KERALA TECHNOLOGICAL UNIVERSITY

Master of Technology

Curriculum, Syllabus and Course Plan

Cluster	**:**	*01*
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	01CS6101	Mathematical Foundations of Computing Systems	3-0-0	40	60	3	3
B	01CS6103	Topics in Database Technology	3-1-0	40	60	3	4
C	01CS6105	Advanced Data Structures and Algorithms	3-1-0	40	60	3	4
D	01CS6107	Advanced Software Engineering	3-0-0	40	60	3	3
E		Elective I	3-0-0	40	60	3	3
S	01CS6999	Research Methodology	0-2-0	100			2
T	01CS6191	Seminar I	0-0-2	100			2
U	01CS6193	Algorithm Design Laboratory	0-0-2	100			1
		TOTAL	**15-4-4**	**500**	**300**	**-**	**22**

TOTAL CONTACT HOURS : 23
TOTAL CREDITS : 22

Elective I

01CS6151 Data Warehousing & Mining
01CS6153 Data Compression Techniques
01CS6155 Advanced Topics in Distributed Systems
01CS6157 Image Processing
01CS6159 Cloud Computing

SEMESTER 2

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	01CS6102	Parallel Computer Architecture	3-1-0	40	60	3	4
B	01CS6104	Operating System Design	3-0-0	40	60	3	3
C	01CS6106	Advanced Computer Networks	3-0-0	40	60	3	3
D		Elective II	3-0-0	40	60	3	3
E		Elective III	3-0-0	40	60	3	3
V	01CS6192	Mini Project	0-0-4	100			2
U	01CS6194	Network & OS Laboratory	0-0-2	100			1
		TOTAL	**15-1-6**	**400**	**300**	**-**	**19**

TOTAL CONTACT HOURS : 22
TOTAL CREDITS : 19

Elective II

01CS6152 Parallel Algorithms
01CS6154 Soft Computing
01CS6156 Computational Geometry
01CS6158 Semantic Web Technology
01CS6162 Advanced Complier Design

Elective III

01CS6172 Machine Learning
01CS6174 Advanced Graph Theory
01CS6176 Cyber Laws & Ethics
01CS6178 Principles of Information Security

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
T	01CS7191	Seminar II	0-0-2	100			2
W	01CS7193	Project (Phase 1)	0-0-12	50			6
		TOTAL	**6-0-14**	**230**	**120**	**-**	**14**

TOTAL CONTACT HOURS : 20
TOTAL CREDITS : 14

Elective IV

01CS7151 Complexity Theory
01CS7153 Distributed Algorithms
01CS7155 Advanced Computer Graphics
01CS7157 Ad-hoc and Sensor Networks

Elective V

01CS7171 Principles of Network Security
01CS7173 Fuzzy Set Theory & Applications
01CS7175 Decision Support Systems
01CS7177 Advanced Software Project Management

SEMESTER 4

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credit
					Marks	Duration (hours)	
W	01CS7194	Project (Phase 2)	0-0-23	70	30		12
		TOTAL	**0-0-23**	**70**	**30**	**-**	**12**

TOTAL CONTACT HOURS : 23
TOTAL CREDITS : 12

TOTAL NUMBER OF CREDITS: 67

SEMSTER 1

SYLLABUS & COURSE PLAN

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6101	Mathematical Foundations of Computing Systems	3-0-0	3	2015

Course Objectives

1. To understand and apply the fundamental concepts in
   a. theorem proving
   b. Recurrence relations
   c. Counting and probability
   d. Probability distributions
   e. Special graphs and circuits
   f. Important structures

Syllabus

Techniques for theorem proving, Principle of mathematical induction, principle of complete induction. Recursive definitions, Generating functions, Fundamental principles of counting, pigeonhole principle, countable and uncountable sets, principle of inclusion and exclusion – applications, derangements, permutation and combination, theory – Properties of Probability, Methods of Enumeration, Conditional Probability, Independent Events, Bayes Theorem, Mathematical Expectation, Random variables Discrete Distribution, Binomial Distribution, Mean and variance The Poisson Distribution, Continuous Distribution. Uniform and Exponential Distributions, Normal Distribution, Graphneys and algorithms, Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, rings, finite fields.

Expected Outcome

1. Conceptual understanding of the above topics and ability to apply them in practical situations.

References

1. J. P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Application to Computer Science", Tata McGrawHill, 2000.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7/e, McGraw Hill Inc, 2011.
3. Robert V. Hogg, Elliot A. Tanis, Meda J. M. Rao,"Probability and Statistical Inference", 7/e,, Pearson Education India, 2006.
4. J. Truss, "Discrete Mathematics for Computer Scientists", 2/e, Addison Wesley, 1999. Bernard Kolman, Robert C Busby,SharonKutler Ross, "Discrete Mathematical Structures", 2/e, Prentice-Hall India Private Limited, 1996.

01CS6101-COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Techniques for theorem proving: Direct Proof, Proof by Contra position, Proof by exhausting cases and proof by contradiction,	3	15
	Linear-time temporal logic and Branching-time logic-Syntax, Semantics, Practical patterns of specifications, Important equivalences, Adequate sets of connectives.	4	
II	Principle of mathematical induction, principle of complete induction. Recursive definitions, Generating functions, function of sequences calculating coefficient of generating function, solving recurrence relation by substitution and generating functions Solution methods.	4	15
FIRST INTERNAL EXAM			
III	Fundamental principles of counting, pigeonhole principle, countable and uncountable sets, principle of inclusion and exclusion – applications, derangements,	3	15
	permutation and combination,Pascal's triangles, binomial theorem	4	
IV	Probability theory – Properties of Probability, Methods of Enumeration, Conditional Probability, Independent Events, Bayes Theorem, Mathematical Expectation, Random variables	5	15
	Discrete Distribution, Binomial Distribution, Mean and varianceThe Poisson Distribution, Continuous Distribution. Uniform and Exponential Distributions,Normal Distribution.	4	
SECOND INTERNAL EXAM			
V	Graphs, Terminology, Euler tours, planar graphs, Hamiltonian graphs, Euler's formula (proof), Warshall's algorithm, Decision Trees, weighted trees	5	20
	four colour problem (without proof) and the chromatic number of a graph, five colour theorem, chromatic polynomials	4	
VI	Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, rings	3	20
	polynomial arithmetic, quadratic residues, reciprocity, discrete logarithms, elliptic curve arithmetic	3	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6103	Topics in Database Technology	3-1-0	4	2015

Course objectives

1. To understand the implementation and management aspects of databases.
2. To understand the principles of distributed databases.
3. To understand object based data models and their implementation.
4. To understand the recent advances in database technology.

Syllabus

Query Processing & Optimization, Transaction Processing, Concurrency Control, Recovery. Database Security. Database System Architectures, Parallel and Distributed Databases, Inter-query and Intra-query parallelism, Distributed Transaction processing, concurrency and recovery, distributed query processing. Temporal and Spatial Databases, Object-oriented databases, ODMG, OQL, and object relational databases, Case studies. Semi-structured databases, XML, XPATH and XQUERY, RDF.

Expected Outcome

1. Ability to use query optimization and transaction processing concepts
2. Ability to distinguish between various types of threats and security issues
3. Ability to technically distinguish between various architectures and associated algos.
4. Ability to write queries using query languages in various DB platforms.

References

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", 5/e, Pearson Education/Addison Wesley, 2011
2. Patrick O'Neil , Elizabeth O'Neil , "Database: Principles, Programming and Performance", 2/e, Morgan Kaufmann, 2011
3. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 3/e, Pearson Education, 2010.
4. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", 5/e, Tata McGraw Hill, 2006.
5. C.J. Date, A.Kannan and S. Swamynathan,"An Introduction to Database Systems", 8/e, Pearson Education India, 2006.
6. Joe Fawcett, Danny Ayers , Liam R. E. Quin, Beginning XML, 5/e, John Wiley & Sons, 2012
7. Grigoris Antoniou. Frank van Harmelen, "A Semantic Web Primer", The MIT Press,
8. Cambridge, Massachusetts, 2003.

01CS6103 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Query Processing Algorithms – Query Optimization Techniques – Transaction Management: Transaction Processing Concepts - Concurrency Control – Deadlocks – Recovery Techniques	12	25
II	Database Security: threats to databases, control measures, database security and DBA, Discretionary access control, Mandatory access control (role-based only), SQL injection. Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures	09	10
INTERNAL TEST I			
III	Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Distributed Database – Functions – Distributed RDB design- Transparency– Distributed Transactions - Commit Protocols – Concurrency Control –Deadlocks – Recovery - Distributed Query Processing.	12	20
IV	Temporal Databases – Time in Databases, Spatial and geographical data management: geographical data, representation, spatial queries, indexing spatial data, k-d trees, quad trees and R-trees	05	10
INTERNAL TEST II			
V	Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects, ODMG, ODL, OQL, basic OQL queries. Object Relational Systems – Case studies: Oracle and Informix.	10	20
VI	Semi-structured Data and XML Databases: XML Data Model – DTD – XPath and XQuery – Example Queries. Storing, RDF (Fundamental Concepts only).	08	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6105	Advanced Data Structures and Algorithms	3-1-0	4	2015

Course objectives

1. To understand about advanced data structures.
2. To understand how to analyze and establish correctness of algorithms
3. To understand the theory behind various classes of algorithms.

Syllabus

Amortized Analysis – aggregate, accounting and potential methods. Advanced data structures: binomial heap, fibonacci heap, disjoint sets - applications.Number-Theoretic algorithms: maxflow-mincut theorem, String matching: Overview of Complexity classes Probabilistic algorithms: Numerical algorithms Las Vegas algorithms, Complexity classes in randomized algorithms – RP, PP, ZPP, BPP.Geometric Algorithms:

Expected Outcome

Upon successful completion of this course, the student will:

1. have deep conceptual understanding of advanced data structures and their applications
2. know the theory behind various classes of algorithms.
3. be able to design, prove the correctness and analyze new algorithms

References

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to algorithms", Prentice-hall of India Private Limited, New Delhi, 2010.
2. Gilles Brassard and Paul Bratley, "Fundamentals of algorithms", Prentice-hall of India Private Limited, New Delhi, 2001.
3. Rajeev Motwani, PrabhakarRaghavan, "Randomized Algorithms", Cambridge University Press, 2000.
4. Ellis Horowitz, SartajSahni and Dinesh Mehta, "Fundamentals Of Data Structures In C++ ", Galgotia Publications, 2006.
5. Dexter C. Kozen, "The Design and Analysis of Algorithms", Springer.
6. Jon Kleinberg and Eva Tardos, "Algorithm Design", Pearson Education, 2006.
7. M. H. Alsuwaiyal, "Algorithms Design Techniques and Analysis", World Scientific Publishing Co. Beijing, 1999.
8. S. K. Basu, "Design Methods and Analysis of Algorithms", Prentice Hall India, 2005.

01CS6105 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Amortized Analysis – aggregate, accounting and potential methods	4	15
	Advanced data structures: binomial heap, Fibonacci heap, disjoint sets - applications.	6	
II	Number-Theoretic algorithms: GCD algorithm, Extended Euclid's algorithm	3	15
	Primality testing, Miller-Rabin test	3	
	Integer factorization - Pollard Rho heuristic.	3	
FIRST INTERNAL EXAM			
III	Network flow algorithms: flow properties, augmenting path	4	15
	Ford-Fulkerson method, Edmonds-Karp heuristics	2	
	Maxflow-mincut theorem	3	
	push-relabel, relabel-to-front algorithms	3	
IV	String matching: Rabin-Karp, Knuth-Morris-Pratt algorithms.	4	15
	Overview of Complexity classes – P, NP, Co-NP, NP-hard, NP-complete. Space complexity.	3	
SECOND INTERNAL EXAM			
V	Probabilistic algorithms: Numerical algorithms: Integration, Counting	3	20
	Monte-Carlo algorithms - verifying matrix multiplication, min-cut in a network.	3	
	Las Vegas algorithms, selection sort, quick sort, Dixon's factorization.	2	
	Complexity classes in randomized algorithms – RP, PP, ZPP, BPP	2	
VI	Geometric Algorithms: Plane sweep technique, role of sweep- line status and event-point schedule, line segment intersection problem.	3	20
	Convex Hull : Graham's scan algorithm, Jarvis March algorithm.	3	
	Finding closest pair of points, proof of correctness.	2	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6107	Advanced Software Engineering	3-0-0	3	2015

Course objectives

- To study the concepts and principles in Software Engineering.
- To concentrate on engineering principles to apply for building quality software.
- To provide the necessary methods for testing the software.

Syllabus

Software Process modeling, Software development Life Cycle, Software Requirements Engineering, Software Project Planning, Risk Management , Software Design, Programming, Testing , Software Reliability , Maintenance , software tools

Expected Outcome

Upon successful completion of this course, students will be able to:

- Apply software Engineering principles
- Design a software
- To do testing
- To create a reliable software

References

1. Shari Lawrence Pfleeger, Joanne M Atlee, "Software Engineering Theory and Practice", 4/e, Pearson Education, 2011.
2. Software Engineering: A Practitioner's Approach, Roger S Pressman, 7/e,. McGraw Hill Int.Ed., 2010.
3. K.K Aggarwal&Yogesh Singh, "Software Engineering", New Age International 2007. Ian Somerville, "Software Engineering", 8/e, Addison-Wesley 2007
4. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", 2/e, PHI Learning Private Ltd., 2010
5. PankajJalote, "An Integrated Approach to Software Engineering", 3/e, Springer 2005.

01C6107 - SCOURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction: Role of Software Engineering	1	15
	Quality of software process and product	2	
	Systems Approach to Software Engineering	1	
	An Engineering Approach to Software Engineering How has Software Engineering Changed?	2	
	Modelling the Process and Life Cycle	1	
II	Software Process Models – Waterfall Model – V Model Prototyping Model – Spiral Model – Agile methods	2	15
	Tools and Techniques for Process Modeling – Planning and Managing the Project	1	
	Tracking project progress - Project personnel and organization	1	
	Effort and schedule estimation	1	
	Risk Management – Process Models, Project Management	2	
FIRST INTERNAL EXAM			
III	Requirements Engineering, Types of Requirements	1	15
	Requirements Elicitation,Requirements Analysis	2	
	Requirements Documentation, Requirements validation	2	
	Software Design, Types of Cohesion	1	
	Designing Modules, Design Methodology	1	
	Design Principles	1	
IV	Object Oriented (OO) design, Representing designs using UML	1	15
	OO Design Patterns, OO Measurement	1	
	Designing Modules, Design Methodology	2	
	Programming Standards and Procedures, Programming Guidelines, Documentation	2	

SECOND INTERNAL EXAM			
V	Testing the Programs	1	20
	Principles of System Testing, Function Testing - Performance Testing	2	
	Acceptance Testing - Installation Testing, Automated System Testing	2	
	Test Documentation, Testing Safety Critical Systems	1	
VI	Software Reliability – Concepts	1	20
	Software Reliability models	2	
	Reliability - Availability and Maintainability	1	
	Capability Maturity models	1	
	Software Maintenance concepts	1	
	Software Maintenance models , CASE	2	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6151	Data Warehousing & Mining	3-0-0	3	2015

Course Objectives

1. To understand and practice the fundamental and advanced concepts Data Warehousing and Data Mining

Syllabus

Data warehousing – OLAP, schema, Data architecture, Data Mining. Mining Tasks, Issues, Metrics, KDD Vs Data mining, DMQL, Classification Clustering, Association, Web mining, Spatial mining, temporal mining.

Expected Outcome

1. Ability to explain Data warehousing, OLAP and basic data mining activities
2. Ability to apply data mining algorithms for classification and clustering
3. Ability to explain and apply association rule mining techniques
4. Ability to explain Web mining and Spatial mining

References

1. Margaret H Dunham, "Data Mining – Introductory and Advanced Topics", Pearson India, 2005.
2. Ian H. Witten, Eibe Frank, Mark A. Hall," Data Mining: Practical Machine Learning Tools and Techniques", 3/e, Morgan Kaufmann, 2011.
3. J. Han, M. Kamber, "Data Mining: Concepts and Techniques", 2/e, Morgan Kaufman, 2006.

01CS6151 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% Marks in End of Semester Examination**
I	Data warehousing – Multidimensional data model, OLAP operation, Warehouse schema, Data Warehousing architecture, warehouse server, Metadata, OLAP engine, Data warehouse Backend Process , Data Warehousing to Data Mining.	07	15
II	Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective,Knowledge Discovery in Database Vs Data mining. Data Preprocessing**:** Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization, Concept Hierarchy Generation, Introduction to DMQL.	09	20
FIRST INTERNAL EXAM			
III	Similarity measures, Bayes Theorem, Classification - regression, Bayesian classification, Decision tree based algorithm-ID3, Neural network based algorithm- supervised learning, back propagation, gradient-descent algorithm, Rule based algorithm-IR, PRISM,	09	20
IV	Clustering algorithms – Hierarchical algorithm – Dendrograms- Single link algorithm, Partitional algorithm-Minimum spanning tree, squared error, K-means, PAM algorithm.	05	15
SECOND INTERNAL EXAM			
V	Association Rules : Apriori algorithm, Sampling algorithm, Partitioning algorithm, Parallel and distributed algorithms, Web mining-web content mining, web structure mining, web usage mining,	07	20
VI	Spatial mining- spatial queries, spatial data structures, Generalization and specialization, spatial classification, spatial clustering, Introduction to temporal mining.	05	10
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6153	Data Compression Techniques	3-0-0	3	2015

Course Objectives

- Develop theoretical foundations of data compression, concepts and algorithms for lossy and lossless data compression, signal modelling and its extension to compression with applications to speech, image and video processing.

Syllabus

Speech Compression & Synthesis, Image Compression, Video Compression, Fractal techniques, Comparison of compression algorithms, Implementation of compression algorithms.

Expected Outcome

1. Awareness about various data compression techniques and their practical significance.
2. Ability to apply techniques in practical scenarios.

References

1. David Solomon, Data compression: the complete reference, 2/e, Springer-verlag, New York. 2000.
2. Stephen Welstead, Fractal and wavelet Image Compression techniques , PHI, 1999.
3. Khalid Sayood, Introduction to data compression, Morgan Kaufmann Publishers, 2003.
4. Sleinreitz ―Multimedia System‖ Addison Wesley.

01CS6153 - COURSE PLAN			
Module	**Contents**	**Hours**	**% Marks in End-of-Semester Examination**
I	Compression techniques,Compression ratio, lossless &lossy compression, Huffman coding, Non binary Huffman Algorithms, Adaptive Coding, applications,ArithmeticCoding,applications, Finite Context Modeling.	08	20
II	Dictionary based Compression, Sliding Window Compression, LZ77,LZ78, LZW compression. Predictive Coding - prediction and partial match, move to front coding, Run Length encoding.	08	20
FIRST INTERNAL EXAM			
III	Speech Compression & Synthesis: Digital Audio concepts, Sampling Variables, Lossless compression of sound, lossy compression & silence compression	07	20
IV	Image Compression, Transform based techniques, Wavelet Methods, adaptive techniques. Images standards, JPEG Compression, ZigZagCoding .	07	20
SECOND INTERNAL EXAM			
V	Video Compression- motion compensation, MPEG standards,recent development in Multimedia Video compression, packet video	06	10
VI	Fractal techniques. Comparison of compression algorithms, Implementation of compression algorithms.	06	10
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6155	Advanced Topics in Distributed Systems	3-0-0	3	2015

Course Objectives

1. To impart deeper understanding in
   a. Architecture and issues of distributed systems
   b. Distributed algorithms
   c. *Hadoop* system

Syllabus

Distributed System: System Architecture, Processes, Threads, Code migration, Communication , Naming, Hadoop: Map and Reduce, Hadoop Distributed File System, Map Reduce Types, Administering Hadoop, Distributed Algorithms: Causality, Modeling a Distributed Computation, Failures in a Distributed System., Synchronization and Election, Distributed Mutual Exclusion, Algorithms in General Synchronous Networks

Expected Outcome

1. The student gains insight into conceptual and practical aspects of distributed systems.
2. The student gains a complete understanding of the usage of Hadoop systems.

References

1. Andrew S. Tanenbaum, Maarten Van Steen." Distributed Systems – Principles and Paradigms ", 2/e, PHI, 2004.
2. Randy Chow Theodore Johnson, "Distributed Operating Systems and Algorithm Analysis", Pearson Education, 2009.
3. Nancy A. Lynch, Morgan, " Distributed Algorithms", Kaufmann Publishers, Inc, 1996.
4. Tom White, "Hadoop: The Definitive Guide", 1/e, O'reilly, 2012.
5. Eric Sammer, "Hadoop Operations: A Guide for Developers and Administrators", O'reilly, 2012.
6. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", John Wiley, 2013.

COURSE PLAN

01CS6155 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Distributed System: Overview, System Architecture, Processes – Threads – Virtualization – Clients – Servers – Code migration,	2	15
	Communication – Message Oriented – Stream Oriented – Multicast Communication,	3	
	Naming – Flat – Structured – Attribute Based Naming.	3	
II	Hadoop: Introduction – Comparison with Other Systems, Analyzing Data with Hadoop – Map and Reduce – Scaling Out – Data Flow – Combiner Functions, Hadoop Distributed File System – Concepts and Basic Operations.	7	15
FIRST INTERNAL EXAM			
III	Map Reduce Types – Input and Output Formats, Map Reduce Features – Counters – Sorting – Joins – Side Data Distribution, Administering Hadoop – Monitoring – Maintenance.	6	15
IV	Distributed Algorithms: Models of Distributed Computation – Preliminaries – Causality – Distributed Snapshots – Modeling a Distributed Computation – Failures in a Distributed System.	7	15
SECOND INTERNAL EXAM			
V	Synchronization and Election – Distributed Mutual Exclusion – Timestamp Algorithms – Voting – Fixed Logical Structure – Path Compression, Election – The Bully Algorithm.	7	20
VI	Algorithms in General Synchronous Networks – Leader Election – Breadth First Search – Minimum Spanning Tree – Shortest Path– Maximal Independent Set.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6157	Image Processing	3-0-0	3	2015

Course Objectives

1. To impart understanding of the issues and methodologies in digital image processing

Syllabus

Introduction -sample image model,sampling and quantization, relationship between pixels – image geometry;Image transforms :Discrete Fourier transform, properties of 2d-fourier transform (DFT), other separable image transforms;Imageenhancement;Imagerestoration;Image compression: image compression standards. Image reconstruction from projections: filtered back projection algorithms. Point detection, line detection and edge detection in images, Image segmentation.

Expected Outcome

1. Student gets deeper understanding of principles and techniques and algorithms for digital image processing
2. Student is able to apply these techniques in practical scenarios

References

1. Rafael C., Gonzalez & Woods R.E., "Digital Image Processing", Pearson Education.
2. Rosenfeld A. &Kak A.C., "Digital Picture Processing", Academic Press
3. Jain A.K, "Fundamentals of Digital Image Processing", Prentice Hall, Eaglewood Cliffs, NJ
4. Schalkoff R. J., "Digital Image Processing and Computer Vision", John Wiley
5. Pratt W.K., "Digital Image Processing", John Wiley

01CS6157 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction –Digital Image representation, History, Fundamental Steps in Image Processing, Applications, Elements of digital image processing systems.	2	15
	Image Acquisition-Digitization(Sampling and Quantization),Sampling-Theorem, Fourier Transform(in Discrete domain and Time Domain), Sampling-Convolution (Time domain, Discrete domain),convoluting a sampled image example, Nyquist Rate),Quantization	5	
II	Basic relationship between pixels, Image geometry	3	15
	Image transforms - introduction to Fourier transform – discrete Fourier transform, Properties of 2D Fourier transform	4	
	Other separable image transforms - hotelling transform,	3	
FIRST INTERNAL EXAM			
III	Image reconstruction from projections - basics of projection	1	15
	Parallel beam and fan beam projection - method of generating projections	2	
	Fourier slice theorem, Filtered back projection algorithms	2	
IV	Image compression - image compression models - elements of information theory	2	15
	Error-free compression - lossy compression	2	
	Image compression standards	2	
SECOND INTERNAL EXAM			
V	Image enhancement - point processing, spatial filtering - frequency domain,	4	20
	Image Restoration-Degradation Model	2	
	Diagonalization of circulant and block circulantmatrices,Inverse filtering - least mean square filter	2	
VI	Point Detection in Images, Line Detection in Detection in Images, Edge Detection in Images	3	20
	Image Segmentation	3	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6159	Cloud Computing	3-0-0	3	2015

Course Objectives

1. Understanding cloud computing, and compare with existing technologies.
2. Understand how to develop a cloud service

Syllabus

Cloud Computing, History of Cloud Computing, Cloud Architecture, Disadvantages of Cloud Computing, Cloud Services, Types of Cloud Service Development, Centralizing Email Communications, Schedules, To-Do Lists, Contact Lists, Group Projects and Events, Calendars, Schedules and Task Management, Contact Management, Project Management, Databases, Web-Based Communication Tools, Web Mail Services, Social Networks and Groupware, Blogs and Wikis

Expected Outcome

1. Ability to design and develop cloud services
2. Use Cloud Service and collaborate it with various applications and taking it online.

References

1. Dan C. Marinescu , Cloud computing: Theory and Practice, Morgan Kaufmann, 2013
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing,: From Parallel Processing to the Internet of Things, 1/e, Morgan Kaufmann , 2011
3. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, 2008.
4. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for Ondemand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, 2008.

01CS6159 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Companies in the Cloud Today	5	10
II	Cloud Services Web-Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On-Demand Computing	6	20
FIRST INTERNAL EXAM			
III	Discovering Cloud Services Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds.Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists	8	15
IV	Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation. Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications	9	20
SECOND INTERNAL EXAM			
V	Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files	6	15
VI	Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6999	Research methodology	0-2-0	2	2015

Course Objectives

1. To prepare the student to do the M. Tech project work with a research bias.
2. To formulate a viable research question.
3. To develop skill in the critical analysis of research articles and reports.
4. To analyze the benefits and drawbacks of different methodologies.
5. To understand how to write a technical paper based on research findings.

Syllabus

Introduction to Research Methodology-Types of research- Ethical issues- Copy right-royalty-Intellectual property rights and patent law-Copyleft- Openacess-

Analysis of sample research papers to understand various aspects of research methodology:

Defining and formulating the research problem-Literature review-Development of working hypothesis-Research design and methods- Data Collection and analysis- Technical writing- Project work on a simple research problem

Approach

Course focuses on students' application of the course content to their unique research interests. The various topics will be addressed through hands on sessions.

Expected Outcome

Upon successful completion of this course, students will be able to

1. Understand research concepts in terms of identifying the research problem
2. Propose possible solutions based on research
3. Write a technical paper based on the findings.

References

1. C. R. Kothari, Research Methodology, New Age International, 2004
2. Panneerselvam, Research Methodology, Prentice Hall of India, New Delhi, 2012.
3. J. W. Bames, Statistical Analysis for Engineers and Scientists, Tata McGraw-Hill, New York.
4. Donald Cooper, Business Research Methods, Tata McGraw-Hill, New Delhi.
5. Leedy P. D., Practical Research: Planning and Design, McMillan Publishing Co.
6. Day R. A., How to Write and Publish a Scientific Paper, Cambridge University Press, 1989.
7. Manna, Chakraborti, Values and Ethics in Business Profession, Prentice Hall of India, New Delhi, 2012.
8. Sople, Managing Intellectual Property: The Strategic Imperative, Prentice Hall ofIndia, New Delhi, 2012.

01CS6999 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to Research Methodology: Motivation towards research - Types of research: Find examples from literature. Professional ethics in research - Ethical issues-ethical committees. Copy right - royalty - Intellectual property rights and patent law - Copyleft-Openacess -Reproduction of published material - Plagiarism - Citation and acknowledgement. Impact factor. Identifying major conferences and important journals in the concerned area. Collection of at least 4 papers in the area.	5	
II	Defining and formulating the research problem - Literature Survey- Analyze the chosen papers and understand how the authors have undertaken literature review, identified the research gaps, arrived at their objectives, formulated their problem and developed a hypothesis.	4	
FIRST ASSESSMENT			
III	Research design and methods: Analyze the chosen papers to understand formulation of research methods and analytical and experimental methods used. Study of how different it is from previous works.	4	No end semester written examination
IV	Data Collection and analysis. Analyze the chosen papers and study the methods of data collection used. - Data Processing and Analysis strategies used – Study the tools used for analyzing the data.	5	
SECOND ASSESSMENT			

V	Technical writing - Structure and components, contents of a typical technical paper, difference between abstract and conclusion, layout, illustrations and tables, bibliography, referencing and footnotes- use of tools like Latex.	5	
VI	Identification of a simple research problem – Literature survey- Research design- Methodology –paper writing based on a hypothetical result.	5	
END SEMESTER ASSESSMENT			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6191	Seminar I	0-0-2	1	2015

Course Objectives

To make students

1. Identify the current topics in the specific stream.
2. Collect the recent publications related to the identified topics.
3. Do a detailed study of a selected topic based on current journals, published papers and books.
4. Present a seminar on the selected topic on which a detailed study has been done.
5. Improve the writing and presentation skills.

Approach

Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.

Expected Outcome

Upon successful completion of the seminar, the student should be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6193	Algorithm Design Laboratory	0-0-2	1	2015

Syllabus

Experiments are based on but not limited to the topics covered in *01CS6105: Advanced Data Structures and Algorithms.*

Experiment No	Description
I	Fibonacci heap
II	Dinic's algorithm
III	Primality testing
IV	Graham's scan algorithm
V	Push-relabelalgorithm
VI	Relabel-to-front algorithm
VII	Pseudo random generator
VIII	Randomized min-cut algorithm
IX	Randomized selection algorithm
X	Graham's scan algorithm
XI	Jarvis march algorithm
XII	Primality testing
XIII	Integer factorization
XIV	Rabin-Karp algorithm
XV	Knuth-Morris-Pratt algorithm

SEMSTER 2

SYLLABUS & COURSE PLAN

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6102	Parallel Computer Architecture	3-1-0	4	2015

Course Objectives

1. To understand issues and techniques in improving performance of processors
2. To understand the concepts of pipelining
3. To familiarize with the properties of superscalar processors
4. To understand the multiprocessor systems and the concept of cache coherence

Syllabus

Classes of parallelism and parallel architecture, computer architecture- design issues, Performance measurements, quantitative principles of computer design, Instruction level parallelism -concepts and challenges, Data dependencies and hazards, Basic compiler techniques for exposing ILP.
Dynamic Scheduling- Tomasulo's approach, Hardware based speculation, ILP using multiple issue and static scheduling, ILP using dynamic scheduling, multiple issue and speculation, case study- Intel Core i7. Data level parallelism-Vector architecture-Vector instruction types, Vector-Access memory schemes , Graphic processing units. Multiprocessor system interconnects-hierarchical bus system, Cross bar switch and multiport memory, multistage networks, Centralized shared memory architecture, Multiprocessor cache coherence, Schemes for enforcing coherence - Snooping protocol, Limitations, Distributed shared memory and Directory based coherence.

Expected Outcome

In-depth knowledge in

1. Measuring performance of processors
2. Instruction level parallelism
3. Vector Architecture
4. Multiprocessor systems and cache coherence.
5. Interconnection networks

References

1. Hennessy J. L., D. Patterson, "Computer Architecture – A quantitative Approach", 5/e, Morgan Kauffman 2012.
2. DezsoSima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architectures – A Design Space Approach", Pearson Education India, 2009.
3. Kai Hwang, "Advanced Computer Architecture Parallelism, Scalability, Programmability", Tata McGraw-Hill, 2003.
4. John Paul Shen, MikkoLipasti, "Modern Processor Design – Fundamentals of Superscalar Processors", McGraw-Hill International Edition, 2005.
5. WWW Computer Architecture page. http://www.cs.wisc.edu/arch.

01CS6102 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Classes of parallelism and parallel architecture, computer architecture - design issues.	5	15
	Performance measurements, quantitative principles of computer design, Instruction level parallelism -concepts and challenges.	6	
II	Data dependencies and hazards, Basic compiler techniques for exposing instruction-level parallelism.	7	15
FIRST INTERNAL EXAM			
III	Dynamic Scheduling- Tomasulo's approach, Hardware based speculation.	5	15
	ILP using multiple issue and static scheduling, ILP using dynamic scheduling, multiple issue and speculation.	5	
IV	Case study- Intel Core i7.	5	15
	Data level parallelism-Vector architecture-Vector instruction types, Vector-Access memory schemes , Graphic processing units.	5	
SECOND INTERNAL EXAM			
V	Multiprocessor system interconnects - hierarchical bus system, Cross bar switch and multiport memory.	6	20
	Multistage networks. Centralized shared memory architecture.	4	
VI	Multiprocessor cache coherence, Schemes for enforcing coherence - Snooping protocol, Limitations.	4	20
	Distributed shared memory and Directory based coherence.	**4**	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6104	Operating System Design	3-0-0	3	2015

Course Objectives

1. To understand the configuration and functions of a typical OS Kernel
2. To have an overview on concepts implemented in modern operating systems.

Syllabus

Process Management, Process Scheduling, Real-Time Scheduling Policies. System Calls, Interrupts and Interrupt Handlers, Kernel Synchronization, Kernel Synchronization Methods, Timers and Time Management - Memory Management, Virtual Filesystem, I/O Schedulers
Distributed Operating System, strategies for ordering events in a distributed system. Issues with distributed mutual exclusion-Solutions, Heuristic.Deadlock Handling strategies

Expected Outcome

1. In-depth knowledge in Design and implementation of Kernel modules.
2. An understanding on how the basic concepts are modified to cater changing architectural features.

References

1. Robert Love, "Linux Kernel Development", 3/e, Addison-Wesley, 2010.
2. Advanced Concepts in Operating Systems – Singhal
3. Daniel Bovet, Marco Cesati, "Understanding the Linux Kernel", 3/e, OReilly Media Inc., 2005.
4. Operating Systems Concepts, 9th Edition- Silberschatz, Galvin, Gagne
5. Linux Kernel Architecture – Wolfgang Mauerer.
6. Reilly Christian Benvenuti, "Understanding Linux Network Internals", 1/e, OReilly Media Inc.,2005.
7. Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman, "Linux Device Drivers", 3/e, OReilly Media Inc., 2005.

0CS6104 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction - Process Management - Process Descriptor and the Task Structure, Process Creation, The Linux Implementation of Threads, Process Termination. Process Scheduling - Policy, Linux Scheduling Algorithm and Implementation, Preemption and Context Switching, Real-Time Scheduling Policies. System Calls - Communicating with the Kernel, Syscalls, System Call Handler, System Call Implementation, and System Call Context. * Linux commands like ps, pmap may be used to understand how the address space changes during process creation and thread creation.	6	15
II	Interrupts and Interrupt Handlers - Registering an Interrupt Handler, Writing an Interrupt Handler, Interrupt Context, Interrupt Control, Bottom Halves – Task Queues, Softirqs, Tasklets, Work Queues *(Students are not expected to memorize the system calls used/ structure formats of the different constructs used in implementing Bottom Halves. The main highlight should be to understand the way in which the different constructs are used)* * Students may be encouraged to implement their own interrupt handler in a custom compiled kernel.	6	15
FIRST INTERNAL EXAM			
III	Kernel Synchronization – Introduction, Critical Regions and Race Conditions, Locking, Deadlocks, Contention and Scalability *(Self Study – These topics are already covered in undergraduate classes)***.** Kernel Synchronization Methods - Atomic Integer and Atomic Bitwise Operations (Concepts only), Spin Locks - Types, Semaphores – Types, Mutexes, Completion Variables, BKL: The Big Kernel Lock, Sequential Locks, Preemption Disabling.	7	20
IV	Timers and Time Management - Kernel Notion of Time, Jiffies, Hardware Clocks and Timers, Using Timers, Delaying Execution. Memory Management - Pages and Zones, functionality of kmalloc(), kfree(), vmalloc(). Slab Layer – Design, Per-CPU Allocations. The Virtual File system – VFS objects, data structures their relationship and functionalities.	7	15
SECOND INTERNAL EXAM			
V	The Block I/O Layer - Request Queues, I/O Schedulers – Types, Scheduler Selection. Portability – Issues related to Word size and Data types, Data Alignment, Byte Order, Time, Processor Ordering.	7	15
VI	Distributed processing – client/ server and clusters. Distributed process management - process migration, distributed global states, distributed mutual exclusion, distributed deadlock.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6106	Advanced Computer Networks	3-0-0	3	2015

Course Objectives

1. To impart a deeper understanding of protocols, quality of service and congestion management, wireless transmission and compression.
2. To analyze the issues of transmitting real time data.
3. To identify the technologies that can transmit data efficiently.

Syllabus

Network Architecture - Internet Protocol - Packet switching- Cell switching -Routers – TCP protocol – UDP protocol - Congestion Management - Wireless Transmission – Routing - Quality of Service - Peer to Peer Networks -Content Distribution Networks - Virtual Private Networks and tunnels - Multimedia Networking - Streaming Stored Audio and Video, Protocol for Real time Application – Text, Image, Audio and Video Compression Techniques.

Expected Outcome

Deeper understanding of existing techniques for developing new technologies for transmitting data in real time without congestion.

References

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks – A systems Approach", Elsevier, Fourth Edition, 2008.
2. Andrews S. Tanenbaum, "Computer Networks", Fourth Edition, Pearson Education, 2003.
3. Natalia Olifer Victor Olifer, "Computer Networks - Principles, Technologies and Protocols for Network Design", - Wiley India(P) Ltd. 2006.
4. William Stallings, "High Speed Networks and Internets – Performance and Quality of Service", Pearson Education, 2005.
5. James F. Kurose and Keith W. Ross ,"Computer Networking- A Top Down Approach Featuring Internet", Pearson Education, 2006.
6. Fred Hallsall, Lingana Gouda Kulkarni, "Computer Networking and the internet" Fifth Edition", Pearson Education, 2007.
7. Fred Hallsall, "Multimedia Communications – Applications, Networks, Protocols and Standards", Pearson Education, 2012.

01CS6106 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Network Architecture: Reference models of OSI, TCP/IP, ATM. Protocol implementation issues. Physical address, Logical address.	3	15
	Internet Protocol: Packet Format (IPV4 and IPV6), Features of IPv6, CIDR notation, Subnetting, Supernetting, DHCP.	4	
II	Packet switching: Datagrams, Virtual circuit switching, Fragmentation of IP packets. Cell switching in ATM, Internetworking devices: Repeaters, Hubs, Bridges, LAN switches, Routers and Gateway.	4	15
	Routers: Router functions, Classification of routers, Features of IP Routers, Filtering, Network Address Translation (NAT).	3	
FIRST INTERNAL EXAM			
III	TCP Protocol: Services, protocol operation, TCP connection establishment and termination, Nagle's algorithm, Silly Window Syndrome, TCP timer Management, Karn's algorithm. UDP protocol : services and protocol operation.	3	15
	Congestion Management: Congestion control in Data Networks and Internets, Random Early Detection (RED). TCP congestion control: Additive increase/Multiplicative decrease, Slow start, Fast retransmit and Fast recovery.	3	
IV	Wireless Transmission : Wireless systems, Bluetooth architecture and protocol stack, Wireless Ad-hoc networks, Overview of generations of cell phone technologies.	4	15
	Routing: Static and Dynamic routing, Internetworking routing, Border Gateway Protocol (BGP), Routing in Ad-hoc networks.	3	
SECOND INTERNAL EXAM			
V	Quality of Service: Requirements and parameters of Quality of Service, Integrated Services, Resource Reservation Protocol (RSVP), Differentiated Services.	3	20
	Peer to Peer Networks: Gnutella, BitTorrent. Node Lookup in Peer to Peer Networks, Content Distribution Networks. Virtual Private Networks and tunnels.	4	
VI	Multimedia Networking: Streaming Stored Audio and Video, Real time Streaming Protocol (RTSP), Real Time Transport Protocol (RTP).	3	20
	Compression: Text compression – LZ and LZW coding, Huffman coding, JPEG image compression, Adaptive differential pulse code modulation (ADPCM), MPEG Audio Coders, Principles of Video Compression, MPEG1, MPEG2 and MPEG4 standards.	5	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6152	Parallel Algorithms	3-0-0	3	2015

Course Objectives

1. To understand the principles and applications of parallel algorithms.
2. To learn parallel algorithms for SIMD and MIMD computers.
3. To learn a large class of commonly used algorithms in parallel environment and their complexity analysis.

Syllabus

Need of parallel computers, Expressing algorithms, tree and Mesh interconnection super computers, sorting **,** Matrix Transposition, Matrix operations – matrix-by-matrix multiplications – mesh multiplications – cube multiplication, Matrix by vector multiplication, Linear array and tree multiplications, Solving numerical problems, solving partial differential equations, computing Eigen values.

Expected Outcome

1. Students gain in-depth theoretical and practical knowledge on parallel algorithms.

References

1. S.G.Akl, "Design and Analysis of parallel algorithms", PrenticeHall, Inc. 1989.
2. S.G.Akl, "Parallel Sorting algorithm", Academic Press, 1985.
3. M.J.Quin, "Parallel computing – theory and Practice", McGrawHill, New York, 1994.
4. S. Lakshmivarahan and S.K.Dhall, "Analysis and design of Parallel Algorithms – Arithmetic & Matrix problems", McGrawHill, New York, 1990.
5. B. Wilkinson, M. Allen, "Parallel Programming", 2/e, Pearson Education Inc, 2007.
6. M .J. Quin, "Parallel Programming in C with MPI and openMP", Tata McGraw Hill, 2007.

01CS6152 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Need of parallel computers – Models of computation – Analyzing algorithms – Expressing algorithms – Broadcast – All sums and selection algorithms on SIMD, Searching a sorted sequence – EREW, CREW SMSIMD algorithms, Searching a random sequence – SMSIMD – tree and Mesh interconnection super computers.	9	20
II	Sorting – Sorting on a linear array – sorting on a mesh – sorting on EREW SIMD computer – MIMD enumeration sort – MIMD quick sort – sorting on other networks.	6	15
FIRST INTERNAL EXAM			
III	Matrix Transposition – Mesh transpose – shuffle transpose – EREW transpose, Matrix operations – matrix-by-matrix multiplications – mesh multiplications – cube multiplication.	7	15
IV	Matrix by vector multiplication, Linear array multiplication – tree multiplications, Solving numerical problems – solving systems of linear equations – SIMD algorithms and MIMD algorithms.	7	15
SECOND INTERNAL EXAM			
V	Numerical problems – finding roots of nonlinear equations – SIMD and MIMD algorithms, solving partial differential equations, computing eigen values.	7	20
VI	Graph theoretical problems – computing connectivity matrix – finding connected components – all pairs shortest path – traversing combinatorial spaces – sequential tree traversals.	6	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6154	Soft Computing	3-0-0	3	2015

Course Objectives

1. To familiarize the salient approaches in soft computing, based on artificial neural networks, fuzzy logic, and genetic algorithms
2. To introduce applications of soft computing in different research areas in Computer Science / Information Technology

Syllabus

Artificial Neural Network, Typical architectures, Different learning methods, Common activation functions, Models Of Neural Network, Fuzzy Sets & Logic, Defuzzification methods, Genetic Algorithm, Evolutionary Computation, Genetic Programming Schema theorem; Multi-objective & Multimodal optimization in GA; Applications, Hybrid Systems

Expected Outcome

1. Understand basic concepts in artificial neural networks, fuzzy logic, and genetic algorithm
2. Able to apply soft computing techniques to research problems

References

1. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", 2/e, John Wiley India, 2012.
2. S. Haykin, "Neural Networks - A Comprehensive Foundation", 2/e, Pearson Education, 2005.
3. T.S. Rajasekaran, G.A. VijaylakshmiPai, "Neural Networks, Fuzzy Logic & Genetic Algorithms – Synthesis and Applications", Prentice-Hall India, 2003.
4. Sanchez, Takanori, Zadeh, "Genetic Algorithm and Fuzzy Logic System", World Scientific, 1997.
5. Goldberg David, "Genetic Algorithms", Pearson Education, 2006.
6. Zimmermann H. J, "Fuzzy Set Theory & Its Applications", Allied Publishers Ltd, 1991.

01CS6154 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Artificial Neural Network, Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model.	3	15
	Properties of neural networks, Typical architectures: single layer, multilayer, competitive layer;	3	
II	Different learning methods: Supervised, Unsupervised & reinforced; Common activation functions; Feed forward, Feedback & recurrent neural networks; Application of neural networks; Neuron.	6	15
FIRST INTERNAL EXAM			
III	Models Of Neural Network : Architecture, Algorithm & Application of – McCullo h-Pitts.	4	15
	Back propagation NN, ADALINE, MADALINE, Discrete Hopfield net, BAM, Maxnet.	3	
IV	Fuzzy Sets & Logic : Fuzzy versus Crisp; Fuzzy sets—membership function, linguistic variable, basic operators, properties; Fuzzy relations—Cartesian product, Operations on relations;	4	15
	Crisp logic—Laws of propositional logic, Inference; Predicate logic—Interpretations, Inference; Fuzzy logic—Quantifiers, Inference; Defuzzification methods.	3	
SECOND INTERNAL EXAM			
V	Genetic Algorithm Basic concept; role of GA in optimization, Fitness function, Selection of initial population, Cross over(different types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation.	4	20
VI	Applications: Travelling Salesman Problem, Graph Coloring problem.	4	20
	Hybrid Systems : GA based BPNN(Weight determination); Neuro Fuzzy Systems—Fuzzy BPNN--fuzzy Neuron, architecture, learning; Fuzzy Logic controlled G.A.	4	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6156	Computational Geometry	3-0-0	3	2015

Course Objectives

1. To fill the gap between geometric properties and algorithm design
2. To familiarize data structures used for developing efficient algorithms
3. To learn efficient techniques for solving geometric problems

Syllabus

Geometric Preliminaries, Data Structures for geometric problems, Geometric Searching, applications, Range Searching using Kd-trees, Convex Hulls, Triangulatio, Voronoi Diagrams, Delaunay Triangulation, Introduction to Visibility Problems, Visibility graph

Expected Outcome

4. Capable to develop efficient algorithms by exploiting geometric properties
5. Capable in identifying properties of objects, expressing them as lemmas and theorems and proving their correctness.
6. Capable in applying learned algorithm in diversified fields like data base
7. Searching, data mining, graphics, image processing pattern recognition,
8. computer vision motion planning and robotics

References

1. Franco P. Preparata, Michael Ian Shamos, "Computational Geometry- An Introduction", Texts and Monographs in Computer Science , Springer – Verlag
2. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars " Computational Geometry, Algorithms & Applications" Springer
3. Herbert Edelsbrunner, "Algorithms in Combinatorial Geometry", EATCS Monographs on Theoretical Computer Science, Springer – Verlag.
4. Art Gallery Theorems, Joseph O' Rourke, Oxford Press.
5. Joseph O' Rourke, " Computational Geometry in C", Cambridge University Press

01CS6156 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Geometric Preliminaries, Data Structures for geometric problems : DCEL (Doubly Connected Edge List), Quad trees, Kd-trees and BSP (Binary Space Partition) trees.	5	15
II	Geometric Searching - Planar Straight Line Graph (PSLG), Point Location Problem, Location of a point in a planar subdivision, Plane Sweep Technique-applications- line segment inter section using plane sweep ,Slab method, Regularization of PSLG, Monotone polygons , Range Searching using Kd-trees	9	25
FIRST INTERNAL EXAM			
III	Convex Hulls, Convex Hull Algorithms in the Plane -- Graham's Scan Algorithm, Jarvi's March, Divide and Conquer Algorithm, Quick Hull Algorithm. Triangulation— Polygon Triangulation	8	20
IV	Art Gallery Theorem, Fisk's proof of Art Gallery theorem. Post Office Problem - Voronoi Diagrams- Properties , computing Voronoi diagram, Applications in the plane , Delaunay Triangulation	8	20
SECOND INTERNAL EXAM			
V	Introduction to Visibility Problems-- Definition of direct visibility, Point visibility and Edge visibility, Algorithm for computing point-visible region inside a polygon	7	15
VI	Kernel of a simple polygon , Linear time algorithm for computing Kernel. Visibility graph, Shortest path for a point Robot	5	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6158	Semantic Web Technology	3-0-0	3	2015

Course Objectives

1. To understand the principles, practices and applications of Semantic Web Technology.

Syllabus

Introduction to Semantic Web, RDF and RDF schema, SPARQL, Web Ontology Language, formal semantics, Description logic, automated reasoning, ontology rules and queries, ontology engineering, software tools and applications.

Expected Outcome

1. Ability to use the technologies related Semantic Web
2. Ability to express and process domains using ontology and associated tools.

References

1. Liyang Yu, Introduction to the Semantic Web and Semantic Web Services, Chapman & hall/CRC, 2007.
2. Pascal Hitzler, MarkusKrötzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, Chapman & hall/CRC, 2010.
3. Peter Szeredi, GergelyLukacsy, TamasBenko, Zsolt Nagy, The Semantic Web Explained The Technology and Mathematics behind Web 3.0, Cambridge University Press, 2014.
4. Dean Allemang, James Hendler, "Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL", Morgan Kaufmann, 2008.
5. David Wood, Marsha Zaidman, Luke Ruth, Michael Hausenblas, Linked Data, Manning Publication Company, 2014.
6. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez "Ontological Engineering: with examples from the areas of Knowledge Management, e- Commerce and the Semantic Web", Springer, 2009.
7. Grigoris Antoniou, Frank van Harmelen, "A Semantic Web Primer (Cooperative Information Systems)", The MIT Press, 2009
8. http://www.w3.org/wiki/SemanticWebTools
9. http://protege.stanford.edu/
10. https://jena.apache.org/

01CS6158 – COURSE PLAN			
Module	***Contents***	***Hours Allotted***	***% of Marks in End-Semester Examination***
I	Introduction to Semantic Web and semantic web technologies (Reading: L. Yu [Ch.1, 2], P. Szeredi [Ch.1], P.Hitzler [Ch. 1])–XML review, First order Logic (review) (Reading: P. Hitzler(Appendix 1, 2])	4	10
II	RDF: overview, elements of RDF, basic syntax, advanced features – Relationship between doubling core, XML and RDF (Reading: L. Yu [Ch.3], P.Hitzler [Ch. 2])	8	20
FIRST INTERNAL EXAM			
III	RDF schema, syntax and semantics, examples. (Reading: L. Yu [Ch.4], P.Hitzler [Ch. 3]) Web ontology language (OWL): Syntax an semantics, reasoning power (informal treatment only), flavours of OWL, OWL2 standard. (Reading: L. Yu [Ch.5], P. Hitzler [Ch. 4]. Additional Reading: P. Szeredi [Ch.8])	10	20
IV	Formal semantics: description Logic, model theoretic semantics of OWL, automated reasoning. (Reading: P. Hitzler [Ch. 5]. Additional Reading: P. Szeredi [Ch.4])	10	20
SECOND INTERNAL EXAM			
V	Ontology Rules and Queries: combining OWL and DL, SPARQL, Query examples,conjuctive queries (Reading: P. Hitzler [Ch. 6,7]). Ontology Engineering: Requirement Analysis, Ontology creation, quality assurance, Modular ontology.	6	20
VI	Software tools: protégé, Jena (Reading: P. Hitzler [Ch. 8.4] and www links (see references)]).Applications (Reading: P. Hitzler [Ch. 9]. Additional Reading: D. Wood [Ch. 6], L. Yu [Ch.9, 10])	4	10
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6162	Advanced Compiler Design	3-0-0	3	2015

Course Objectives

1. To make aware the importance of code optimization in compiler design.
2. To learn various intermediate representations.
3. To understand various data flow analyses and optimization techniques.
4. To learn register allocation technique.
5. To learn machine code generation techniques.
6. To understand back end design of compilers.

Syllabus

Control Flow Analysis, Data Flow Analysis, Dependence analysis & Dependence graphs, Alias analysis, Global Optimizations, Redundancy Elimination, Loop Optimizations, procedure Optimization techniques, Machine Dependent tasks, Low Level Optimization techniques, Introduction to inter-procedural analysis and optimization, Introduction to Affine Transform Theory.

Expected Outcome

1. Conceptual understanding of theory behind compiler design.
2. Ability to build a complete compiler.

References

1. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kauffmann, 1997.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education, 2009.
3. Andrew W. Appel, "Modern Compiler Implementation in Java", Cambridge University Press, 2009.
4. Keith D. Cooper, Linda Torczon, "Engineering a Compiler", 2/e, Morgan Kauffmann, 2011.

01CS6162 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Review of compiler phases, Informal Compiler Algorithm Notation(ICAN), Symbol Table Structure – local and global symbol tables, Intermediate Representations – HIR – MIR and LIR, Run Time Issues.	5	15
II	Control Flow Analysis – basic blocks – DFS – dominators and postdominators – loops – dominator tree, Data Flow Analysis – reaching definitions – available expressions, – live variable information, Dependence analysis & Dependence graphs, Alias analysis.	9	15
FIRST INTERNAL EXAM			
III	Global Optimizations – constant folding – algebraic simplification and reassociation– constant and copy propagation – dead code elimination, Redundancy Elimination – common subexpression elimination – loop invariant code motion – partial redundancy elimination – code hoisting, Value numbering.	8	20
IV	Loop Optimizations – strength reduction and induction variable elimination, Procedure Optimization techniques, Static Single Assignment(SSA) form – dominance frontier – pi-functions – variable renaming.	8	15
SECOND INTERNAL EXAM			
V	Machine Dependent tasks: Register Allocation – graph coloring – coalescing, Code Scheduling – Instruction Scheduling – Speculative Scheduling – Software pipelining.	5	15
VI	Low Level Optimization techniques, Introduction to inter-procedural analysis and optimization, Machine code generation, Optimizing for Parallelism and Locality – Introduction to Affine Transform Theory.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6172	Machine Learning	3-0-0	3	2015

Course Objectives

1. To understand formulation of machine learning problems corresponding to different applications
2. To impart deeper understanding of concepts of machine learning, attributes, selection, reduction techniques, performance measurements
3. To understand a range of machine learning algorithms for classification, clustering, association rule formation along with their strengths and weaknesses

Syllabus

Introduction to Learning, Attributes, Selection, Reduction techniques, Classification using ANN, Bayes Classifier, Metrics for evaluating classifier performance, Association Rules- Apriori, FP Growth, Eclat, Hidden Markov Models, Algorithms, Self organizing Maps, Support Vector Machines, Unsupervised learning, K-Means algorithm, Hierarchical Clustering Algorithms

Expected Outcome

1. The ability apply preprocessing of data by attribute selection, reduction techniques
2. The ability to apply different machine learning methods for practical applications

References

5. Stephan Marsland, Machine Learning : An Algorithmic Perspective, CRC Press, 2009
6. Jiawei Han, MichelineKamber, Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufmann Publishers, 2012
7. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson 2014
8. Tomm. Mitchell, Machine Learning , McGraw Hill Education (India) Pvt Ltd, 2015
9. Vinod Chandra S S , AnandHareendran, Artificial Intelligence and Machine Learning, PHI learning Pvt Ltd, 2014

01CS6172 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to learning, types of learning, role of learning, Machine learning, supervised learning, unsupervised learning, semi-supervised learning, Applications of machine learning	2	15
	Types of data, attributes, types- nominal, ordinal, interval, ratio, Measuring the central tendency-Mean, Median, Mode, Measuring the dispersion of data- Range, Quartiles, Variance, Standard Deviation, Measuring Data Similarity and Dissimilarity between nominal, binary, ordinal attributes, Euclidian, Manhattan distance, Cosine similarity.	3	
II	Chi-square test, Correlation Coefficient for Numeric data, Dimensionality reduction techniques- Principal Component Analysis, Attribute Subset Selection, Parametric data reduction, Histograms	3	15
	Classification- Concepts, Decision trees, Information Gain, Gain Ratio, Gini Index, ID3 Algorithm, C 4.5 algorithm,	3	
FIRST INTERNAL EXAM			
III	Bayes Theorem, Naive Bayesian Classification, Metrics for evaluating Classifier performance- Accuracy, Error rate, Precision, Recall	3	15
	Artificial Neural Networks- basics, learning perception model, Multi layer feed forward network, back propagation	4	
IV	Association Learning, Basics of Association, Apriori Algorithm, Eclat Algorithm, FP Growth Algorithm.	4	15
	Stochastic Process, Markov Process, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Baum-Welch Algorithm	4	
SECOND INTERNAL EXAM			
V	Support Vector Machines- Maximum margin hyperplanes, Linear SVM, Non-linear SVM, Kernel Trick	4	20
	Inductive Logic Programming, Case Based Reasoning, CBR Issues, Ensemble Methods –Bagging, Boosting, AdaBoost, Random Forests,	4	
VI	Unsupervised learning- Clustering – Partitioning Method-K-Means, K-Medoids, Hierarchical Methods- Agglomerative versus Divisive clustering, Single link algorithm, Complete link algorithm, Distance measures in algorithmic methods, BIRCH- Multiphase Hierarchical	4	20

01CS6172 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
	clustering using clustering feature trees. Reinforcement learning,		
	Expectation Maximization(EM), EM Algorithm, Self Organizing Maps, Learning Process of SOM, Important ART Networks, Art Architecture, ART Algorithms	4	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6174	Advanced Graph Theory	3-0-0	3	2015

Course Objectives

1. To impart deeper understanding in advanced concepts in graph theory and their practical applications.

Graphs, Connectivity and Hamiltonicity, Connectivity, The Center and Edge connectivity- Self Central Graphs - The Median – Central Paths- Other Generalized Centers, Extremal Distance Problems, Distance sequences, Matrices, Symmetry, Digraphs, Graph Algorithms, Critical Path Method

Expected Outcome

2. Students become aware of the advanced concepts of graph theory and gain ability to apply those concepts in practical scenarios.

References

1. Fred Buckley and Frank Harary , "Distance in Graphs", Addison – Wesley, 1990.
2. C. R. Flouds: "Graph Theory Applications", Narosa Publishing House, 1994.
3. Harary F: "Graph Theory", Addison- Weslwy pub. 1972.
4. Deo N: "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall Inc. 1974.

01CS6174 – COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Graphs, Connectivity and Hamiltonicity: Graphs: Graphs as models- Paths and connectedness-Cutnodes and Blocks- Graph classes and graph operations. Connectivity: Connectivity and edge connectivity - Menger's theorem - Properties of n-connected graphs-Circulants	8	15
II	Hamiltonicity: Necessary or sufficient conditions- Connectivity and Hamiltonicity- Graph operations and Hamiltonicity - Generations of Hamiltonicity. Centers: The Center and Edge connectivity- Self Central Graphs - The Median – Central Paths- Other Generalized Centers	8	15

01CS6174 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
FIRST INTERNAL EXAM			
III	Extremal Distance Problems: Radius- Small Diameter- Diameter- Long paths and Long Cycles. Distance sequences: The Eccentric Sequence - Distance Sequences - Distribution - Path Sequence - Other Sequences.	8	15
IV	Matrices: The Adjacency Matrix - The incidence Matrix - The Distance Matrix. Convexity: Closure Invariants-Metrics on Graphs - Geodetic Graphs- Distance Heredity Graphs. Symmetry: Groups- Symmetric Graphs - Distance Symmetry	8	20
SECOND INTERNAL EXAM			
V	Digraphs: Digraphs and connectedness - Acyclic Digraphs - Matrices and Eulerian Digraphs- Long paths in Digraphs- Tournaments. Graph Algorithms: Polynomial Algorithms and NP completeness - Path Algorithms and Spanning Trees	6	20
VI	Centers - Maximum Matchings - Two NP-Complete Problems. Networks: The Max- Flow Min-Cut Theorem - Minimum Spanning Trees - Traveling Salesman Problem - Shortest Paths - Centers - Critical Path Method.	4	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6176	Cyber laws and Ethics	3-0-0	3	2015

Course Objectives

1. To impart sufficient knowledge on the fundamental principles of IPR and computer contracts.
2. To understand the different types of cyber crimes and cyber laws in India and abroad.
3. To expose to ethical issues in today's computer based environment.

Syllabus

Intellectual Property Rights, Computer contracts and licences, Computer crimes - different forms, Cyber law in India, IT Act 2000, Offences under IT Act., Protection of IPR in Cyber space in India, International cyber laws and crimes, Ethical issues in computer security.

Expected Outcome

1. Awareness of the different forms of IPR's and related rules and regulations, and of the laws applicable to computer and software related contracts.
2. Exposure to different forms of Cyber crimes and the Indian and International laws to combat Cyber crimes and facilitate e-commerce.
3. Capability to reason out different situations of ethics faced in the cyber world.

References

1. D. Bainbridge, Introduction to Information Technology Law, 6/e, Pearson Education, 2007.
2. Harish Chander, Cyber Laws and IT Protection, PHI Learning Private Limited, 2012.
3. P. Duggal, Cyber law: the Indian Perspective, Saakshar Law Publications, Delhi, 2005.
4. C. P. Fleeger and S. L. Fleeger, Security in Computing, 3/e, Pearson Education, 2003.

01CS6176 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Intellectual property rights, computer software copyrights, copyright in databases and electronic publishing, trade secrets, patent laws, trademarks, industrial designs, international implications of IPR	6	15
II	Computer contracts, liability for defective hardware and software, Contract for writing software, Licence agreements, Website development contracts, Electronic contracts and torts, Liability of ISP's.	5	15
FIRST INTERNAL EXAM			
III	Computer crime, computer frauds, hacking, unauthorized modification of information, piracy, cyber harassment. cyberstalking, cyber defamation. Domain names and cybersquatting.	7	15
IV	Cyber law in India, IT Act 2000- Objectives, Provisions under IT Act, Authentication of electronic records, Digital signature	7	15
SECOND INTERNAL EXAM			
V	Offences under the IT Act 2000: sections 65 to 74, Case studies, Positive aspects and grey areas of the IT Act.	5	20
	Protection of IPR in Cyber space in India: copyright, patents; IPR's needing protection.	3	
VI	International organizations to regulate e-commerce and cyber crimes, COE convention on cyber crimes.	3	20
	Ethical issues in computer security, Case studies.	6	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6178	Principles of Information Security	3-0-0	3	2015

Course Objectives

1. To understand the founding principles of Information security
2. Understand various vulnerability possibility
3. Familiarize with Network security

Syllabus

Security Models, Access control mechanisms, Intellectual property rights, Basics of Copy right, Software vulnerabilities, Malwares, Cryptography Topics: C Attacks, Message Authentication , Digital signature, Discrete Logarithmic protocols , Diffie Hellman Key exchange, El-Gamal encryption, Biometric Authentication

Expected Outcome

1. Conceptual understanding of the principles of information security, its significance and the domain specific security issues.
2. Gather in depth knowledge in vulnerability possibilities
3. Understand the relevance of security in various domains

.

References

1. Bernard Menezes, "Network security and Cryptography", Cengage Learning India, 2010.
2. Behrouz A. Forouzan, "Cryptography and Network Security", Special Indian Edition, Tata McGraw Hill, 2007
3. William Stallings, "Cryptography and Network Security: Principles and Practice", 6/e Pearson Education, 2013.
4. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker, "Digital Watermarking and Steganography", 2/e, Morgan Kaufmann, 2008.
5. Dieter Gollmann. "Computer Security", John Wiley and Sons Ltd., 2006.
6. Whitman and Mattord, "Principles of Information Security", Cengage Learning, 2006.
7. D. Bainbridge, "Introduction to Computer Law", 5/e, Pearson Education, 2004.
8. C. Kaufman, R. Perlman and M. Speciner, "Network Security: Private Communication in a public World", 2/e, Prentice Hall, 2002.
9. W. Mao, "Modern Cryptography: Theory & Practice", Pearson Education, 2004.
10. H. Delfs and H. Knebl, "Introduction to Cryptography: Principles and Applications", Springer Verlag, 2002.

01CS6178 – **COURSE PLAN**			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Security Models as basis for OS security, Access Control in OS-Discretionary Access control, Mandatory Access control and Role-based access control, Introduction to DB Security	4	7
	Laws and ethics, Intellectual property rights - Copy right law, Patent law, Copy right basics and Implications of software copy right law	2	
II	Software vulnerabilities- Phishing, Buffer and stack overflow, Heap overflow. Mobile Malware, Viruses, Worms and Trojans	4	11
	Internet scanning worms, Worm Propagation models, Topological worms- E-mail worms, P2P worms.	3	
FIRST INTERNAL EXAM			
III	Cryptography Topics: Cryptographic hash- SHA1, Collision resistance, Birthday attack, Message Authentication code,	4	8
	Digital signature, Discrete Logarithm- Diffie Hellman Key exchange-Protocol, Attacks	4	
IV	*El-Gamal encryption- Signature Scheme, One way and Mutual* authentication, Dictionary attack	4	15
	Needham Schroeder protocol, Kerberos basics, Biometrics for authentication.	3	
SECOND INTERNAL EXAM			
V	Network security topics: Network layer security – IPSec – overview, IP and IPv6, IPSec Protocols: AH and ESP, Tunnel Mode and trasport mode. Internet Key exchange Protocol- IPSec cookies.	8	20
VI	Transport layer security -SSL, SSL Record Layer Protocol. DoS and DDos attacks-SYN flooding, DDoS Attack Detection and prevention, Session Hijacking and ARP spoofing, firewalls- Types, Practical issues, RFID and E-passport, electronic payment, web services security.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6192	Mini Project	0-0-4	2	2015

Course Objectives

To make students

Design and develop a system or application in the area of their specialization.

Approach

The student shall present two seminars and submit a report. The first seminar shall highlight the topic, objectives, methodology, design and expected results. The second seminar is the presentation of the work/ hardware implementation.

Expected Outcome

Upon successful completion of the mini project, the student should be able to

1. Identify and solve various problems associated with designing and implementing a system or application.
2. Test the designed system or application.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS6194	Network & OS Laboratory	0-0-2	1	2015

Syllabus

Experiments are based on but not limited to topics covered in *01CS6104: Operating Design* and*01CS6106: Advanced Computer Networks*.

01CS6194 - Experiments	
Experiment No	**Description**
I	Implementation of producer-consumer problem, without using threads.
II	Implementation of dining philosopher problem, without using threads.
III	Development of a new device driver in Linux.
IV	Implementation of web proxy server with filtering and caching
V	Linux kernel configuration, compilation and rebooting from the newly compiled kernel
VI	Implementation of web proxy server with filtering and caching
VII	Implementation of DNS server(defined in RFC 1034 and RFC 1035)
VIII	Implementation of a web (HTTP/1.1) server(HTTP defined in RFC 2616), supporting multiple simultaneous clients or multiple connections from the same client. The server must print all requests it receives to a log file, along with the headers of responses it sends.
IX	Implementation of reliable file transfer over UDP
X	Study and use of packet tracer software(eg. WireShark)
XI	Study and use of protocol analyzer
XII	Study of protocol simulation in NS3 Single Flow TCP experiment using NS3
XIII	Multiple Flow TCP experiment using NS3

01CS6194 - Experiments	
Experiment No	**Description**
XIV	Varying the RTT experiment using NS3
XV	Study of Software-defined networking (SDN)

SEMSTER 3

SYLLABUS & COURSE PLAN

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7151	Complexity Theory	3-0-0	3	2015

Course Objectives

1. To understand fundamental time and space related complexity classes.
2. To understand randomized computation and associated complexity classes.
3. To explore various NP complete problems.
4. To understand parallel computation and associated complexity classes.
5. To understand the importance of complexity theory in cryptography.

Syllabus

Review of time and space related complexity classes, class L, NL, Co-NL, NL completeness. NP complete problems, NP and Co-NP, function problems, Randomized computation , RP, ZPP, PP, BPP – branching program – random sources. Cryptography – randomized cryptography – interactive proofs – zero-knowledge. Approximability – Approximation algorithms class MAXSNP, MAXSNP completeness – non-approximability. Parallel computation, algorithms, models of computation – class NC, P-completeness – RNC algorithms.

Expected Outcome

1. Ability to distinguish between various complexity classes.
2. Explain the significance of complexity classes and computation strategies.

References

1. Christos H. Papadimitriou, "Computational Complexity", Addison-Wesley Publishing Company Inc, 1994.
2. Michael Sipser, "Introduction to the Theory of Computation", Thompson Course Technology, 2/e, 2006.
3. Dexter C. Kozen, "Theory of Computation", Springer, 2006.
4. Vazirani V., "Approximation Algorithms", Springer, 1/e, 2004.
5. Rajeev Motwani, PrabhakarRaghavan, "Randomized Algorithms", Cambridge University Press, 2000.
6. JorgRothe, "Complexity Theory and Cryptology: An Introduction to Crypto-complexity", Springer-Verlag, 2005.

01CS7151 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Review of time and space related complexity classes – hierarchy theorem – reachability method, Space complexity – class L, NL, Co-NL, NL completeness.	6	15
II	NP complete problems – problems in NP – variants of satisfiability – graph theoretic problems – sets and numbers, NP and Co-NP – function problems.	6	15
FIRST INTERNAL EXAM			
III	Randomized computation – randomized algorithms – complexity classes – RP, ZPP, PP, BPP – branching program – random sources.	8	15
IV	Cryptography – one-way functions – trapdoor functions – cryptography and complexity – randomized cryptography – interactive proofs – zero-knowledge.	8	20
SECOND INTERNAL EXAM			
V	Approximability – Approximation algorithms – Approximation and complexity – L-reductions – class MAXSNP, MAXSNP completeness – non-approximability.	6	15
VI	Parallel computation – parallel algorithms – parallel models of computation – class NC, P-completeness – RNC algorithms.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7153	Distributed Algorithms	3-0-0	3	2015

Course Objectives

1. Provide an introduction to the most important basic results in the area of distributed algorithms.
2. Should be able to use basic distributed algorithms and impossibility results
3. Ability to apply distributed algorithms in large computer networks to multiprocessor shared-memory systems.

Syllabus

Synchronous Network Algorithm: Network Model, Leader election, , Algorithms in General Synchronous Networks, Distributed consensus with link failures, Distributed consensus with process failures, Asynchronous Algorithms: System model, Properties and proof methods.Asynchronous Shared Memory Algorithms: Shared Memory Model, Mutual Exclusion, Resource allocation, Consensus. Asynchronous Network Algorithms: Network Model, Basic asynchronous network algorithms, Synchronizers, Applications. Partially Synchronous Algorithms: System model, Timed automata, Basic Definitions and operations

Expected Outcome

- Ability to discuss and apply various synchronous algorithms and consensus problems.
- Ability to discuss and apply various asynchronous shared memory algorithms and asynchronous network algorithms.
- Ability to discuss and apply partially synchronous algorithms.

References

1. Nancy Lynch, "Distributed Algorithms", Morgan Kaufmann, 1996.
2. Vijay K. Garg, "Elements of Distributed Computing", John Wiley, 2006.
3. S. Mullender, "Distributed Systems", Addison-Wesley, 1993.
4. *Gerard Tel,* "Introduction to Distributed Algorithms", Cambridge Univ. Press, 2000.

01CS7153 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Synchronous Network Algorithm: Synchronous Network Model, Leader election in a synchronous ring, Algorithms in General Synchronous Networks – Flooding algorithm – Breadth First Search – Shortest Paths – Minimum Spanning Tree – Maximal Independent Set.	7	15
II	Distributed consensus with link failures – Deterministic coordinated attack problem, Distributed consensus with process failures – Algorithm for Byzantine failure. Asynchronous Algorithms: Asynchronous System model – I/O automata – Operations on automata – Fairness – Inputs and outputs for problems – Properties and proof methods.	7	15
FIRST INTERNAL EXAM			
III	Asynchronous Shared Memory Algorithms: Asynchronous Shared Memory Model, Mutual Exclusion – Dijkstra's Mutual Exclusion algorithm – Lock out free Mutual Exclusion algorithms, Mutual Exclusion using Read – Modify – Write Variables – TicketME algorithm.	7	15
IV	Resource allocation – The problem – Nonexistence of Symmetric Dining Philosophers Algorithm – Left Dining Philosophers Algorithm, Drinking Philosophers Problem, Consensus – Agreement using Read/Write shared memory.	7	15
SECOND INTERNAL EXAM			
V	Asynchronous Network Algorithms: Asynchronous Network Model, Basic asynchronous network algorithms – Leader election – Spanning Tree construction – BFS – Shortest path –Minimum Spanning Tree, Synchronizers – The Local synchronizer – The safe synchronizer – Implementations – Applications.	7	20
VI	Partially Synchronous Algorithms: System model – MMT Timed automata – General Timed automata – Basic Definitions and operations – Transforming MMT automata into General Timed Automata, Mutual Exclusion with partial synchrony – The problem – Single-Register algorithm.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7155	Advanced Computer Graphics	3-0-0	3	2015

Course Objectives

1. To introduce geometric modeling and modeling transformations
2. To learn different techniques for representing Solids
3. To learn visible surface determination algorithms
4. To learn concepts of global illumination modeling using advanced Ray tracing algorithms and Radiosity methods

Syllabus

Geometric modelling :Hierarchy in Geometric models, Defining and Displaying structures, Modelling Transformations, Interaction, Optimizing display of hierarchical models, Limitations of SPHIGS. User Interface Software, User Interface Management systems, Solid Modelling, Visible surface determination algorithms, Image manipulation and storage, Advanced geometric and raster transforms, Animation: Conventional and computer assisted animation, Methods of controlling animation, Multiprocessor Graphics System.

Expected Outcome

1. Be able to apply appropriate mathematical models to solve computer graphics problems

References

1. James D. Foley, Andries van Dam, Steven K. Feiner and F. Hughes John, "Computer Graphics, principles and Practice in C", 2/e, Pearson Education.
2. Donald Hearn and M. Pauline Baker, " Computer Graphics", Prentice Hall India
3. Alan Watt , " 3D Computer Graphics", Addison Wesley

01CS7155 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Geometric modelling :Hierarchy in Geometric models, relationship between model, application program and Graphical System, Defining and Displaying structures, Modelling Transformations, Hierarchical structure networks, Appearance attribute handling in hierarchy, Screen updating and rendering modes,	8	15
II	Interaction, Output features, Implementation issues, Optimizing display of hierarchical models, Limitations of SPHIGS. User Interface Software: Basic interaction handling models, Window management systems, Output handling in window systems, Input handling in window systems, User Interface Management systems.	7	15
FIRST INTERNAL EXAM			
III	Solid Modelling: Regularized Boolean set of operations, Sweep representations, Boundary representations, Winged –Edged representations, Boolean Set Operations, Spatial Partitioning representations, Octrees, Constructive Solid Geometry, Comparisons of representations.	7	15
IV	Visible surface determination algorithms: Scan line algorithm, Area subdivision algorithm, visible surface ray tracing. Illumination and shading: Illumination models, diffuse reflection and Specular reflection, illumination models, Shading models for polygons. Global illumination algorithms. Recursive ray tracing and distributed ray tracing. Radiosity methods, Combining radiosity and ray tracing.	8	20
SECOND INTERNAL EXAM			
V	Image manipulation and storage : Geometric transformation of images, Filtering, Multipass transforms, Generation of transformed image with filtering, Image Compositing, Mechanism for image storage. Advanced geometric and raster transforms: Clipping- clipping polygon against rectangles and other polygons.	7	20
VI	Animation: Conventional and computer assisted animation, Methods of controlling animation. Advanced Raster graphics architecture. Display processor system, Standard graphics pipeline, Multiprocessor Graphics System.	5	15
END SEMESTER EXAM			

01CS7157	Ad-hoc and Sensor Networks	3-0-0	3	2015

Course Objectives

1. To introduce wireless sensor networks and learn the concepts and principles behind WSN
2. To learn WSN network design, sensor node embedded system design and implementation
3. To understand issues involved in wireless network security

Syllabus

Fundamentals of wireless communication, characteristics of wireless channels, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet. Introduction to adhoc/sensor networks, advantages of ad-hoc/sensor network, issues in adhoc wireless networks, sensor network architecture, data dissemination and gathering.
MAC Protocols, issues, design goals, classification, S-MAC. Routing Protocols : Issues, classification, QoS and Energy Management, Issues and, classifications, QoS frameworks, need for energy management, classification, Security in Ad-hoc wireless Networks.

Expected Outcome

1. The student is familiar with the main standards and specifications of WSNs and identifies the key building blocks for them.
2. The student can define and explain the essential challenges of resource-constrained WSN design and implementation, including applications, interfaces, energy-efficient protocols and platform functionalities.
3. The student can apply both theoretical and practical tools for WSN design and utilization and design potential application scenarios for WSNs.

References

1. C. Siva Ram Murthy, B. S. Manoj, "AdHoc Wireless Networks ", Pearson Education, 2008.
2. Feng Zhao, LeonidesGuibas, "Wireless Sensor Networks ", Elsevier, 2004.
3. Jochen Schiller, "Mobile Communications ", 2/e, Pearson Education, 2003.
4. William Stallings, "Wireless Communications and Networks ", Pearson Education, 2004.

01CS7157 – COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction: Fundamentals of wireless communication technology, the electro-magnetic spectrum, radio propagation mechanisms, characteristics of wireless channels.	3	15
	Multiple access techniques, Wireless LANs-Fundamentals of WLANS,	6	

	IEEE 802.11 Standard, PANs-Bluetooth, WANs- cellular concept, cellular architecture and MANs-IEEE 802.16 Standard, Wireless Internet- Introduction, Mobile IP.		
II	Introduction to ad-hoc/sensor networks: Key definitions of ad-hoc/ sensor networks, unique constraints and challenges, advantages of adhoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.	5	15
FIRST INTERNAL EXAM			
III	MAC Protocols: Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols.	4	15
	MAC protocols for sensor network, location discovery, S-MAC.	4	
IV	Routing Protocols: Issues in designing a routing protocol.	2	15
	Classification of routing protocols, Destination Sequenced Distance Vector routing protocol, Dynamic Source Routing Protocol.	4	
SECOND INTERNAL EXAM			
V	QoS: Concept, Issues and challenges in providing QoS, QoS –Classifications.	4	20
	MAC layer solutions, QoS frameworks for Ad-hoc Wireless networks- QoS Models ,INSIGNIA , INORA .	5	
VI	Energy Management - need for energy management, classification.	2	20
	Security in Ad-hoc wireless networks-Network security Requirements, Issues and challenges in security provisioning, Network Security Attacks.	**3**	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7171	Principles of Network Security	3-1-0	4	2015

Course Objectives

1. To impart understanding of the main issues related to security in modern networked computer systems
2. The student should gain extensive, detailed and critical understanding of the concepts, issues, principles and theories of computer network security

Syllabus

Cryptographic Algorithms, DES, RSA, Hash function, Secure Hash Algorithm (SHA), Digital Signature schemes, Key Management, distribution and authentication, Wireless Security, Wireless LAN IEEE 802.11i, WAP, Security in Application layer, Transport layer and Network layer, Intrusion detection and firewalls.

Expected Outcome

3. Students should attain the ability to identify security vulnerabilities in a networked systems
4. Students should attain the ability apply network security algorithms and principles at different layers in typical networked environment

References

1. William Stallings, "Cryptography and Network Security Principles and Practice", 5/e, Pearson Education Asia, 2011.
2. Behrous A. Forouzan, "Cryptography and Network Security", TMH, 2007.
3. William Stallings, "Network Security Essentials", 4e, Pearson Education, 2011.
4. Roberta Bragg et. al., "Network Security: The Complete Reference", TMH, 2008.

01CS7171 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	DES, Strength of DES, Principles of public key crypto systems, The RSA algorithm, Cryptographic Hash functions- Applications, Requirements, Secure Hash Algorithm (SHA)	4	15
	Digital signatures- Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Standard.	4	
II	Wireless LAN protocol architecture, Wireless LAN security,	2	15
	IEEE 802.11i Phases of operation- Discovery, Authentication, Key management, Protected data transfer. Wireless Application Protocol (WAP).	3	
FIRST INTERNAL EXAM			
III	IP Security, Modes of operation, Protocols -Authentication Header (AH), Encapsulating Security Payload(ESP), Security Associations, Security policy,	3	15
	Internet Key Exchange – Diffie-Hellman key exchange, Attacks, IKE phases- Main mode, Aggressive and Quick mode	3	
IV	Email Architecture, Security, PGP-authentication, confidentiality, PGP Certificates and public keys, Trust model in PGP, Key Revocation, PGP packets, S/MIME- MIME, S/MIME data content types	4	15
	Secure Socket Layer, SSL Architecture, key exchange algorithms , Sessions and connections, Protocols –Handshake protocol, Change cipherSpec protocol, Record protocol, Alert protocol, Transport layer security, HTTPS, SSH	4	
SECOND INTERNAL EXAM			
V	Symmetric Key Agreement- Diffie-Hellman Key exchange, Station to Station Key exchange, Distribution of public keys, X.509 certificates, Public Key Infrastructure, Remote user authentication, Remote user authentication using symmetric key encryption	4	20
	Kerberos- version 4 message exchanges, improvements in version 5, Zero Knowledge Protocols – Fiat-Shamir protocol, Feige-Fiat Shamir Protocol.	3	
VI	Statistical anomaly detection, Rule based Intrusion detection,	4	20

01CS7171 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
	distributed intrusion detection, Password Management- password protection, password selection strategies		
	Malicious software- types, virus, worms, distributed denial of service, Firewalls -types of firewalls	4	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7173	Fuzzy Set Theory& Applications	3-0-0	3	2015

Course Objectives

1. To understand Fuzzy Set Theory and the basis of fuzyy logic and fuzzy logic applications such as fuzzy control and fuzzy decision making

Syllabus

Introduction – crisp sets an overview – the notion of fuzzy sets – Basic concepts of fuzzy sets – classical logic an overview – Fuzzy logic. Operations on fuzzy sets - fuzzy complement – fuzzy union – fuzzy intersection – combinations of operations – general aggregation operations. Crisp and fuzzy relations – binary relations – binary relations on a single set–equivalence and similarity relations. Compatibility or tolerance relations– orderings – Membership functions – methods of generation – defuzzification methods. General discussion – belief and plausibility measures – probability measures– possibility and necessity measures – relationship among classes of fuzzy measures. Classical logic: An overview – fuzzy logic – fuzzy rule based systems – fuzzy decision making Fuzzy logic in database and information systems – Fuzzy pattern recognition – Fuzzy contriol systems.

Expected Outcome

The students who succeeded in this course should be

1. able to examine the Set Theory problems.
2. able to interpret the systems which include fuzzines within the scope of fuzzy set theory.
3. able to combine the information of decision theory and the information of fuzzy set theory.
4. able to improve the proof techniques of Fuzzy Set Theory.
5. able to solve problems that include uncertainty with using Fuzzy Set Theory.

References

1. George J Klir and Tina A Folger, “Fuzzy Sets, Uncertainty and Information”, Prentice Hall of India, 1998.
2. H.J. Zimmerman, “Fuzzy Set Theory and its Applications”, 4/e, Kluwer Academic Publishers, 2001.
3. George Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic: Theory and Applications”, Prentice Hall of India, 1997.
4. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill International Editions, 1997.
5. Hung Nguyen and Elbert Walker, “A First Course in Fuzzy Logic, 2/e,, Chapman and Hall/CRC, 1999.

6. Jerry M Mendel, "Uncertain Rule-based Fuzzy Logic Systems: Introduction and New Directions, PH PTR, 2000.
7. John Yen and Reza Lengari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education, 1999.

01CS7173 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction – crisp sets an overview – the notion of fuzzy sets – Basic concepts of fuzzy sets – classical logic an overview – Fuzzy logic. Operations on fuzzy sets - fuzzy complement – fuzzy union – fuzzy intersection – combinations of operations – general aggregation operations	8	15
II	Crisp and fuzzy relations – binary relations – binary relations on a single set–equivalence and similarity relations.	7	15
FIRST INTERNAL EXAM			
III	Compatibility or tolerance relations– orderings – Membership functions – methods of generation – defuzzification methods.	7	15
IV	General discussion – belief and plausibility measures – probability measures– possibility and necessity measures – relationship among classes of fuzzy measures.	8	20
SECOND INTERNAL EXAM			
V	Classical logic: An overview – fuzzy logic – fuzzy rule based systems – fuzzy decision making	7	20
VI	Fuzzy logic in database and information systems – Fuzzy pattern recognition – Fuzzy control systems.	5	15
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7175	Decision Support Systems	3-0-0	3	2015

Course Objectives

1. To understand the theory and applications of various types of DSS

Syllabus

Introduction, Concepts of Data, Information, Information Systems & End Users. Systems Concepts, Building Information System, Prototyping Evolution of Information Systems, Decision Making, Characteristics and Capabilities. Components of DSS, Certainty, Uncertainty, and Risk, Sensitivity Analysis, Making Decisions in Groups, Group Decision Support System(GDSS), Supporting Group work with Computerized Systems, Knowledge Management System, Introduction to Business Intelligence: Origins and Drivers of Business Intelligence, General Process of Intelligence Creation and Use, Characteristics of Business Intelligence, Towards Competitive Intelligence, Successful BI Implementation, Structure and Components of BI ,Future trends.Data Warehousing Definitions and Concepts, Analytical Processing (OLAP). Knowledge Discovery in Databases (KDD, Data Mining Concepts and Applications

Expected Outcome

1. The student should have conceptual strength in DSS and should be able apply it identify the most apt DSS in a practical scenario.

References

1. Turban, Efrain, "Decision Support & Business Intelligent Systems", 8/e, Pearson Education
2. Marakas, George.M, "Decision Support Systems in the 21st Century", Pearson Education
3. Mallach, Efrem G., " Decision Support & Data Warehouse Systems", Tata McGraw-Hill
4. Keen,Peter G.W, "Decision Support System and Organizational Perspective", Addison-Wesley
5. Theierauff, Robert J., "Decision Support System for Effective Planning", Prentice Hall, 1982.
6. Krober,Donald W., and Hugh J. Watson, "Computer Based Information System", New York,1984.
7. Andrew P. Sage, "Decision Support System Engineering", John Wiley & Sons, New York,1991.
8. Leod. Raymond Me JR, "Management Information Systems", 5/e, Macmillian Publishing Company, 1993.

01CS7175 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction, Concepts of Data, Information, Information Systems & End Users. Systems Concepts: Open System, Closed System; Information Systems and Systems Concept. Building Information System: System Analysis and Design – Systems Development Cycle (Identification of Requirements, Feasibility Study, System Analysis, Design And Implementation), Prototyping Evolution of Information Systems: PS,OAS,MIS,DSS,EIS,ES	7	15
II	Decision Making: Introduction and Definitions, Simons Decision Making Model, How Decisions are Supported, DSS Configurations, DSS Characteristics and Capabilities. Components of DSS, DSS Classifications DSS Modeling-Static and Dynamic Models, Certainty, Uncertainty, and Risk, Sensitivity Analysis, What-IF, and Goal Seeking	7	15
FIRST INTERNAL EXAM			
III	Making Decisions in Groups: Group Decision Support System(GDSS),Characteristics, Process, Benefits, and Dysfunctions, Supporting Group work with Computerized Systems, Tools for Indirect and Indirect Support of DecisionMaking, From GDSS to GSS Knowledge Management System: Definition and types of Knowledge, Frame work for Knowledge Management Knowledge Representation Techniques: Rules, Frames, Semantic Networks	8	20
IV	Introduction to Business Intelligence: Origins and Drivers of Business Intelligence, General Process of Intelligence Creation and Use, Characteristics of Business Intelligence, Towards Competitive Intelligence, Successful BI Implementation, Structure and Components of BI, Future trends.	7	15
SECOND INTERNAL EXAM			
V	Data Warehousing Definitions and Concepts, Types of Data warehouse. Business Analytics-Online Analytical Processing (OLAP), Reporting and Queries, Multidimensionality.	6	15
VI	Knowledge Discovery in Databases (KDD), framework of KDD. Data Mining Concepts and Applications, Framework of data mining, Text Mining, Web Mining Usage, Benefits, and Success of Business Analytics.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7177	Advanced Software Project Management	3-0-0	3	2015

Course Objectives

1. To impart comprehensive knowledge of software project management
2. To familiarise with the planning and implementing of complex software projects.

Syllabus

Planning a software project; Project evaluation; Selection of Process model; Software effort estimation; Activity planning; Risk analysis and risk management; Resource allocation; Project tracking and control; Contract management; People management; Software quality assurance; Configuration management.

Expected Outcome

1. Ability to explain and exemplify to the different stages of planning a software project and managing it.
2. Capability to plan a large software project, and to effectively monitor and control it.

References

5. Bob Hughes and Mike Cotterell, "Software Project Management", 5/e, 2011,McGraw Hill
6. PankajJalote, "Software Project Management in Practice", 2002, Pearson Education Asia.
7. Roger S. Pressman, "Software Engineering: A practitioner's Approach", 7/e, 2010, McGraw Hill
8. Robert T. Futrell, Donald F. Shafer, and Linda I. Shafer, "Quality Software Project Management", 2002, Pearson Education Asia.
9. Ramesh Gopalaswamy, "Managing Global Software Projects", 2003, Tata McGraw Hill.

01CS7177 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to Software Project Management: Stakeholders; Software product, process, resources, quality, and cost;Objectives, issues, and problems relating to software projects.	3	15
	Project Planning: Defining scope and objectives; Work breakdownstructure; Time, cost, and resource estimation. Case studies.	3	
II	Project Evaluation: Strategic assessment; Technical assessment; Cost benefit analysis; Risk evaluation. Choice of process model: Rapid application development; Waterfallmodel; V-process model; Spiral model; Prototyping; Incremental delivery, Agile methods. Case studies.	5	15
FIRST INTERNAL EXAM			
III	Software Effort Estimation: Effort estimation techniques; Algorithmic methods; Function point analysis; COCOMO model. Case studies.	4	15
	Activity Planning: Network planning model; Critical path; Slack and float.	3	
IV	Risk Analysis and Management: Risk Identification; Risk assessment; Risk mitigation, monitoring, and management.	4	15
	Resource Allocation: project resources; Allocating and scheduling resources; cost of resources; Cost variance; time-cost tradeoff. Case studies.	4	
SECOND INTERNAL EXAM			
V	Project Tracking and Control: Measurement of physical and financial progress; Status reports; Change control.	4	20
	Contract Management: Outsourcing; Types of contracts; Stages and Terms of contract; Contract monitoring; Managing People and Organizing Teams: Recruitment; Motivation; Group behaviour; LeadershipMini and leadership styles; forms of organizational structures.	6	
VI	Software Quality Assurance: Planning for quality; Product versus process quality; Defect analysis and prevention; Statistical process control; Pareto analysis; Causal analysis; Quality standards and Models; Quality audit.	4	20
	Configuration Management: CM Process; Change control; Configuration audit; Status reporting.	2	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7191	Seminar II	0-0-2	1	2015

Course Objectives

To make students

1. Identify the current topics in the specific stream.
2. Collect the recent publications related to the identified topics.
3. Do a detailed study of a selected topic based on current journals, published papers and books.
4. Present a seminar on the selected topic on which a detailed study has been done.
5. Improve the writing and presentation skills.

Approach

Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.

Expected Outcome

Upon successful completion of the seminar, the student should be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7193	Project (Phase I)	0-0-12	6	2015

Course Objectives

To make students

1. Do an original and independent study on the area of specialization.
2. Explore in depth a subject of his/her own choice.
3. Start the preliminary background studies towards the project by conducting literature survey in the relevant field.
4. Broadly identify the area of the project work, familiarize with the tools required for the design and analysis of the project.
5. Plan the experimental platform, if any, required for project work.

Approach

The student has to present two seminars and submit an interim Project report. The first seminar would highlight the topic, objectives, methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is the presentation of the interim project report of the work completed and scope of the work which has to be accomplished in the fourth semester.

Expected Outcome

Upon successful completion of the project phase 1, the student should be able to

1. Identify the topic, objectives and methodology to carry out the project.
2. Finalize the project plan for their course project.

SEMESTER 4

SYLLABUS & COURSE PLAN

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01CS7194	Project (Phase II)	0-0-23	12	2015

Course Objectives

To continue and complete the project work identified in project phase 1.

Approach

There shall be two seminars (a mid-term evaluation on the progress of the work and pre submission seminar to assess the quality and quantum of the work). At least one technical paper has to be prepared for possible publication in journals / conferences based on their project work.

Expected Outcome

Upon successful completion of the project phase II, the student should be able to

1. Get a good exposure to a domain of interest.
2. Get a good domain and experience to pursue future research activities.