KERALA TECHNOLOGICAL UNIVERSITY

Master of Technology

Curriculum, Syllabus and Course Plan

Cluster	:	*10*
Branch	:	*Computer Science & Engineering*
Stream	:	*Computer Science & Engineering*
Year	:	*2015*
No. of Credits	:	*67*

SEMESTER 1

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	10CS6101	Advanced Mathematical Structures	3-0-0	40	60	3	3
B	10CS6103	Computer Algorithms and Complexity	3-1-0	40	60	3	4
C	10CS6105	Computer Networks and Network Management	3-1-0	40	60	3	4
D	10CS6107	Computer Architecture	3-1-0	40	60	3	4
E		Elective I	3-0-0	40	60	3	3
F	10GN6001	Research Methodology	0-2-0	100			2
G	10CS6109	Seminar I	0-0-2	50			2
H	10CS6111	Advanced Networking Lab	0-0-2	50			1
		TOTAL	**15-5-4**	**400**	**300**	**-**	**23**

TOTAL CONTACT HOURS : 24
TOTAL CREDITS : 23

Elective I

10CS6113 Information Security
10CS6115 Mobile and Pervasive Computing
10CS6117 Linear Algebra and Applications
10CS6119 Soft Computing
10CS6121 Concurrency Models

SEMESTER 2

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	10CS6102	Modern Database Systems	3-0-0	40	60	3	3
B	10CS6104	Advanced Operating Systems	3-0-0	40	60	3	3
C	10CS6106	Advanced Compiler Design	2-1-0	40	60	3	3
D		Elective II	3-0-0	40	60	3	3
E		Elective III	3-0-0	40	60	3	3
F	10CS6108	Mini Project	0-0-4	100			2
G	10CS6112	Software Systems Lab	0-0-2	50			1
		TOTAL	**14-1-6**	**350**	**300**	**-**	**18**

TOTAL CONTACT HOURS : 21
TOTAL CREDITS : 18

Elective II	
10CS6114	Ad-Hoc & Wireless Sensor Networks
10CS6116	Artificial Intelligence
10CS6118	Computational Linguistics
10CS6122	Data Compression
10CS6124	Principles of Distributed Computing
Elective III	
10CS6126	Image Processing
10CS6128	Web Technologies
10CS6132	Information Retrieval
10CS6134	Real Time Systems
10CS6136	High Performance Computing

SEMESTER 3

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A		Elective IV	3-0-0	40	60	3	3
B		Elective V	3-0-0	40	60	3	3
	10CS7101	Seminar II	0-0-2	50			2
	10CS7103	Project (Phase 1)	0-0-12	100			6
		TOTAL	**6-0-14**	**230**	**120**	**-**	**14**

TOTAL CONTACT HOURS : 20
TOTAL CREDITS : 14

Elective IV	
10CS7105	Grid Computing
10CS7107	XML and Web Services
10CS7109	Data Mining and Data Warehousing
10CS7111	Software Project Management
10CS7113	Machine Learning
	Elective V
10CS7121	Cloud Computing
10CS7123	Bioinformatics
10CS7125	Database Tuning
10CS7127	Object Oriented Software Engineering
10CS7129	Information Storage Management

SEMESTER 4

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credit
					Marks	Duration (hours)	
	10CS7104	Project (Phase 2)	0-0-23	100			12
		TOTAL	**0-0-23**	**100**		**-**	**12**

TOTAL CONTACT HOURS : 23
TOTAL CREDITS : 12

TOTAL NUMBER OF CREDITS: 67

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6101	ADVANCED MATHEMATICAL STRUCTURES	3-0-0-3	2015

Course Prerequisites

Basic knowledge in statistics.

Course Objectives

To enable students to:

1. Familiarize with the concepts of stochastic processes and identify the real life examples.
2. Demonstrate the problems with the help of mathematical tools.
3. Classify problems and identify the queuing models.
4. Synthesize efficient tool to solve problems mathematically.

Syllabus

Random processes, Stochastic processes, Markov chains, BD equations, Continuous and discrete time Markov chains, Matrix operations, LU decomposition.

Expected Outcomes

The students will be to

1. Explain and use the concepts of stochastic processes in real life.
2. Explain the major concepts in Markov chain and use it in problems.
3. Classify problems into different models and solve them by applying these concepts.
4. Explain the basic properties of matrix operators and use it in problems.
5. Explain the basic models in queuing systems and the methods to analyze them.
6. Explain and use the concepts behind matrix operations for computations.

References

1. Ronald W. Wolff, Stochastic Modeling and Theory of Queues, Prentice- Hall International Inc 1989.
2. Anurag Kumar, D. Manjunath and Joy Kuri, Communication Networking: An Analytical Approach, Morgan Kaufman Publ. 2004.
3. Gary N Higginbottom, Performance Evaluation of Communication Networks, Artech House, 1998.
4. E. Kreizig: Advanced Engineering Mathematics. Wiley.
5. S. M. Ross, Introduction to Probability Models, Harcourt Asia Pvt. Ltd. and Academic Press.
6. John B Thomas, An Introduction to Applied Probability and Random Processes, John Wiley & Sons.

	Course plan		
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Essential statistics**: Random variables, mean, variance, expectation. [Ref 5]. **Discrete distributions-** definition, binomial, Poisson exponential and geometric distributions [Ref 6].	5	15
II	**Random processes:** definition, stochastic processes, Renewal processes, Poisson processes and applications [Ref 1].	5	15
First Internal Examination			
III	**Markov chains:** Markov Chains: Definition, Examples, Transition Probability Matrices of a Markov Chain, Classification of states and chains, Basic limit theorem, Limiting distribution of Markov chains. [Ref 1,2]	8	15
IV	**BD processes:** Continuous Time Markov Chains: General pure Birth processes and Poisson processes, Birth and death processes, Finite state continuous time Markov chains[Ref 2]	8	15
Second Internal Examination			
V	**Queuing theory:** definition, Single Class and Multi class Queuing Networks: Simple Markovian queues- M/G/1 queue, M/G/C queues, other models, central limit theorem, Elementary renewal theorem, Brownian motion, Martingales[Ref 2,3,4]	8	20
VI	**Matrix theory:** : Matrix operations, Eigen values and Eigen vectors, LU decomposition, Singular Value decomposition, Review of Vector Algebra[Ref 5]	8	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6103	**COMPUTER ALGORITHMS AND COMPLEXITY**	**3-1-0-4**	**2015**

Course Prerequisites: Basic knowledge of Computer Algorithms and complexity at UG Level.

Course Objectives

The course is designed to provide students a strong background in the concept of analysis and design of computer algorithms. Upon completion of this course, students will be able to do the following:

1. Analyze the asymptotic performance of algorithms.
2. Demonstrate a familiarity with major graph algorithms and advanced data structures.
3. Classification of computing problems based on deterministic and randomized category
4. Synthesize efficient algorithms in common engineering design situations.

Syllabus

Analysis of Algorithms, Asymptotic notations, Recurrence analysis, Amortized Analysis, Advanced Data structures, Design and Analysis of Graph algorithms, all pair shortest path algorithms, Network flow, Matroid, Complexity Classes, reduction, Approximation Algorithms, Randomized algorithms.

Expected Course outcomes

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

1. Analyze running times of algorithms using asymptotic analysis. Describe different strategies for amortized analysis, including the accounting method and the potential method. Solve recurrence relations.
2. Explain and use the major advanced data structures like B. Tree, Binomial heap, Fibonacci heap, and Disjoint set.
3. Explain the major graph algorithms and their analyses. Employ graphs to model shortest path and flow problems, when appropriate.
4. Classify problems into different complexity classes corresponding to both deterministic and randomized algorithms.
5. Analyze approximation algorithms including algorithms that are polynomial time approximation scheme and fully polynomial time approximation scheme.
6. Explain the basic properties of randomized algorithms and methods for analyzing them

References

1. Thomas H Cormen, C E Leiserson, R L Rivest, C Stein Introduction to Algorithms, The MIT Press.
2. Dexter C Kozen, The Design and Analysis of Algorithms, Springer.
3. Rajeev Motwani and Prabakar Ragavan, Randomized Algorithms, Cambridge University Press.
4. Jon Kleinberg, Eva Tardos Algorithm Design, Pearson.
5. Gilles Brassard, Paul Bratley, Fundamentals of Algorithms, PHI.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Addison Wesley.

7. Christos H Papadimitriou, Kenneth Steiglitz Combinatorial Optimization Algorithms and Complexity, Dover Books.
8. Michael Sipser, Introduction to Theory of Computation, Wadsworth Publishing Co Inc.
9. Garey Michael R, Johnson davis S, Computers and Intractability: A Guide the theory of NP-Incompleteness, W.H. Freeman & Co.1979.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Analysis of Algorithms:** Model of Computation- RAM Model [Ref. 1,6] Asymptotic Notations; Recurrence Analysis: Substitution Method, Recursion tree Method, Master Method- and its Proof; [Ref. 1]. **Amortized Analysis:** Aggregate analysis, Accounting method, Potential method; [Ref. 1].	9	15
II	**Advanced Data structures:** Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, Disjoint Sets, Union by Rank and Path Compression; [Ref. 1].	9	15
First Internal Examination			
III	**Design and Analysis of Graph algorithms:** Graph Algorithms and complexity: All-Pairs Shortest Paths: The Floyd-Warshall algorithm, Johnson's algorithm; Maximum Flow: The Ford-Fulkerson method, The Edmonds-Karp algorithm; Bipartite Matching;[Ref. 1,4] Matroid Theory-task-scheduling problem [Ref. 1].	10	15
IV	**Complexity Classes:** Complexity Classes, NP Hard & NP Complete Problems, Reductions and NP Completeness, Cook's Theorem[Ref. 2,4,7,8,9]; NP completeness reductions for clique, vertex cover, subset sum, Hamiltonian cycle and TSP.	9	15
Second Internal Examination			
V	**Approximation Algorithms:** Polynomial Time and Fully Polynomial Time Approximation Schemes [Ref. 8]; Approximation Algorithms, vertex cover, TSP, set covering and subset sum [Ref. 1].	9	20

VI	**Randomized algorithms:** Randomized Algorithms: Las Vegas and Monte Carlo Algorithms [Ref. 3, 5], Randomized Divide and conquer Approach [Ref. 4], Randomized version of Quick Sort Algorithm [Ref. 4, 1], Miller Rabin Randomized Primality Test; Integer factorization: Pollard's rho heuristic [Ref. 1]; De-Randomization; Randomized Complexity Classes [Ref. 6]; Probabilistic Algorithms [Ref. 8].	10	20
	Total	56	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6105	COMPUTER NETWORKS AND NETWORK MANAGEMENT	3-1-0- 4	2015

Course Prerequisites

Basic knowledge of Data Communication at UG Level.

Course Objectives

The course is intended to provide students a strong understanding in the principles, protocols, issues and advances in computer Networking. It also gives an overview of the network Monitoring and control protocols.

Syllabus

Introduction to computer networks, Data link layer protocols and issues, concepts in Network layer, Transport layer protocols and issues, Application Layer Technology and Introduction to security, Advanced networking concepts and Network management.

Expected Outcomes

The students will be able to

1. Understand the working principle of data link layer such as switching, framing, error control, MAC etc.
2.
    a. Understand routing protocols in internet.
    b. Design, calculate, and apply subnet masks and addresses to fulfill networking requirements.
3. Acquire knowledge of transport layer issues such as connection less and connection oriented protocols, congestion and different Queuing management options.
4. Get a basic knowledge of the advanced networking concepts such as QoS, VPN, and MPLS etc.
5.
    a. Analyze the features and operations of various application layer protocols such as HTTP, FTP, DNS, and Email Protocols.
    b. Understand the basics of network security.
6. Understand network management using SNMP and RMON.

References

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Third Edition, Morgan Kauffmann Publishers Inc., 2003.
2. Andrew S. Tanenbaum, Computer Networks, Fourth Edition, 2003.
3. Behrouz A. Forouzan: Data Communications and Networking, 4th Edition, Tata McGraw-Hill, 2006.
4. Computer Networking: A Top-Down Approach Featuring the Internet by J. Kurose, K. W. Ross, 3rd edition, Addison-Wesley 2004.
5. High-speed networks and internets: performance and quality of service, William Stallings, Pearson Education India, 2002.
6. Alberto Leon Garcia &Indra Widjaja, Communication Networks – Fundamental Concepts & key architectures, 2nd Edition, Tata McGraw-Hill, India.
7. Nadir F Mir, Computer & Communication Networks, Pearson Education, India.
8. Mani Subramanian, Network Management: Principles and Practice, Pearson Education India, 2010.

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Introduction to computer networks**: layers – Physical links – Issues in the data link layer – Framing, Switching – Error correction and detection – Link-level Flow Control, Medium access, Ethernet and its fast Variants , Wireless LAN	10	15
II	**The Internet Protocol**: Switching vs.Routing,IPv6,Internet Routing Protocols-RIP and OSPF, Multicast Routing, BGP, DHCP, NAT, CIDR, Introduction to Mobile IP,ARP	10	15
First Internal Examination			
III	**Transport introduction**: Port numbers, service models, UDP. Introduction to reliability, TCP, Congestion Control in TCP, buffer management, FIFO, FQ, RED. Congestion control taxonomy, fairness and effectiveness	9	15
IV	**Applications, Network Security:** Application layer overview, Domain Name System (DNS), Remote Login Protocols, E-mail(SMTP,POP,IMAP), FTP,HTTP and HTTPS Overview of network security, Overview of security methods, Firewalls	8	20
Second Internal Examination			
V	**QoS, VPNs, Tunnelling, Overlay Networks** : Overview of QoS, Integrated Services QoS, Differentiated services QoS, Virtual Private Networks, MPLS, Overlay networks.	10	15
VI	**Network Monitoring:** Monitoring and Control – SNMP, V2, V3, RMON, RMON2.	9	20
	Total	56	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6113	INFORMATION SECURITY	3-0-0-3	2015

Course Prerequisites

Basic knowledge of Cryptography and Number Theory at UG Level.

Course Objectives

The course is designed to understand the fundamentals of Cryptography and to acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity. And, to understand the various key distribution and management schemes.

Syllabus

Introduction to security, Computer Security Concepts Attacks, Number Theory concepts, Digital Signature Standard and Trusted systems.

Expected Outcomes

Upon Completion of the course, the students will be able to,

1. Understand computer security concepts and encryption algorithms.
2. Apply the knowledge of public key encryption.
3. Analyze the need for digests and Hash Algorithms.
4. Understand digital signature and various authentication applications.
5. Apply the knowledge of system and network security.
6. Examine the need for intellectual property, privacy and ethical issues.

References

1. Stallings, Cryptography & Network Security Principles & Practice, Prentice Hall, 3rdEdition 2002.
2. Bruce, Schneier, Applied Cryptography, 2nd Edition, Toha Wiley & Sons, 1996.
3. Man Young Rhee, Internet Security, Wiley, 2003.
4. Pfleeger & Pfleeger, Security in Computing, Pearson Education, 3rd Edition, 2003.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction**: Computer Security Concepts Attacks -The OSI Security Architecture -Steganography - Classical Encryption Techniques-DES Differential and Linear Cryptanalysis – Modes of operation – Encryption Algorithms -Triple DES.	8	20
II	**Public Key Encryption**: Number Theory concepts, Primality, Modular Arithmetic, Fermat & Euler Theorem, Euclid Algorithm. RSA Algorithm – Elliptic Curve Cryptography – Diffie Hellman Key Exchange.	8	20
	First Internal Examination		
III	**Authentication and Security Practice**: Digests – Requirements –MAC-Hash function –Security of Hash and MAC – Birthday Attack – MD5– SHA – RIPEMD.	6	20
IV	**Digital Signature**, Digital Signature Standard - Authentication applications – Kerberos – Kerberos Encryption Techniques – PGP.	6	15
	Second Internal Examination		
V	**System and Network Security**: Intruders and Intrusion – Viruses and Worms– Firewalls – Design Principles – Packet Filtering – Application gateways, Trusted systems – Counter Measures, IP Security - Electronic Mail Security - transport layer security-secure electronic transaction.	8	15
VI	**Legal and Ethical Issues**: Cyber Crime and Computer Crime, Intellectual property, Privacy, Ethical issues.	6	10

	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6115	MOBILE AND PERVASIVE COMPUTING	3-0-0-3	2015

Course Prerequisites: None.

Course Objectives

The course is designed to provide students a background in mobile and pervasive computing. Upon completion of this course, students will be able,

1. To understand fundamentals of mobile and pervasive computing and different MAC methods in mobile networks.
2. To understand the mobile computing environment and different handoff mechanisms in mobile networks.
3. To understand the concepts of pervasive computing and the open protocols in context aware computing.

Syllabus

Introduction to wireless, mobile and cellular mobile systems, Medium access control , Emerging technologies in Wireless networks, Mobile computing environment and Handoff in wireless mobile networks, Pervasive Computing, Open protocols, Context aware mobile services.

Expected Course outcomes

1. At the end of the course the student will be able to
2. Explain the concepts of mobile and wireless communications.
3. Describe emerging technologies and Mobile IP protocols in wireless networks.
4. Discuss the components for mobile environment creation.
5. Explain hand offs and location management mechanisms in wireless mobile networks.
6. Describe the pervasive computing.
7. Explain context aware networks and open protocol useful in pervasive computing.

References

1. Ivan Stojmenovic , Handbook of Wireless Networks and Mobile Computing, John Wiley & sons Inc, Canada, 2002.

2. Asoke K Taukder,Roopa R Yavagal,Mobile Computing, Tata McGraw Hill Pub Co., New Delhi, 2005.

3. Seng Loke, Context-Aware Computing Pervasive Systems, Auerbach Pub., New York,

2007.

4. Uwe Hansmannetl , Pervasive Computing, Springer, New York,2001.

5. JochenSciiiller, Mobile Communications, Pearson Education Asia Publications (Low Price Edition), 2000

6. William C.Y Lee, Mobile Cellular Telecommunications , McGraw Hill International Editions, 1995

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction to wireless, mobile and cellular mobile systems**- cellular mobile telephone systems, analog and digital cellular systems- - frequency reuse, co-channel interference. **Medium access control** - MAC, SDMA, FDMA, TDMA, CDMA, Hand offs and dropped calls-initiation of handoff, power difference, mobile assisted cell-site and Intersystem Handoff	7	15
II	**Wireless networks**- emerging technologies- Bluetooth, WiFi, WiMAX, 3G, WATM. Mobile IP protocols -WAP push architecture-Wml scripts and applications.	6	15
	First Internal Examination		
III	**Mobile computing environment**—functions-architecture-design considerations, content architecture - CC/PP exchange protocol, context manager. Data management in WAE-Coda file system- caching schemes- Mobility QOS, Security in mobile computing.	8	15
IV	**Handoff in wireless mobile networks**-reference model-handoff schemes. Location management in cellular networks - Mobility models-location and tracking management schemes- time, Movement, profile and distance based update strategies, ALI technologies.	7	15
	Second Internal Examination		
V	**Pervasive Computing**- Principles, Characteristics- interaction transparency, context aware, automated experience capture. Architecture for pervasive computing- Pervasive devices embedded controls.- smart sensors and actuators -Context communication and access services	7	20
VI	**Open protocols**- Service discovery technologies- SDP, Jini, SLP, UpnP protocols–data synchronization- SyncML framework - Context aware mobile services -Context aware sensor networks, addressing and communications. Context aware security	7	20
	Total	42	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6117	LINEAR ALGEBRA AND APPLICATIONS	3-0-0-3	2015

Course Prerequisites: None.

Course Objectives

- To provide students with a good understanding of the concepts and methods of linear algebra
- To help the students to develop the ability to solve problems using linear algebra.
- To connect linear algebra to other fields both within and without mathematics.

Syllabus

Introduction, Vector Spaces, Subspace, Solutions of Linear Systems, Important Subspaces associated with a matrix, Rank theorem, Orthogonality, Matrices, Determinants, Eigenvalues and Eigenvectors, Diagonalizable Matrices, General Matrices, Jordan Normal Form , Selected Topics in Applications.

Expected Course outcomes

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

1. Apply the concepts and methods of vector space and subspace in solving various problems.
2. Solve systems of linear equations and homogeneous systems of linear equations by Gaussian elimination and Gauss-Jordan elimination.
3. Find the kernel, range, rank, and nullity of a linear transformation.
4. Use the Gram-Schmidt process to produce an orthonormal basis.
5. Determine if a matrix is diagonalizable, and if it is, how to diagonalize it.
6. Know a number of applications of linear algebra and solve.

References

1. Peter D. Lax, Linear Algebra and its Application, Second Edition, Wiley.

2. Greub, W. : Linear Algebra, Springer-Verlag, Graduate Texts in Mathematics 97, (4-th 3. edition) 1981.

3. Halmos, P. R. : Finite-Dimensional Vector Spaces, Springer-Verlag, 1993.

4. Hoffman, K. and Kunze, R, Linear Algebra, Prentice-Hall, 1972.

5. Gilbert Strang, Linear Algebra and Its Applications, 4th Edition, Brooks Cole, 2005.

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	Algebraic Structures – Vector Spaces – Subspaces – Linear Equations – Gauss Elimination –Generating Systems – Linear Independence – Bases – Dimension of Vector Spaces- Homomorphism of Groups - Linear Maps – Space of Linear Maps – Linear Maps and Bases.	7	15
II	The Rank Theorem – Direct Sums and Projections – Dual Spaces – Quotient Spaces –Operations of Groups.	7	15
First Internal Examination			
III	**Orthogonality-** Inner product - Inner product Spaces - Cauchy – Schwarz inequality - Norm – Orthogonality - Gram – Schmidt orthonormalization - Orthonormal basis - Expansion in terms of orthonormal basis – Fourier series - Orthogonal complement - Decomposition of a vector with respect to a subspace and its orthogonal complement – Pythagorus Theorem.	8	15
IV	Matrices – Rank of Matrices – Elementary Matrices – Permutations – Multi Linear Maps –Determinant Functions – Computation Rules for Determinants – Determinants of Linear Maps – Orientations – Determinants and Volumes – Polynomials in One Variable and Several Variables – Eigen Values – Characteristic Polynomials – Minimal Polynomials.	8	15
Second Internal Examination			
V	Diagonalisable and Trigonalisable Operators - Decompositions Theorems – Jordan Normal Form.	6	20
VI	Application of linear algebra:- Optimization and Linear Programming - Network models -Game Theory -Image Compression.	6	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6119	SOFT COMPUTING	3-0-0-3	2015

Course Prerequisites: Artificial Intelligence or Machine Learning course at UG level.

Course Objectives

An introduction to advanced topics in artificial neural network and fussy systems are given. It also provides the concepts of Evolutionary and Stochastic techniques, Rough Sets and Hybrid Systems.

Syllabus :

Soft Computing: Introduction, Artificial Intelligence, productions system and control strategies - Knowledge Representation, Reasoning - Artificial Neural Networks - Fuzzy sets and Fuzzy Logics - Rough Sets - Genetic Algorithm, Stochastic models - Hybrid Systems.

Expected Course outcomes

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

1. Familiarize soft computing concepts and techniques, and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems.
2. Explain the students about Artificial Neural Networks and various categories of ANN
3. Familiarize the salient approaches in soft computing based on fuzzy sets and its operations, fuzzy logic and its applications.
4. Comprehend and discuss the concept of Rough Sets and Decision Tables.
5. Introduce genetic algorithm fundamentals and its operators, stochastic models and applications.
6. Evaluate soft computing methodologies and interface them through hybrid system logic in solving problems.

Text Books:

1. S. Rajasekaran and G.A.Vijaylakshmi Pai. Neural Networks, Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India.
2. Rough Sets, Z. Pawlak, Kluwer Academic Publisher, 1991.
3. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997.
4. Neuro-Fuzzy and Soft Computing, Jang, Sun, & Mizutani, PHI.

References:

1. K.H.Lee.. First Course on Fuzzy Theory and Applications, Springer-Verlag.
2. J. Yen and R. Langari.. Fuzzy Logic, Intelligence, Control and Information, Pearson Education.
3. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR.
4. Genetic Algorithms in Search and Optimization, and Machine Learning, D. E. Goldberg, Addison-Wesley, 1989.

Course Plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Soft Computing:** Introduction, requirement, soft computing vs. hard computing, different tools and techniques, usefulness and applications. **Artificial Intelligence:** Introduction, Different types and characteristics of production systems, Search Techniques and various types of control strategies.	6	15
II	**Knowledge Representation Issues**, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP. **Artificial Neural Network:** Introduction, basic models, Learning methods, Architecture of back propagation network, Applications. Issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories.	8	15
First Internal Examination			
III	**Fuzzy sets and Fuzzy logic:** Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database - fuzzification and defuzzification methods - applications.	8	15

IV	**Rough Set:** Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.	4	15
Second Internal Examination			
V	**Evolutionary and Stochastic techniques:** Genetic algorithm-Fundamentals, encoding, fitness function, reproduction, Genetic modeling and operators, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method. Simulated annealing and Stochastic models, Boltzmann Machine, Applications.	8	20
VI	**Hybrid Systems:** Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.	8	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6121	**CONCURRENCY MODELS**	**3-0-0- 3**	**2015**

Course Prerequisites

Basic knowledge of Operating System and JAVA Programming at UG level.

Course Objectives

To enable the students to understand when concurrent programming techniques are appropriate to use and how to create correct programs using several different concurrent programming mechanisms in different programming languages. And also, to enable them to know how to use concurrent programming paradigms or patterns.

Syllabus

FSP and graph models, Modelling, Safety and liveness properties, Concurrency architectures and design, Linear temporal logic.

Expected Outcomes

After completing this course, students will be able to

1. Apply the knowledge of FSP and graph models.
2. Understand the concepts of mutual exclusion, conditional synchronization, semaphores and nested monitors.
3. Understand safety properties of a system.
4. Examine the liveness properties of a system.
5. Understand concurrency architectures and design.
6. Apply the knowledge of linear temporal logic.

References

1. Jeff Magee & Jeff Kramer, "Concurrency: State Models and Java Programs", Second Edition, John Wiley, 2006.
2. M. Huth& M. Ryan, "Logic in Computer Science – Modeling and Reasoning about Systems", Second Edition, Cambridge University Press, 2004.
3. B. Goetz, T. Peierls, J. Bloch, J. Bowbeer, D. Holmes, and D. Lea, "Java Concurrency in Practice", Addison-Wesley Professional, 2006.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**FSP and graph models :**Concurrency and issues in concurrency – models of concurrency – graphical models – FSP & LTSA – modelling processes with FSP – concurrency models with FSP – shared action – structure diagrams – issues with shared objects.	7	15
II	**Modelling:** Mutual exclusion – conditional synchronization – modelling semaphores – nested monitors – monitor invariants.	6	15
	First Internal Examination		
III	**Safety properties**: Deadlocks – deadlock analysis in models – dining philosophers problem – safety properties –single-lane bridge problem.	6	15
IV	**Liveness properties**:– liveness of the single-lane bridge – readers writers problem – message passing – asynchronous message passing	7	20

	models – synchronous message passing models – rendezvous.		
Second Internal Examination			
V	**Concurrency architectures and design**: Modelling dynamic systems – modeling timed systems – concurrent architectures – Filter pipeline – Supervisor-worker model – announcer-listener model – model-based design – from requirements to models – from models to implementations – implementing concurrency in Java – program verification	8	20
VI	**Linear temporal logic (LTL):**Syntax of LTL – semantics of LTL – practical LTL patterns – equivalences between LTL statements – specification using LTL – LTL and FSP – Fluent proposition – Temporal propositions – Fluent Linear Temporal Logic (FLTL) – FLTL assertions in FSP – Database ring problem.	8	15
	Total	42	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6109	**SEMINAR-I**	**0-0-2 -2**	**2015**

Course Prerequisites: None

Course Objectives

1. To develop soft skill
2. To understand research papers and prepare presentation material
3. To understand about new technologies in the modern era.
4. To improve oral communication skills through presentation
5. To prepare original technical write up on the presentation

Methodology

1. To choose the area of interest
2. To consult guide for topic selection
3. To identify current literatures
4. To choose state of the art survey paper/research paper
5. To consult and get confirmed with Seminar Coordinator (Faculty)
6. To prepare the PPT
7. To present as per schedule drawn by Seminar Coordinator
8. To prepare a technical write up and submit to Seminar Coordinator

Expected Outcomes

Students will be able to,

1. Improve their in proficiency in English.
2. Improve their presentation skill.
3. Improve their theoretical knowledge of field related to computer science and engineering.
4. Improve their analytical and reasoning ability.
5. Improve their technical writing skills.

Internal work assessment

1. Evaluation by the supervisor/s : 30 %
2. Presentation & evaluation by the Committee: 40 %
3. Evaluation of the Report: 20%
4. Regular Attendance : 10 %

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6111	**ADVANCED NETWORKING LAB**	**0-0-2-1**	**2015**

Course Prerequisites

Basic knowledge of computer networking at UG.

Course Objectives

The course is designed to provide students a strong background in the working principles of different protocols and networks using Network simulators.

Syllabus

Introduction to Network Simulator, Simulation of different network layer protocols, Simulation of different networks.

Expected Outcomes

After the completion of this course student will be able to,

1. Demonstrate the working of different network layer protocols.
2. Design and simulate Local Area Networks.
3. Examine performance of different Networks.
4. Design and simulate Wireless Networks.

References

1. Teerawat Issariyakul, Ekram Hossain, Introduction to Network Simulator NS2, Springer, 2nd Edition.
2. http://www.isi.edu/nsnam/ns/doc/index.html.
3. Kevin R. Fall, W. Richard Stevens, TCP/IP Illustrated, Volume 1: The protocol, Addison Wesley, 2nd Edition.
4. Gary R. Wright, W. Richard Stevens, TCP/IP Illustrated: The Implementation, Addison Wesley, Vol. 2.

Course plan

Experiments	Semester Exam Marks (%)
1. Implementation of Remote command Execution 2. Basic Network Simulation using simulator. (Eg. NS2/NS3) 3. Exercise using Network Simulator NS2/NS3 4. Basic Network layer protocol simulation using NS2/NS3. 5. Simulating Local Area Network 6. Measuring Network Performance 7. Simulating Wireless Networks (Eg. WiFi,WiMAX, Adhoc, WSN)	50

Assessment :

1. Practical Records /outputs 40%
2. Regular Class Viva-Voce 20%
3. Final Test (Objective) 40%

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6102	MODERN DATABASE SYSTEMS	3-0-0-3	2015

Course Prerequisite(s): Basic course in Database Management Systems

Course Objectives

The course is designed to provide the learner a strong background in the area of Database Management Systems which we use in diverse domains of computing. After completing this course students will be able to do the following:

1. Identify the exact type of database management system that can be used for a specific domain.
2. Design the database structure specifically for domains under consideration.
3. Identify and rectify the problems associated with heavy transactions in different types of databases.

Syllabus

Database Systems architectures, Parallel and Distributed Databases, Object Based Databases, Multimedia Databases, Mobile Database Systems, Transaction Management in Mobile Database Systems.

Expected Course outcomes

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

1. Understand different database system architectures and the contexts where they are applied.
2. Differentiate Parallel and Distributed databases and understands their methods of implementation of query processing for improved performance.
3. Describe the features and uses of Object based databases.
4. Explain the usage of Multimedia databases.
5. Describe the basic concepts of mobile communication and location dependent data distribution.
6. Acquire in-depth knowledge of mobile transactions.

References

1. Elmasri, Navathe. Fundamentals of Database Systems, Third Edition, Pearson Education, 2000.
2. Henry F Korth, Abraham Silberschatz, S. Sudharshan, Database System Concepts, Fifth Edition, McGraw Hill, 2006.
3. V.S.Subramanian, Principles of Multimedia Database Systems, Harcourt India Pvt Ltd., 2001.
4. Vijay Kumar, Mobile Database Systems, John Wiley & Sons, 2006.

Course plan			
Module	**Content**	**Hours**	**Semester Exam Marks (%)**
I	**Database Systems architectures:** Revisiting relational database systems , Advanced data types, Advanced querying and information retrieval, Database system architectures- Centralized and Client-Server Architectures, Server System Architectures – parallel Systems- Distributed Systems, Three Tier Client Server Architecture-Case Studies [Ref. 1,2]	7	10
II	**Parallel and Distributed Databases:** I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism - Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing [Ref. 2]	7	15
First Internal Examination			
III	**Object Based Databases:** Object Identity – Object structure – Type Constructors –Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems : Object Relational features in SQL/Oracle – Case Studies [Ref. 1]	6	15
IV	**Multimedia Databases:** Multidimensional Data Structures -Image Databases – Text/Document Databases- Video Databases – Audio Databases – Multimedia Database Design [Ref. 3]	6	15
Second Internal Examination			
V	**Mobile Database Systems:** Types of Mobility - Radio Frequency - Spectrum and Band- Cellular Communication - Continuous Connectivity - Structure of a Channel - Absence of Free Channel - Signal Fading - Frequency Reuse - Call Processing – GSM- Location Management - Handoff Management- Roaming- Effect of Mobility on Data Management - Location Dependent Data Distribution [Ref. 4]	8	20

VI	**Transaction Management in Mobile Database Systems:** Transaction Execution in MDS - Mobile Transaction Models – HiCoMo- Moflex- Kangaroo- MDSTPM- Mobilaction- ACID for Mobilaction-Concurrency Control- Locking-Based CCMs - CCM Based on *Epsilon* Serializability- Transaction Commit Protocols- Two-Phase Commit Protocol - Centralized 2PC- Decentralized 2PC- Linear or Nested 2PC- Mobile Database Recovery Schemes – Three Phase Hybrid Recovery Scheme – Low-Cost Check pointing and Failure Recovery - Mobile Agent-Based Log Management Scheme - Forward Log Unification Scheme - Forward Notification Scheme [Ref. 4].	8	25
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6104	**ADVANCED OPERATING SYSTEMS**	**3-0-0-3**	**2015**

Course Prerequisites: Basic understanding of Operating Systems in UG level.

Course Objectives

The course is designed to provide students a strong background in Advanced Operating System concepts, Upon completion of this course students will be able,

1. To study the characteristics of Uniprocessor and Multiprocessor OS.
2. To learn the issues related to designing OS.
3. To study the characteristics of Distributed OS.
4. To learn the latest trends in building Mobile OS.

Syllabus

Uniprocessing operating system, Multiprocessor Operating Systems, Distributed Operating System, Synchronization in distributed systems, Distributed file system, Mobile Operating Systems.

Expected Course outcomes

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

1. Explain basic concepts of uniprocessor and multiprocessor operating systems.
2. Discuss design issues and communications methods in distributed operating systems.
3. Explain issues related with synchronization and deadlocks in distributed systems.
4. Illustrate the design and implementation concepts of distributed file systems.
5. Develop modules for mobile devices.

Text books

1.M Singhal and NG Shivaratri , Advanced Concepts in Operating Systems, Tata McGraw

Hill Inc, 2001.

2. A S Tanenbaum, Distributed Operating Systems, Pearson Education Asia, 2001.

References

1. A.S.Tanenbaum, Modern Operating Systems, PHI Edition, 1992.

2. J.L.Peterson and A. Silberchatz, Operating System Concepts, Addison Wesley.

3. M.Milenkovic, Operating Systems: Concepts and Design, Mc Grawhill Inc New york, 1992.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Uniprocessing operating system:** Review of Operating system concepts. Process Concept –Threads process Scheduling – process synchronization – Interprocess Communication - semaphores – Messages – Monitors – critical Regions – conditional critical regions – deadlocks. Real and virtual Memory management Schemes.	7	15
II	**Multiprocessor Operating Systems:** System Architectures- Structures of OS – OS design issues –Process synchronization – Process Scheduling and Allocation- memory management	6	15
	First Internal Examination		
III	**Distributed Operating System:** Introduction - Design Issues. Communication in distributedsystems Layered protocols – ATM - client server model - remote Procedure call – Group Communication.	7	15
IV	**Synchronization in distributed systems:** Clock Synchronization – Mutual Exclusion – Election algorithms – Atomic transactions - Deadlocks in distributed systems. Processes and processors in distributed systems: Threads – system models - Processor allocation - Scheduling in distributed Systems.	8	15
	Second Internal Examination		
V	**Distributed file system:** Design and implementation – Trends in distributed file systems. Case study AMOEBA, MACH, Recent trends and developments.	7	20
VI	**Mobile Operating Systems:** ARM and Intel architectures - Power Management - Mobile OS Architectures - Underlying OS - Kernel structure and native level programming – Runtime issues- Approaches to power management	7	20
	Total	42	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6106	**ADVANCED COMPILER DESIGN**	**3-0-0-3**	**2015**

Course Prerequisites: Understanding of Compiler Design course at UG level.

Course Objectives

An introduction to advanced topics in compiler design is given. It also provides the concepts of code analysis, optimization techniques, code scheduling and Code generation.

Syllabus :

Introduction to Advanced Topics, Symbol Table Structure, Intermediate Representations, Flow analysis-Control Flow Analysis – Data Flow Analysis, Static Single Assignment construction , Machine Dependent optimizations-Register allocation- Instruction scheduling, Machine code generation

Expected Course outcomes

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

1. Review compiler phases and Symbol table structures. Identify run time issues
2. Analyses control and data flow
3. Classify different code optimization techniques to improve the performance of a program in terms of speed & space.
4. Construct Static Single Assignment and optimize.
5. Apply Machine dependent optimization.
6. Apply low level machine code generation.

References

1. Aho A.V., Lam M.S., Sethi R., and Ullman J.D., Compilers: Principles, Techniques, and Tools, Pearson Education, 2007.
2. Steven Muchnick., Advanced Compiler Implementation. Morgan Kauffman Publishers, 1997.
3. Steven S.Muchnick, Advanced Compiler Design & Implementation, Morgan Kaufmann, 2004.
4. Robert. Morgan, Building an Optimizing Compiler, Butterworth-Heinemann, 1998.

Course plan

Module	Content	Hours	Semester Exam Marks (%)

I	**Introduction to Advanced Topics:** Review of compiler phases – Introduction to Advanced Topics – Informal Compiler Algorithm Notation – Symbol Table Structure – Intermediate Representations – Run Time Issues – Support for Polymorphic and Symbolic Languages.	7	15
II	**Analysis:**Flow Analysis: Control Flow Analysis – Data Flow Analysis – , Reaching Definitions, Available Expressions, and Live Variable Analysis. Dependency analysis – Alias analysis	8	15
First Internal Examination			
III	**Optimization:** Introduction – Review of Early Optimizations – Redundancy Elimination– Loop Optimizations – Procedure Optimization	7	15
IV	**SSA**: Static Single Assignment Form (SSA): SSA Construction – Optimizations on SSA Form.	6	15
Second Internal Examination			
V	**Machine Dependent tasks :**Register Allocation – Graph Colouring Algorithm – Local and Global Instruction Scheduling – Advanced Topics in Code Scheduling – Low Level Optimizations – Introduction to interprocedural analysis and scheduling.	7	20
VI	**Control Flow and Low-Level Optimizations:** If Simplifications, Loop Inversion, Branch Optimizations. **Machine code generation:** Machine Code Generation: Instruction Selection - Maximal munch and Dynamic programming Algorithm. Code Generation – Target Machine – Code Generation for Run- time Stage Management. Code Generation Algorithms.	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6114	AD-HOC & WIRELESS SENSOR NETWORKS	3-0-0-3	2015

Course Prerequisites

Basic knowledge of wireless networks at UG/PG Level.

Course Objectives

The course is designed to give the students an understanding of ad-hoc wireless networks and the various challenges and issues in designing such networks.

Syllabus

Ad-Hoc Wireless Networks, Ad-Hoc MAC Protocols, Ad-Hoc Network Routing, Ad-Hoc Transport Layer, Wireless Sensor Network, Wireless Mesh Networks.

Expected Outcomes

At the end of the course the students will be able to,

1. Differentiate between cellular and ad-hoc networks and understand the issues in ad-hoc wireless networks.
2. Understand the issues, classifications and working of Ad-Hoc MAC protocols.
3. Explain various Ad-Hoc networking protocols like DSDV, WRP, AODV, ZRP etc.
4. Understand the issues and working of Ad-Hoc Transport layer protocols.
5. Explain the working of wireless sensor networks.
6. Understand wireless mesh networks and its design challenges. Also, the working of IEEE 802.11s.

References

1. C. Siva Ram Murthy and B.S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice-Hall Pearson, 2004.
2. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic, Mobile Ad Hoc Networking, Wiley Student Edition, 2013, ISBN: 978-81-265-2789-2.
3. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman).
4. Carlos Corderio Dharma P.Aggarwal, Ad Hoc and Sensor Networks – Theory and Applications, World Scientific Publications, March 2006, ISBN – 981-256-681-3.
5. Ekram Hossain, Kin K. Leung, Wireless Mesh Networks: Architectures and Protocols, Springer Science & Business Media, 20-Nov-2007.
6. Yan Zhang, JijunLuo, and Honglin Hu, Wireless Mesh Networking: Architectures, Protocols and Standards, Auerbach Publications, December 2006.
7. Ian Akyildiz and Xudong Wang, Wireless Mesh Networks, John Wiley and Sons, March 2009.

Course plan

Module	Content	Hours	Semester Exam Marks (%)
I	**Ad-Hoc Wireless Networks:** Cellular and Ad-Hoc Wireless Networks-Applications of Ad-Hoc Wireless Networks-Issues in Ad-Hoc Wireless Networks.	7	15
II	**Ad-Hoc MAC Protocols:** Issues, Classifications of MAC protocols-Contention Based (MACAW, FAMA)-Reservation Based (D-PRMA, CATA)-Scheduling Based (Distributed Priority Scheduling and Medium Access in Ad Hoc Networks), Multi-channel MAC & Power control MAC protocol.	8	15
First Internal Examination			

III	**Ad-Hoc Network Routing**: Issues – Classifications of routing protocols– Table Driven (DSDV, WRP)- On Demand (DSR, AODV) – Hybrid routing (CEDAR, ZRP, Zone-Based Hierarchical Link state routing protocol)- Hierarchical and ower aware. Multicast routing – Issues-Operation of Multicast Routing Protocols-Architecture Reference Model for Multicast Routing Protocols- Classifications of Multicast Routing Protocols.	8	15
IV	**Ad-Hoc Transport Layer:** Issues - TCP Over Ad Hoc – Feedback based, TCP with explicit link, TCP BuS, Ad Hoc TCP, and Split TCP.	6	15
Second Internal Examination			
V	**Wireless Sensor Network:** Sensor Network Architecture, Data dissemination, Gathering. MAC Protocols – self-organizing, Hybrid TDMA/FDMA and CSMA based MAC. Issues in WSN routing – OLSR, AODV. Localization – Indoor and Sensor Network Localization. QoS in WSN.	7	20
VI	**Wireless Mesh Networks**: Introduction-Network Architecture-Design challenges-IEEE802.11s Mesh Networks.	6	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6116	**ARTIFICIAL INTELLIGENCE**	**3-0-0-3**	**2015**

Course Prerequisites
NIL

Course Objectives
To give the students exposure to the field of Artificial Intelligence and knowledge in Searching Techniques, Knowledge Representations and Learning.

Syllabus
Introductory Concepts, Searching Techniques, Knowledge Representation, Learning and Applications and Communication.

Expected Outcomes
After completing this course students will be able to,

1. Apply the basic concepts of Artificial Intelligence.
2. Implement AI searching techniques and understand gaming decisions.
3. Understand various knowledge representation techniques.
4. Understand the importance of AI learning.
5. Explain various learning techniques.
6. Understand communication in AI applications.

References

1. Stuart Russell, Peter Norvig, AI – A Modern Approach, 2E, Pearson Education / PHI, 2004.
2. Elaine Rich and Kevin Knight, Artificial Intelligence, 2E, TMH, 2003.
3. George F. Luger, Artificial Intelligence-Structures and Strategies for Complex Problem Solving, Pearson Education / PHI, 2002.
4. Nils J. Nilsson, Artificial Intelligence: A new Synthesis, Harcourt Asia Pvt. Ltd., 2000.

Module	Content	Hours	Semester Exam Marks (%)
I	**Introductory Concepts**: Intelligent Agents – Agents and environments- Good behavior – The nature of environments – structure of agents – Problem Solving – problem solving agents – example. Problems – searching for solutions – uniformed search strategies – avoiding repeated states – searching with partial information.	7	15
II	**Searching Techniques**: Informed search strategies – heuristic function – local search algorithms and optimistic problems – local search in continuous spaces – online search agents and unknown environments – Constraint satisfaction problems (CSP) – Backtracking search and Local search – Structure of problems – Adversarial Search. Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision – games that include an element of chance.	7	20
	First Internal Examination		
III	**Knowledge Representation**: First order logic - syntax and semantics – Using first order logic – Knowledge engineering – Inference – prepositional versus first order logic – unification and lifting – forward chaining – backward chaining – Resolution – Knowledge representation- Ontological Engineering – Categories and objects – Actions – Simulation and events – Mental events and mental objects.	9	20
IV	**Learning and Applications**: Learning from observations – forms of	6	15

	learning – Inductive learning - Learning decision trees – Ensemble learning – Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information.		
Second Internal Examination			
V	Inductive logic programming - Statistical learning methods – Learning with complete data – Learning with hidden variable – EM algorithm – Instance based learning – Neural networks – Reinforcement learning – Passive reinforcement learning – Active reinforcement learning – Generalization in reinforcement learning.	6	10
VI	**Communication** – Communication as action – Formal grammar for a fragment of English – Syntactic analysis – Augmented grammars – Semantic interpretation – Ambiguity and disambiguation – Discourse understanding – Grammar induction – Probabilistic language processing – Probabilistic language models – Information retrieval – Information Extraction – Machine translation	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6118	**COMPUTATIONAL LINGUISTICS**	**3-0-0-3**	**2015**

Course Prerequisites: None

Course Objectives

To acquire basic understanding of linguistic concepts and natural language complexity, variability and to introduce the fundamentals of Language processing from computational viewpoint. And also to understand the design of tools for basic NLP tasks such as tagging and parsing and be able to apply them to text and evaluate their performance.

Syllabus

Introduction, Probabilistic Models, Syntax, Unification of Feature Structures, Semantics, Pragmatics.

Expected Outcomes

After completing this course, a student will be able to,

1. Understand the fundamentals of computational linguistics.
2. Explain various probabilistic models.
3. Apply the knowledge of various syntax models.
4. Understand the importance of unification of feature structures.
5. Examine the need for semantic analysis.
6. Understand language pragmatics.

References

1. Jurafsky, D. and J. H. Martin, Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Prentice-Hall, 2000
2. Charniak, E.: Statistical Language Learning. The MIT Press. 1996.
3. J. Allen: Natural Language Understanding. Benjamin/Cummins.1995.

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction**: Words-Regular Expressions and Automata, Morphology and Finite-State Transducers; Computational Phonology and Pronunciation Modelling, Probabilistic Models of Pronunciation and Spelling.	7	15
II	**Probabilistic Models**: Probabilistic Models of Pronunciation and Spelling; Weighted Automata; N- Grams ; Corpus Analysis; Smoothing ; Entropy; Parts-of-Speech – Taggers Rule based –Hidden Markov Models – Speech Recognition	7	15
	First Internal Examination		
III	**Syntax**: N-gram Models of Syntax - HMMs and Speech Recognition - Word Classes and Part-of-Speech Tagging- Context-Free Grammars for English - Parsing with Context-Free Grammars- Probabilistic Context-Free Grammars- Probabilistic CYK Parsing of PCFGs- Learning PCFG Probabilities-Problems with PCFGs-Probabilistic Lexicalized CFGs-Dependency Grammars-Human Parsing	8	20
IV	**Unification of Feature Structures**: Feature Structures in the Grammar-Agreement-Head Features-Sub categorization-Long Distance Dependencies-Implementing Unification- Unification Data Structures-The Unification Algorithm-Unification Parsing-Integrating Unification into an Earley Parser-Types and Inheritance-Extensions to Typing.	7	15
	Second Internal Examination		
V	**Semantics**: Representing Meaning-Semantic Analysis-Lexical Semantics - Word Sense Disambiguation and Information Retrieval.	7	15

VI	**Pragmatics**: Discourse - Dialog and Conversational Agents -Natural Language Generation - Multilingual Processing -Machine Translation	6	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6122	DATA COMPRESSION	3-0-0-3	2015

Course Prerequisites
Basic knowledge of Digital Signal Processing is desirable, not mandatory, at UG Level.

Course Objectives
To give the students
1. Exposure to the field of Data Compression
2. Knowledge in concepts of Text, Image, Audio and Video compression

Syllabus
Introduction, Different Methods of Compression, Dictionary methods, Image Compression Intuitive Methods, Video Compression, Audio Compression.

Expected Outcomes
After completing this course, a student will be able to,
1. Explain the basic principles of Data Compression.
2. Apply compression techniques in a given data.
3. Explain various dictionary methods.
4. Understand intuitive methods in image compression.
5. Explain various audio compression techniques.
6. Understand video compression methods.

References
1. Khalid Sayood, Introduction to Data Compression, Harcout India(P) Ltd,2/e ,New Delhi,2002
2. David salomon, Data compression - The complete Reference, Springer Publications (4th Edition), 2006.
3. Mark Nelson and Jean-Loup Gailly, The Data compression Book, BPB publications (2nd Edition),1995

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction**: Compression Techniques - Lossy compression & Lossless compression, modeling and compression Mathematical modeling for Lossless compression- Physical models probability models, Markov Models and composite source models. Mathematical modeling for Lossy compression - physical models, Probability models and linear systems models.	8	15
II	**Different Methods of Compression:** Basic Techniques - Run length encoding, RLE Text compression, RLE image compression and scalar quantization. Statistical Methods -Information theory concepts, Huffman coding, Adaptive Huffman coding, facsimile compression Arithmetic coding and Adaptive, Arithmetic coding and Text compression.	8	20
First Internal Examination			
III	**Dictionary methods:** String compression, LZ 77, LZSS, LZ78,LZW - Unix compression, GIF image, ARC and PKZIP, Data compression patterns. Wavelet methods : Fourier Image compression, Multi Resolution decomposition and JPEG 2000.	7	15
IV	**Image Compression Intuitive Methods**: Image Transforms, JPEG, Progressive Image compression, Vector quantization, Adaptive Vector Quantization, Block Matching, Block Truncation coding. Context Tree	7	20

	weighting, Block Decomposition, Binary Tree predictive coding, Quad Trees and Finite Automata Methods.		
Second Internal Examination			
V	**Audio Compression**: Sound, Digital Audio, The Human Auditory System, μ -Law and A-Law companding, ADPCM Audio compression and MPEG-1 Audio Layers.	6	15
VI	**Video Compression**: Analog Video, Composite and Components Video, Digital Video, Video compression, MPEG and H.261.	6	15
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6124	**PRINCIPLES OF DISTRIBUTED COMPUTING**	**3-0-0-3**	**2015**

Course Prerequisites
Basic knowledge of Operating System and Data Communication at UG Level

Course Objectives
The course is designed to learn the basic concepts of DSM and Hardware DSM. It would also help to understand file sharing, DFS Implementation and Replication in DFS.

Syllabus
Introduction to Open Distributed Computing, Load distribution, Fault Tolerance, Types of communications, Distributed Shared Memory and Distributed file systems.

Expected Outcomes
The Student will be able to

1. Understand the relevance of distributed computing.
2. Explain load distribution in distributed systems.
3. Explain the need for fault tolerance.
4. Demonstrate different types of communication like RPC.
5. Understand the concepts of distributed shared memory.
6. Explain distributed file syatems.

References
1. Coulouris, Distributed Systems, Pearson Education.
2. Tanenbaum, Distributed Operating Systems, Pearson Education.
3. Tanenbaum, Distributed Systems: Principles and Paradigms, Pearson Education.
4. Mukesh Singhal and Niranjan G Shivaratri, Advanced Concepts in Operating Systems, TMH.

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction to Open Distributed Computing**: Definition Of distributed systems, goals of distributed systems, types of distributed systems. Synchronization – clock synchronization, logical clocks, mutual exclusion election algorithms.	7	15
II	**Load distribution** – issues in load distribution, components of load distribution algorithm. Case study of some distributed systems – AMOEBA, MACH.	7	15
	First Internal Examination		
III	**Fault Tolerance:** Introduction, process resilience, reliable communication, Distributed commit, Recovery.	8	15
IV	**Types of communications**: remote procedure call, message oriented communication, stream oriented communication, multicast communication	6	20
	Second Internal Examination		
V	**Distributed Shared Memory**: Types of shared memory multiprocessors, Consistency models, page based distributed shared memory, shared variable distributed shared memory, object based distributed shared memory	7	20
VI	**Distributed file systems**: Introduction to distributed file systems, architecture, mechanism for building distributed file system. Case studies of SUN NFS.	7	15

	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6126	**IMAGE PROCESSING**	**3-0-0-3**	**2015**

Course Prerequisites: None

Course Objectives

To Develop an overview of the field of image processing and understand the fundamental algorithms like segmentation, transformation etc. and how to implement them.

Syllabus

Digital image fundamentals, Image transforms and enhancement Image Transforms, Image restoration and construction, Image Compression, Image Segmentation, Colour and multispectral image processing.

Expected Outcomes

The student will be able to

1. Apply the knowledge of various digital image fundamentals.
2. Demonstrate various image transforms.
3. Explain image restoration and construction using appropriate methods.
4. Apply image compression techniques.
5. Demonstrate the knowledge of various image segmentation techniques.
6. Understand color and multispectral image processing..

References

1. Digital Image Processing, Gonzalez.R.C & Woods. R.E., 3/e, Pearson Education, 2008.
2. Digital Image Processing, Kenneth R Castleman, Pearson Education,1995.
3. Digital Image Procesing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education ,2009. Pvt Ltd, NewDelhi
4. Fundamentals of Digital image Processing, Anil Jain.K, Prentice Hall of India, 1989.
5. Image Processing, Sid Ahmed, McGraw Hill, New York, 1995.

Module	Content	Hours	Semester Exam Marks (%)
I	**Digital image fundamentals**: Introduction, Digital Image- Steps of Digital Image Processing Systems-Elements of Visual Perception - Connectivity and Relations between Pixels. Simple Operations-Arithmetic, Logical, Geometric Operations, Mathematical Preliminaries - 2D Linear Space Invariant Systems - 2D Convolution - Correlation 2D Random Sequence - 2D Spectrum.	7	15
II	**Image transforms and enhancement Image Transforms:** 2D Orthogonal and Unitary Transforms-Properties and Examples. 2D DFT-FFT – DCT - Hadamard Transform - Haar Transform - Slant Transform - KL Transform -Properties And Examples. Image Enhancement-Histogram Equalization Technique- Point Processing-Spatial Filtering-In Space And Frequency - Nonlinear Filtering-Use Of Different Masks**.**	7	15
	First Internal Examination		
III	**Image restoration and construction:** Image Restoration, Image Observation And Degradation Model, Circulant and Block Circulant Matrices and its Application In Degradation Model – Algebraic Approach to Restoration- Inverse By Wiener Filtering – Generalized Inverse-SVD And Interactive Methods - Blind Deconvolution-Image Reconstruction From Projections.	7	15
IV	**Image Compression**: Redundancy And Compression Models -Loss Less And Lossy.Loss Less- Variable-Length, Huffman, Arithmetic	7	20

	Coding - Bit-Plane Coding, Loss Less Predictive Coding, Lossy Transform (DCT) Based Coding, JPEG Standard - Sub Band Coding.		
Second Internal Examination			
V	**Image Segmentation**: Edge Detection - Line Detection - Curve Detection - Edge Linking And Boundary Extraction, Boundary Representation, Region Representation And Segmentation, Morphology-Dilation, Erosion, Opening And Closing. Hit And Miss Algorithms Feature Analysis.	7	20
VI	**Color and multispectral image processing**: Color Image-Processing Fundamentals, RGB Models, HSI Models, Relationship Between Different Models. Multispectral Image Analysis - Color Image Processing Three Dimensional Image Processing-Computerized Axial Tomography-Stereometry-Stereoscopic Image Display-Shaded Surface Display.	7	15
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6128	**WEB TECHNOLOGIES**	**3-0-0-3**	**2015**

Course Prerequisites : None

Course Objectives

To provide the students with the fundamental ideas of Web Application Development using HTML5, CSS3, JavaScript's and detailed knowledge about server-side programming using PHP and Frameworks. And to provide detailed knowledge about building Database Applications using MySQL.

Syllabus

Introduction, Client Side Scripting, Server Side Scripting, PHP Frameworks**.**

Expected Outcomes

After completing this course, a student will be able to,

1. Demonstrate an understanding in web application development using HTML and CSS3.
2. Implement web applications using client side scripting.
3. Implement web applications using server side scripting.
4. Implement session management and object oriented programming using PHP.
5. Implement web applications with database interaction.
6. Demonstrate an understanding of PHP framework.

References

1. Jeffrey C Jackson, "Web Technology – A Computer Science Perspective", Pearson Education, 2007.
2. Brian P Hogan, "HTML5 and CSS3: Develop with Tomorrow's Standards Today", Pragmatic Bookshelf, 2010.
3. W Jason Gilmore, "Beginning PHP and MySQL: From Novice to Professional", Apress, 2010.
4. Thomas Myer, "Professional CodeIgniter", John Wiley & Sons, 2008.

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction:** Web essentials – Clients – Servers – Communications – Mark-up Languages – HTML 5 – XHTML – Stylesheets – CSS3.	7	20
II	**Client Side Scripting:** Client Side Scripting using JavaScript – Syntax – Control Structures – Arrays and Objects – In-built objects – DOM – Manipulation of DOM using JS – Dynamic Content Generation using JS – Dynamic Styling using JS – JS Libraries and APIs – jQuery.	7	10
First Internal Examination			
III	**Server Side Scripting**: Introduction to PHP – Variables – Control Structures – Syntax – Arrays – Built-in Arrays – Form Processing.	8	15
IV	**Dynamic Content Generation**: Session Management and Cookies – Object Oriented Programming using PHP.	8	15
Second Internal Examination			
V	**Database Applications**: PHP with MySQL – mysql interface – MySQLi interface – Object Oriented Version of MySQLi.	5	20
VI	**Rapid Application Development using PHP Frameworks:** CodeIgniter Framework – Installation and Setup – MVC Programming using CodeIgniter.	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6132	**INFORMATION RETRIEVAL**	**3-0-0-3**	**2015**

Course Prerequisites
Basic knowledge of Data Base Management Systems at UG Level.

Course Objectives
To understand the principles and techniques of information retrieval, Multimedia IR and to understand about languages computer interactions and online IR systems.

Syllabus
Basic Concepts, Languages, Document Pre-processing, Human Computer Interaction, Online IR systems.

Expected Outcomes
At the end of the course students will be able to,

1. Demonstrate the knowledge in basic concepts in image retrieval.
2. Explain querying, user relevant feedback, local and global analysis, text and multimedia languages.
3. Apply the knowledge of document preprocessing techniques.
4. Understand human computer interaction.
5. Explain multimedia information retrieval concepts.
6. Demonstrate an understanding of online IR systems.

References

1. R. Baeza-Yates, B. Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", Pearson Education India, 1/e, 2009.
2. G.G. Chowdhury, "Introduction to Modern Information Retrieval", Neal- Schuman Publishers; 2nd edition, 2003.

Module	Content	Hours	Semester Exam Marks (%)
I	**Basic Concepts** – Retrieval Process – Modeling – Classic Information Retrieval – Set Theoretic, Algebraic and Probabilistic Models – Structured Text Retrieval Models – Retrieval Evaluation.	8	20
II	**Languages** – Key Word based Querying – Pattern Matching – Structural Queries – Query Operations – User Relevance Feedback – Local and Global Analysis – Text and Multimedia languages.	8	20
	First Internal Examination		
III	**Document Preprocessing** – Clustering – Text Compression - Indexing and Searching – Inverted files – Boolean Queries – Sequential searching – Pattern matching – User Interface and Visualization	6	15
IV	**Human Computer Interaction** – Access Process – Starting Points – Query Specification - Context – User relevance Judgment – Interface for Search.	6	15
	Second Internal Examination		
V	**Multimedia IR**: Models and Languages, Indexing and searching. Applications: Searching the Web – Challenges – Characterizing the Web – Search Engines – Browsing – Meta-searchers –	7	15

VI	**Online IR systems** – Online Public Access Catalogs – Digital Libraries – Architectural Issues – Document Models, Representations and Access – Prototypes and Standards	7	15
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6134	REAL TIME SYSTEMS	3-0-0-3	2015

Course Prerequisites
Basic knowledge of Operating Systems, Computer Networks and DBMS at UG level.

Course Objectives
To understand the principles and techniques of Real Time System and provide understanding on basic multi-task scheduling algorithms for periodic, aperiodic, and sporadic tasks as well as understand the impact of the latter two on scheduling.

Syllabus
Introduction, Real Time Task Scheduling ,Resource sharing, Commercial Real Time Operating Systems, Real Time Communication, Real Time databases.

Expected Outcomes
Students will be able to,

1. Explain the basic concepts in real time systems.
2. Understand real time task scheduling.
3. Explain various resource sharing techniques.
4. Demonstrate a knowledge of commercial real time OS.
5. Illustrate real time communication techniques.
6. Explain the concepts behind real-time databases.

References

1. Rajib Mall, Real Time Systems: Theory and Practice, Pearson Education, 2007
2. Jane W S Liu, Real Time Systems, Pearson Education.

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction:** Basic Model, Characteristics and applications of real time systems, Safety and Reliability, Types of Real Time Tasks, Timing Constraints. Real Time Task Scheduling: clock driven scheduling, event driven scheduling, Rate monotonic algorithm, issues associated with RMA.	7	20
II	**Real Time Task Scheduling**: Scheduling Real time Tasks in Multiprocessor and distributed systems. Clocks in distributed real time systems.	7	15
	First Internal Examination		
III	**Resource sharing**: Resource sharing among real time tasks, Priority inversion, Priority Inheritance protocol, Highest Locker Protocol, Priority Ceiling Protocol, Handling task dependencies.	6	15
IV	**Commercial Real Time Operating Systems**: Real Time operating system features, Unix as a real time operating system, Windows as a real time operating system, POSIX, Benchmarking real time systems.	7	15
	Second Internal Examination		
V	**Real Time Communication :**Basic concepts, Real time communication in a LAN, Bounded access protocols for LANs, Real time communication over packet switched networks, Routing, Resource reservation, Rate control, QoS Models.	7	20
VI	**Real Time databases**: Applications of real time databases, real time database application design issues, characteristics of temporal data, concurrency control in real time databases, locking based concurrency	8	15

	control protocols, optimistic concurrency control protocols, speculative control protocols.		
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
110CS6136	HIGH PERFORMANCE COMPUTING	3-0-0-3	2015

Course Prerequisites

Basic knowledge of computer organization and architecture at UG Level.

Course Objectives

The course is designed to get an understanding of various activities that happen during program execution, and how they are managed by the hardware (architectural features) and system software (operating systems, run-time systems).

Syllabus

Introduction to Computer Systems, Instruction set architecture, Instruction processing, Pipelined processors, Virtual memory, Cache memory, Parallel Computing, synchronization and deadlocks, Distributed memory programming using MPI/PVM, Shared memory parallel programming. Multithreading, Operating systems, File systems, Inter-process communication.

Expected Outcomes

After the course students will be able to,

1. Understand the organization of computer systems.
2. Explain pipelined processors.
3. Understand the concepts of parallel computing.
4. Understand synchronization and deadlocks.
5. Understand the functions of OS.
6. Demonstrate knowledge of interprocess communication.

References

1. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
2. A. Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, John Wiley.
3. R. E. Bryant and D. R. O'Hallaron, Computer Systems: A Programmer's Perspective, Prentice Hall.
4. Dowd, K., High performance Computing, O'Reilly Series, 1993.
5. Culler, D. and Singh, J.P., Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann Pub., 1999.
6. Gropp, W.Lusk, E., and Skjellum, A., Using MPI: Portable Parallel Programming with the Message-passing Interface, MIT Press, 1997

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction to Computer Systems**: Processors, Memory, I/O Devices; Cost, timing, and scale (size) models. Program execution: Program, Compilation, Object files, Function call and return, Address space, Data and its representation. Computer organization: Memory, Registers, Instruction set architecture, Instruction processing.	7	15
II	**Pipelined processors**: Pipelining, Structural, data and control hazards, Impact on programming Virtual memory: Use of memory by programs, Address translation, Paging, Cache memory: Organization, impact on programming, virtual caches.	7	15
	First Internal Examination		
III	**Parallel Computing**: Introduction to parallel Architectures and Interconnection Networks, communication latencies. Program parallelization: task partitioning and mapping, data distribution, Message passing	7	15

IV	**Synchronization and deadlocks**: Distributed memory programming using MPI/PVM. Shared memory parallel programming. Multithreading	7	15
Second Internal Examination			
V	**Operating systems**: Processes and system calls, Process management, Program profiling, File systems: Disk management, Name management, Protection, Parallel architecture.	7	20
VI	**Interprocess communication**: Synchronization, Mutual exclusion, Basics of parallel architecture, Parallel programming with message passing using MPI.	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6108	**MINI PROJECT**	**0-0-4-2**	**2015**

Course Objectives

The student is expected to start the preliminary background studies towards the project by conducting a literature survey in the relevant field. He/she should broadly identify the area of the work, familiarize with the design and analysis tools required for the work and plan the experimental platform, if any, required for project work. The student will submit a detailed report of these activities at the end of the semester.

Expected Outcomes

After the course students will be able to,

1. Identify the problem of a research project through literature survey.
2. Analyze the technical feasibility of the project.
3. Identify and propose the solution for the research problem.
4. Analyze and design the proposed solution using software engineering practices.
5. Improvement in technical writing.

Internal work assessment

First Review:	
Guide	20 marks
Evaluation Committee	20 marks
Second review:	
Guide	30 marks
Evaluation Committee	30 marks

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS6112	**SOFTWARE SYSTEMS LAB**	**0-0-2-1**	**2015**

Course Prerequisites: None

Course Objectives

The course is designed to provide students hands-on experience on text processing, scripting languages, debugging, compiling the user code and software development environments.

Syllabus

Web programming, Source code control system, Debuggers, Scripting and Document creation tools.

Expected Course outcomes

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

1. Familiarize with General purpose programming tools, development tools
2. Implement web applications
3. Apply Version control system on software development
4. Familiarize of Scripting languages
5. Work with Document preparing tools

References

1. Harvey M. Deitel, Paul J. Deitel, A. B. Goldberg, Internet& World Wide Web: How to Program, Pearson Education International, 2004.
2. Norman Matloff , Peter Jay Salzman, The Art of Debugging with GDB, DDD, and Eclipse, 2008.
3. Jon Loeliger, Matthew McCullough,Version Control with Git, ,o'RELLY 2nd edition.
4. Arnab Banerjee, Introduction to Python Programming (4th Edition)
5. Leslie Lamport, LATEX , Pearson Education.

Course plan

List of Experiments	Semester Exam Marks (%)

1. General purpose programming tools, VIM, gedit 2. Web programming 3. Tools for good software development process, eclipse, 4. Make / gmake 5. Source code control systems, git, 6. Debuggers & memory allocation debuggers – Eg. gdb ,ddd etc. 7. Integrated development environments 8. Scripting languages – Eg. perl, python etc. 9. Tools for text processing 10. Document creation tools – Eg. LaTeX etc.	50
Assessment : 4. Practical Records /outputs 40% 5. Regular Class Viva-Voce 20% 6. Final Test (Objective) 40%	

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7105	**GRID COMPUTING**	**3-0-0-3**	**2015**

Course Prerequisites

Computer Network course at UG level is desirable, not mandatory.

Course Objectives

The course is designed to understand the principles and techniques of Grid Computing Systems.

Syllabus

Introduction to grid computing, Grid computing architecture, Grid Computing anatomy, Grid computing technologies, Grid computing tool kit, Grid services.

Expected Outcomes

The students will be able to,

1. Explain the past, present and future of Grid computing.
2. Understand grid computing organizations and their goals.
3. Understand grid computing architecture.
4. Explain various grid computing technologies.
5. Illustrate about grid computing toolkit.
6. Understand high level grid services.

References

1. Joshy Joseph & Craig Fellenstein, Grid Computing, Pearson/PHI PTR-2003.
2. Ahmar Abbas, Grid Computing: A Practical Guide to Technology and Applications, Charles River media, 2003.

Module	Content	Hours	Semester Exam Marks (%)
I	**Introduction to grid computing:** Introduction – The Grid – Past, Present and Future.	7	10
II	Applications of grid computing organizations and their roles.	6	10
	First Internal Examination		
III	**Grid computing architecture:** Grid Computing anatomy – Next generation of Grid computing initiatives–Merging the Grid services architecture with Web services architecture.	8	25
IV	**Grid computing technologies:** OGSA – Sample use cases that drive the OGSA platform components – OGSI and WSRF– OGSA Basic Services – Security standards for grid computing.	9	25
	Second Internal Examination		
V	**Grid computing tool kit:** Globus Toolkit –Versions – Architecture – GT Programming model –A sample grid service implementation.	6	15
VI	**High level grid services** – OGSI .NET middleware Solution Mobile OGSI.NET for Grid computing on Mobile devices	6	15
	Total	42	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7107	XML AND WEB SERVICES	3-0-0-3	2015

Course Prerequisites: None

Course Objectives

To provide the students

1. The fundamental ideas of XML and Web Services
2. Detailed knowledge about using XML and related technologies to build web services
3. Knowledge about content management using XML

Syllabus

Introduction to XML, Web services and Semantic web.

Expected Outcomes

After completing this course, a student will be able to,

1. Demonstrate an understanding of XML
2. Understand business motivations for web services.
3. Apply the knowledge of transport protocols for web services.
4. Explain about B2B and B2C applications.
5. Explain about semantic web.
6. Apply the professional ethics in web service development.

References

1. Ron schmelzer et al, "XML and Web Services", Pearson Education, 2002.
2. Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004.

Module	Content	Hours	Semester Exam Marks (%)
I	**XML** – benefits – Advantages of XML over HTML – EDL –Databases – XML based standards –DTD –XML Schemas – X- Files – XML processing – DOM –SAX- presentation technologies –XSL – XFORMS – XHTML – voice XML – Transformation – XSLT – XLINK – XPATH –XQ.	7	15
II	**Business motivations for web services** – B2B – B2C- Technical motivations – limitations of CORBA and DCOM – Service – oriented Architecture (SOA) – Architecting web services –Implementation view – web services technology stack – logical view – composition of web services – deployment view – from application server to peer to peer – process view – life in the run time.	8	15
First Internal Examination			
III	**Transport protocols for web services** – messaging with web services – protocols – SOAP –describing web services – WSDL – Anatomy of WSDL – manipulating WSDL – web service policy – Discovering web services – UDDI – Anatomy of UDDI- Web service inspection – Ad-Hoc Discovery – Securing web services.	8	20
IV	B2B - B2C Applications – Different types of B2B interaction – Components of e-business XML systems – ebXML – Rosetta Net Applied XML in vertical industry – Web services for mobile devices.	9	25
Second Internal Examination			
V	**Semantic Web** – Role of Meta data in web content – Resource	8	20

	Description Framework – RDF schema – Architecture of semantic web – content management workflow – XLANG –WSFL.		
VI	**Professional Ethics in Web service development-** security and best practices, open frameworks.	2	5
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7109	DATA MINING AND DATA WAREHOUSING	3-0-0-3	2015

Course Prerequisites

Basic knowledge of DBMS at UG level.

Course Objectives

To give the students

1. Exposure to the field of Data Mining and Warehousing.
2. Knowledge in concepts of classification and prediction.
3. Practical experience in modeling and simulation.

Syllabus

Fundamentals of data mining and Data Warehousing, Data mining using classifiers and prediction, Mining complex types of data.

Expected Outcomes

After completing this course students will be able to,

1. Demonstrate knowledge of basic principles of Data Mining.
2. Understand data warehousing.
3. Explain multidimensional data model, OLAP and data warehouse backend process.
4. Understand classification and prediction techniques.
5. Explain Classification based on concepts from Association Rule Mining and by using other methods.
6. Understand Multidimensional Analysis and Descriptive Mining of Complex, Data Objects and mining in World Wide Web.

References

1. Paulraj Ponnaiah, "Data Warehousing Fundamentals", Wiley Publishers, 2001.
2. Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufman Publishers, 2000.
3. Sam Anahory, Dennis Murray, Data Warehousing in the Real World Pearson Asia.
4. Margaret H Dunham, Data Mining Introductory and advanced topics, Pearson Education.
5. Adriaan, Introduction to Data Mining, Addison Wesley publication 2005.
6. A.K.Pujari, Data Mining Techniques,University Press,2002.

Module	Content	Hours	Semester Exam Marks (%)
I	Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining.	5	10
II	Data Warehouse and OLAP Technology for Data Mining Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining.	7	15
	First Internal Examination		
III	Multidimensional Data Model, Data Cube, Dimension Modeling, OLAP Operations, Warehouse Schema, Data Warehouse Architecture, Data Mart, Meta Data, Types of Meta Data, Data Warehouse Backend Process, Development Life Cycle.	8	20
IV	Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification	8	15

	by Back propagation.		
Second Internal Examination			
V	Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy.	6	20
VI	Multidimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web.	8	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7111	SOFTWARE PROJECT MANAGEMENT	3-0-0-3	2015

Course Prerequisites

Basic knowledge of Software Engineering at UG level.

Course Objectives

To give the students

1. Introduction to advanced methods and tools of project management.

Syllabus

Fundamentals of data mining and Data Warehousing, Data mining using classifiers and prediction, Mining complex types of data.

Expected Outcomes

Students will be able to,

1. Understand various activities in Software project management.
2. Demonstrate knowledge of activity planning.
3. Explain risk management in software development.
4. Explain Resource allocation, Creating Framework and Cost Monitoring.
5. Understand Change Control and Managing Contracts.
6. Understand the behavioral aspects of people and the importance of teamwork.

References

1. Bob Hughes, Mike Cotterell, Software Project Management, Third Edition, Tata Mc Graw Hill, 2000.
2. Ramesh, Gopalaswamy, Managing Global Projects, Tata McGraw Hill, 2001.
3. Royce, Software Project Management, Pearson Education, 1999.

Module	Content	Hours	Semester Exam Marks (%)
I	Project Definition-contract management-activities covered by software project management-overview of project planning-stepwise project planning-strategic assessment-technical assessment-cost benefit analysis-cash flow forecasting-cost benefit evaluation techniques-risk evaluation-software effort estimation.	7	15
II	Activity planning: Objectives, Project Schedule , Sequencing and Scheduling Activities , Network Planning Models, Forward Pass, Backward Pass, Activity Float, Shortening Project Duration, Activity on Arrow Networks.	7	15
	First Internal Examination		
III	Risk Management, Nature Of Risk,Types OfRisk, Managing Risk ,Ha zard Identification, Hazard Analysis,Risk Planning andControl.	7	10
IV	Monitoring and control: Resource allocation identifying and scheduling resources, publishing resource and cost schedule, scheduling sequence, Creating Framework, Collecting The Data, Visualizing Progress, Cost Monitoring, Earned Value, Prioritizing Monitoring.	7	25
	Second Internal Examination		
V	Getting Project Back To Target, Change Control, Managing Contracts, Introduction, Types Of Contract, Stages In Contract Placement, Typical Terms Of A Contract, Contract Management – Acceptance.	7	10
VI	Managing people and organizing teams: Introduction, Understanding	7	25

	Behavior,Organizational Behaviour, Selecting The Right Person For The Job, Instruction In The Best Methods Motivation, The Oldman Hackman Job Characteristics Model, Working In Groups , Becoming A Team Decision Making, Leadership, Organizational Structures – Stress –Health And Safety – Case Studies.		
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7113	MACHINE LEARNING	3-0-0-3	2015

Course Prerequisites: None

Course Objectives

1. To introduce the prominent methods for machine learning, such as supervised and unsupervised learning, connectionist and other architectures for machine learning.
2. Describe the strength and weakness of each of these models.

Syllabus

Learning Problems –issues-Concept Learning- Decision tree learning – Heuristic space search- Neural Network Representation–- Genetic Algorithms - Bayesian Learning- K- Nearest Neighbour Learning- Rules based learning- Analytical Learning

Expected Outcomes

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

1. Identify instance based learning algorithms.
2. Design neural network and genetic algorithm to solve classification problems.
3. Use Bayes optimal classifier and Naïve Bayes Classifier.
4. Familiarize KNN algorithms and case based learning.
5. Understand probabilistic methods for learning.
6. Explain analytical learning.

References

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Science /Engineering /Math; 1edition, 1997
2. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation andMachine Learning)", The MIT Press 2004
3. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1edition, 2001

Module	Content	Hours	Semester Exam Marks (%)
I	Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm– Heuristic Space Search	7	15
II	Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search –Genetic Programming – Models of Evaluation and Learning.	7	15
First Internal Examination			
III	Bayesian Learning: Bayes Theorem – Concept Learning – Maximum Likelihood – MinimumDescription Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample	7	15
IV	K- Nearest Neighbour Learning – Locally weighted Regression – Radial Bases Functions –Case Based Learning.	7	15
Second Internal Examination			

V	Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution.	7	20
VI	Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7121	CLOUD COMPUTING	3-0-0-3	2015

Course Prerequisites

Computer Network course at UG level is desirable, not mandatory.

Course Objectives

The course is designed to

1. To introduce the broad perceptive of cloud architecture and model.
2. To understand the concept of Virtualization and familiar with the lead players in cloud.
3. To apply different cloud programming model as per need.
4. To be able to set up a private cloud and understand the design of cloud Services.
5. To learn to design the trusted cloud Computing system

Syllabus

Introduction to cloud computing, building cloud network, virtualization, security issues, design issues.

Expected Outcomes

Upon Completion of the course, the students will be able to

1. Compare the strengths and limitations of cloud computing
2. Identify the architecture, infrastructure and delivery models of cloud computing
3. Apply suitable virtualization concept.
4. Understand SaaS, Software Application Services Framework and Database Systems for Multitenant Architecture.
5. Analyze various design considerations in implementing a cloud.
6. Explain about different security approaches.

References

1. John W. Rittinghouse and james F. Ransome, “Cloud Computing Implementation, Management and Security”, 2010, CRC Press, Taylor & Francis Group. London New York
2. Alfredo Mendoza, “Utility Computing Technologies, Standards, and Strategies”, Artech House INC, 2007
3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
4. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
6. Bunker and Darren Thomson, “Delivering Utility Computing”, 2006, John Wiley & Sons Ltd
7. George Reese, “Cloud Application Architectures”, O’reilly Publications, 2009.
8. Kumar Saurabh, “ Cloud Computing – insights into New-Era Infrastructure”, Wiley India,2011.
9. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud” O'Reilly
10. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
11. Katarina Stanoevska-Slabeva, Thomas Wozniak, Santi Ristol, “Grid and Cloud Computing – A Business Perspective on Technology and Applications”, Springer.
12. Ronald L. Krutz, Russell Dean Vines, “Cloud Security – A comprehensive Guide to Secure Cloud Computing”, Wiley – India, 2010.
13. Rajkumar Buyya, Christian Vecchiola, S.Tamarai Selvi, ‘Mastering Cloud Computing”, TMGH,2013.
14. Gautam Shroff, Enterprise Cloud Computing, Cambridge University Press, 2011
15. Michael Miller, Cloud Computing, Que Publishing,2008
16. Nick Antonopoulos, Cloud computing, Springer Publications, 2010

Module	Content	Hours	Semester Exam Marks (%)
I	Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Web Services Deliver from the Cloud – Communication-as-a-Service – Infrastructure-as-a-Service – Monitoring-as-a-Service – Platform-as-a-Service – Software-as-a-Service.	6	10
II	Building Cloud Network-Cloud Models- Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud – Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.	6	10
First Internal Examination			
III	Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization, Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices Virtual Clusters and Resource management – Virtualization for Data-center Automation- Data Center Challenges and Solutions - Automating the Data Canter	7	15
IV	Software Utility Application Architecture - Characteristics of a SaaS - Software Utility Applications - Cost Versus Value - Software Application Services Framework – Common Enablers – Conceptual view to Reality – Business Profits - Implementing Database Systems for Multitenant Architecture.	8	20
Second Internal Examination			
V	Other Design Considerations - Design of a Web Services Metering Interface – Application Monitoring Implementation - A Design for an Update and Notification Policy - Transforming to Software as a Service - Application Transformation Program - Business Model Scenarios, Virtual Services for Organizations-The Future.	8	25
VI	Cloud Security, Infrastructure Security, Data security and Storage, Identity & Access Management, Access Control, Trust, Reputation, Risk Authentication in cloud computing, Homomorphic Encryption.	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7123	**BIOINFORMATICS**	**3-0-0-3**	**2015**

Course Prerequisites: None

Course Objectives

To give the students,

1. Exposure to the field of Bio Informatics.
2. Knowledge in concepts of data mining and pattern matching.
3. Practical experience in modelling and simulation.

Syllabus

Introduction to bioinformatics, statistical methods, data mining and visualization, pattern matching, modeling and simulation.

Expected Outcomes

After completing this course, a student will be able to,

1. Demonstrate the ability to understand the basic principles of Bio Informatics.
2. Understand statistics and its relevance in Bio Informatics.
3. Explain different data mining methods.
4. Understand visualization methods and pattern recognition.
5. Understand modeling and simulation methods.
6. Explain drug discovery fundamentals and protein structure.

References

1. Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2003
2. T K Attwood and D J Perry Smith, "Introduction to Bio Informatics", Longman Essen, 99
3. EKrane, M L Raymer, "Fundamental Concepts of Bioinformatics", Pearson Education, 2002

Module	Content	Hours	Semester Exam Marks (%)
I	The Central Dogma – The Killer Application, Parallel Universes, Watson's Definition, Top Down vs Bottom Up, Information Flow, Convergence. Databases – Definitions, Data Management, Data Life Cycle, Database Technology, Interfaces, Implementation.	8	15
II	Statistics – Statistical Concepts, Microarrays, Imperfect Data, Basics, Quantifying Randomness, Data Analysis, Tool Selection, Statistics of Alignment, Clustering and Classification.	6	10
First Internal Examination			
III	Data Mining – Methods, Selection and Sampling, Pre-processing and Cleaning, Transformation and Reduction, Data Mining Methods, Evaluation.	7	15
IV	Visualization, Designing New Queries, Pattern Recognition and Discovery, Machine Learning, Text Mining, Tools.	7	20
Second Internal Examination			
V	Fundamentals, Dot Matrix Analysis, Substitution Matrices, Dynamic Programming, Word Methods, Bayesian Methods, Multiple Sequence Alignment, Tools.	7	20
VI	Drug Discovery, Fundamentals, Protein Structure, Systems Biology, Tools.	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7125	DATABASE TUNING	3-0-0-3	2015

Course Prerequisites

Basic knowledge of database management systems, data structures & operating systems at UG Level.

Course Objectives

This course will cover basic principles of how to tune database applications. Such knowledge helps to tune applications on database management systems, operation system, and hardware. Specifically, performance criteria for choosing a database management system will be addressed, including sets of experimental data and scripts that help to test particular aspects of systems under consideration.

Syllabus

Fundamentals of Tuning, Index of Tuning, Query Optimization, Troubleshooting and Case Studies**.**

Expected Outcomes

At the end of the course the students will be able to,

1. Apply basics of database tuning.
2. Understand indexing in database tuning and compare it with hashing techniques.
3. Demonstrate knowledge of query optimization techniques.
4. Explain about client server mechanisms.
5. Understand troubleshooting techniques.
6. Illustrate database tuning using case studies.

References

1.Dennis Shasha and Philippe Bonnet "Database Tuning, Principles, Experiments, and Troubleshooting Techniques", Morgan Kaufmann, An Imprint of Elsevier, 2003.

2. M.Tamer Ozsu, Patrick Valduriez and S. Sridhar "Principles of Distributed Database Systems", Pearson Education, 2007.

3. Thomas Connoly and Carlolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2003.

Module	Content	Hours	Semester Exam Marks (%)
I	**Fundamentals of Tuning** :Relational Databases – Relational constraints & Relational Algebra – database tuning-principles & examples-Locking and Concurrency Control – Correctness Consideration – Lock Tuning Logging and the Recovery Subsystem – Principles of Recovery – Tuning the Recovery Subsystem – Operating Systems Considerations – Hardware Tuning.	7	15
II	**Index of Tuning:** – Data Structures – B tree – B+ Tree – Hash Structures – Bit Map Indexes – Clustering Indexes . Non Clustering Indexes – Composite Indexes – Hot Tables – Comparison of Indexing and Hashing Techniques.	7	15
First Internal Examination			
III	**Query Optimization:** Techniques **–** Tuning Relational Systems – Normalization – Tuning Denormalization. Clustering Two Tables – Aggregate Maintenance – Record Layout – Query Tuning – Triggers.	7	15
IV	**Client Server Mechanisms** – Objects, Application Tools and Performance – Tuning the Application Interface – Bulk Loading Data – Accessing Multiple Databases.	7	15
Second Internal Examination			

V	**Troubleshooting-** Introduction-gather information: tools-Query Plan Explainers – Performance Monitors Event Monitors – Finding "Suspicious" Queries – Analyzing a Query's Access Plan – Profiling a Query Execution – DBMS Subsystems	7	20
VI	**Case Studies:** Transaction Chopping – Time Series Databases – Understanding Access Plans – Configuration Parameters. Oracle; SQL Server; DB2UDB – Distributed Database – Implementation.	7	20
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7127	OBJECT ORIENTED SOFTWARE ENGINEERING	3-0-0-3	2015

Course Prerequisites
Basic knowledge of Software Engineering at UG level.

Course Objectives
The course is designed to investigate principles of object-oriented software engineering, from analysis through testing.

Syllabus
System Concepts – Software Engineering Concepts – Development Activities – Managing Software Development – Unified Modeling Language – Project Organization – Communication.
Requirements Elicitation – Concepts – Activities – Management – Analysis Object Model –Managing analysis.
Decomposing the system – Overview of System Design – System Design Concepts – System Design Activities – Addressing Design Goals – Managing System Design.
Reusing Pattern Solutions – Specifying Interfaces – Mapping Models to Code – Testing-Rationale Management.
Configuration Management – Project Management – Software Life Cycle-ARENA case study.

Expected Outcomes
Students will be able to,
1. Demonstrate knowledge of software engineering concepts.
2. Understand requirement elicitation and analysis.
3. Apply system design concepts.
4. Explain code reuse, testing and rationale management.
5. Explain configuration management, project management and software lifecycle.
6. Illustrate the software engineering concepts using ARENA case study.

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

Module	Content	Hours	Semester Exam Marks (%)
I	System Concepts – Software Engineering Concepts – Development Activities – Managing Software Development – Unified Modeling Language – Project Organization – Communication.	8	15
II	Requirements Elicitation – Concepts – Activities – Management – Analysis Object Model –Managing analysis	8	15
	First Internal Examination		
III	Decomposing the system – Overview of System Design – System Design Concepts – System Design Activities – Addressing Design Goals – Managing System Design.	7	15
IV	Reusing Pattern Solutions – Specifying Interfaces – Mapping Models to Code – Testing-Rationale Management.	7	20
	Second Internal Examination		

V	Configuration Management – Project Management – Software Life Cycle.	7	20
VI	ARENA case study for all the concepts.	5	15
	Total	42	
Cluster Level End Semester Examination			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7129	INFORMATION STORAGE MANAGEMENT	3-0-0-3	2015

Course Prerequisites: NIL

Course Objectives

To give the students knowledge in modern storage infrastructure technology and management including: challenges and solutions for data storage and data management, intelligent storage systems, storage networking, backup recovery, and archive.

Syllabus

Introduction to Information Storage and Management, Components of an Intelligent Storage System, Network Attached Storage, Securing the Storage Infrastructure

Expected Outcomes

Students will be able to,

1. Describe and apply storage technologies.
2. Identify leading storage technologies that provide cost-effective IT solutions for medium to large scale businesses and data centers.
3. Describe important storage technologies' features such as availability, replication, scalability and performance.

References

1. Information Storage and Management Storing, Managing, and Protecting Digital Information , by EMC, Hopkinton and Massachusetts, Wiley

Module	Content	Hours	Semester Exam Marks (%)
I	Introduction to Information Storage and Management- Evolution of Storage Technology and Architecture- Data Centre Infrastructure- Key Challenges in Managing Information- Information Lifecycle- Components of a Storage System Environment- Disk Drive Components-performance-RAID-Components-levels-comparison.	10	20
II	Components of an Intelligent Storage System- Intelligent Storage Array-Types of Direct Attached Storage- Benefits and Limitations- Disk Drive Interfaces- Introduction to Parallel SCSI-SCSI Command Model.	6	20
	First Internal Examination		
III	Storage Area Networks-Overview-evolution-components-Fibre Channel concepts.	5	10
IV	Network Attached Storage: General-Purpose Servers vs. NAS Devices - benefits of NAS- NAS File I/O-components and implementation of NAS-NFS-CIFS- NAS I/O Operations- Factors Affecting NAS Performance and Availability- Content-Addressed Storage- Storage Virtualization.	10	25
	Second Internal Examination		
V	Securing the Storage Infrastructure- Storage Security Framework- Risk Triad- Storage Security Domains- Security Implementations in Storage Networking.	6	15
VI	Monitoring the Storage Infrastructure- Storage Management Activities- Storage Infrastructure Management Challenges.	5	10
	Total	42	
	Cluster Level End Semester Examination		

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7101	**SEMINAR II**	**0-0-2-2**	**2015**

Course Prerequisites None

Course Objectives

1. To develop soft skill
2. To understand research papers and prepare presentation material
3. To understand about new technologies in the modern era.
4. To improve oral communication skills through presentation
5. To prepare original technical write up on the presentation

Methodology

1. To choose the area of interest
2. To consult guide for topic selection
3. To identify current literatures
4. To choose state of the art survey paper/research paper
5. To consult and get confirmed with Seminar Coordinator (Faculty)
6. To prepare the PPT
7. To present as per schedule drawn by Seminar Coordinator
8. To prepare a technical write up and submit to Seminar Coordinator

Expected Outcomes

The students will be able to,

1. Improve their proficiency in English
2. Improve their presentation skill.
3. Improve their theoretical knowledge in the field related to computer science and engineering.
4. Improve their analytical and reasoning ability.
5. Improve their technical writing skills.

Internal work assessment

1. Evaluation by the supervisor/s : 30 %
2. Presentation & evaluation by the Committee: 40 %
3. Evaluation of the Report: 20%
4. Regular Attendance : 10 %

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7103	**PROJECT PHASE I**	**0-0-12-6**	**2015**

Course Prerequisites: None

Course Objectives

The course is designed to create an

1. Awareness and understanding of important current work in the field.
2. Ability to plan a research activity, Knowledge and motivation to carry out the planned research activity.
3. Ability to analyze the results of the research.
4. Ability to draw reasonable conclusions from the research
5. Ability to complete a written description of the work in the form of a well-written, properly organized thesis.
6. Ability to complete a thesis with potential for presentation at and/or participation in professional meetings and/or publication in scholarly journals.

Methodology

1. Student should meet with a professor in the area of subject interest.
2. Student should conduct preliminary research to formulate a topic.
3. Literature review and/or theoretical framework.
4. To identify and propose research questions or hypotheses.
5. Research objectives and procedures for each objective.
6. Presentation of any data collected during this time.
7. To prepare a technical write up and publish it.

Expected Outcomes:

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

1. Identify the problem of a research project through literature survey.
2. Analyze the technical feasibility of the project.
3. Identify and propose a solution for the research problem.
4. Analyze and design the proposed solution using software engineering practices.
5. Improve technical writing skills.

Master research work phase-I consists 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.

Internal work assessment:

First Review:	
Guide	20 marks
Evaluation Committee	20 marks
Second review:	
Guide	30 marks
Evaluation Committee	30 marks

Course No.	Course Name	L-T-P-Credits	Year of Introduction
10CS7104	**PROJECT PHASE II**	**0-0-23-12**	**2015**

Course Prerequisites : None

Course Objectives

The course is designed to create an,

1. Awareness and understanding of important current work in the selected field.
2. Ability to plan a research activity, knowledge and motivation to carry out the planned research activity
3. Ability to analyze the results of the research.
4. Ability to draw reasonable conclusions from the research .
5. Ability to complete a written description of the work in the form of a well-written, properly organized thesis.
6. Ability to complete a thesis with potential for presentation at and/or participation in professional conferences and/or publication in scholarly journals

Methodology

1. Continue working with advisor and committee
2. Synthesize and apply prior knowledge to designing and implementing the work.
3. Analysis of the research work with standard data sets
4. Evaluate of the work using various validation and verification methods.
5. Presentation of the research work.
6. To prepare a technical write up and publication in scholarly journals / conference

Expected Outcomes:

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

1. Synthesize and apply prior knowledge to designing and implementing solutions to open-ended computational problems.
2. Design and develop the standards software with software engineering practices and standards.
3. Analyze database, network and application design methods.
4. Evaluate various validation and verification methods
5. Analyze professional issues, including ethical, legal and security issues, related to computing projects.

Master research work phase-II consists of thesis work, two reviews of the work and the submission of thesis report. First review evaluates the progress of the work done and expected results are to be assessed. Second review evaluates the complete assessment of the research work.

Internal work assessment:

First Review:	
Guide	20 marks
Evaluation Committee	20 marks
Second review:	
Guide	30 marks
Evaluation Committee	30 marks