS 7115 COURSE TITLE: BIG DATA ANALYTICS **(L-T-P : 3-0-0) CREDITS:3**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction (7 hours)** Introduction To Big Data: Nuances of big data – Value – Big data characteristics - Volume, Veracity, Velocity, Variety. Features of Big Data - Security, Compliance, auditing and protection - Evolution of Big data Analyst Perspective on Data Repositories , State of the Practice in Analytics, BI Versus Data Science, Current Analytical Architecture, Drivers of Big Data, Key roles for new big data ecosystem, Examples .	2 2 3	15
MODULE : 2 **Big Data Analytics (7 hours)** Big Data Analytics : Data Analytics Lifecycle Overview- Phases: Discovery ,data preparation Model planning, model building, communicate results, operationalize . Case Study: Global Innovation Network and Analysis (GINA)	3 2 2	15
FIRST INTERNAL TEST		
MODULE : 3 **Introduction to R (7 hours)** Review of basic data analytic methods using R : Introduction to R, R graphical user interface-data import and export-attribute and data type. Exploratory data analysis-Visualization, Dirty data, single and multiple variables, data exploration vs presentation. Statistical methods for evaluation-Hypothesis testing, difference of means, Wilcoxon ranksum test, type I and II errors, power and sample size, ANNOVA	2 2 3	15
MODULE: 4 **Advanced analytical theory and methods. (6 hours)** Advanced analytical theory and methods: Time Series Analysis- Overview of Time Series Analysis, Box-Jenkins Methodology ARIMA Model, Autocorrelation Function (ACF), Autoregressive Models, Moving Average Models ARMA and ARIMA Models Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions.	1 3 2	15
SECOND INTERNAL TEST		
MODULE : 5 **Text Analysis (7 hours)** Text Analysis : Text Analysis Steps, A Text Analysis Example Collecting Raw Text, Representing Text , Term Frequency Inverse Document Frequency (TFIDF) Categorizing Documents by Topics, Determining Sentiments, Gaining Insights.	2 2 3	20
MODULE : 6 **Advanced Analytics-technology and tools (8 hours)** Advanced Analytics-technology and tools: MapReduce and Hadoop, Analytics for Unstructured Data , MapReduce Framework ,Apache Hadoop, The Hadoop Ecosystem, Pig , Hive , HBase, Mahout , NoSQL.	5 3	20

Internal continuous assessment: 40 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are two tests for the course (2 x 15 = 30 marks) and assignments (10 marks). The assignments can be in the form of seminar, Tutorial or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07CS 7117 SEMINAR-2

Credits: 0-0-2 : 2 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

To assess the debating capability of the student to present a technical topic. In addition, to impart training to students to face audience and present their ideas and thus creating in them self-esteem and courage that are essential for engineers.

Assessment Guidelines:

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. A detailed write up on the topic of the seminar is to be prepared in the prescribed format given by the Department. The seminar shall be of 30 minutes duration and a committee with the PG coordinator as chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer questions put forward by the committee.

Course Outcomes:

This course empowers students with problem analysis skills, improve effective communication skills, and also inculcate lifelong learning skills.

Internal Continuous Assessment (100 marks):

Presentation : 40 %
Seminar Report : 30%
Ability to answer questions on the topic : 30%

07CS 7119 MASTER RESEARCH PROJECT PHASE-I

Credits: 0-0-12 : 6 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply acquired theoretical concepts and practical tools/techniques to solve real life problems related to industry and current research.

Assesment Guidelines:

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in computer science/inter disciplinary topics. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute, subject to the conditions in M. Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and two experts in the specified area each.

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

Course Outcomes:

This course enables students to apply the acquired fundamental engineering knowledge for investigating and solving complex problems. Empowers students with problem analysis skills, familiarizes with the usage and study of modern tools. Students also gain expertise for the design and development of solutions, by enhancing engineering knowledge, and improving inter-personal skills.

Internal Continuous Assessment (50 marks):

Project Progress Evaluation:

Progress evaluation by project supervisor	: 20 Marks
Presentation and evaluation by the committee	: 30 Marks

SEMESTER -4

07CS 7102 MASTER RESEARCH PROJECT PHASE-II

Credits: 0-0-21 : 12 **Year:** 2015

Pre-requisites: Nil

Course Objectives:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical concepts and practical tools/techniques to solve real life problems related to industry and current research.

Assesment Guidelines:

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in computer science/inter disciplinary topics. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute, subject to the conditions in M. Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and two experts in the specified area.

Master Research project phase - II is a continuation of project phase - I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre-submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre-qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

Course Outcomes:

This course enables students to apply the acquired fundamental engineering knowledge for investigating and solving complex problems. Empowers students with problem analysis skills, familiarizes with the usage and study of modern tools. Students also gain expertise for the design and development of solutions, by enhancing engineering knowledge. This course also teaches the importance of team work, by improving upon the aspects of communication and inter-personal skills.

Internal Continuous Assessment (100 marks):

Project evaluation by the supervisor/s	:30 Marks
Evaluation by external expert	:30 Marks
Presentation and evalution by the commitee	:40 Marks