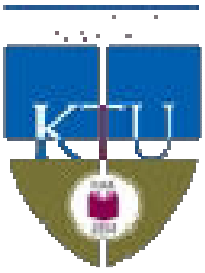
APJ ABDUL KALAM KERALA TECHNOLOGICAL UNIVERSITY



(KOLAM CLUSTER - 02)

SCHEME AND SYLLABI

of

M. TECH.

in

COMPUTER AND INFORMATION SCIENCE

OFFERING DEPARTMENT

COMPUTER SCIENCE AND ENGINEERING

CLUSTER LEVEL GRADUATE PROGRAM COMMITTEE

NO	MEMBER
1	Dr. S. Mohan, Professor, IIT Madras, Chennai
2	Principal, TKM College of Engineering, Kollam
3	Principal, Baselios Mathews II College of Engineering, Sasthamcotta, Kollam
4	Principal, College of Engineering, Karunagapally, Kollam
5	Principal, College of Engineering, Perumon, Kollam
6	Principal, Pinnacle School of Engineering and Technology, Anchal, Kollam
7	Principal, Shahul Hameed Memorial Engineering College, Kadakkal, Kollam
8	Principal, TKM Institute of Technology, Ezhukone, Kollam
9	Principal, Travancore Engineering College, Parippally, Kollam
10	Principal, Younus College of Engineering and Technology, Pallimukku, Kollam

Principals of the colleges in which the programme is offered

No	Name of the college	Principal's Name	Signature
1	College of Engineering Perumon, Kollam	Dr.Z A Zoya	
2	T K M Institute of Technology, Ezhukone, Kollam	Dr. David K. Daniel	

Date:
Place:

Dr S. Mohan,
Professor, IIT, Madras
Chairman

Programme Educational Objectives

I. Ability to craft pioneering proficiency in research using technical and analytical skills to overcome the resilient challenges in the arena of computing and technology.
II. To mould learners as an entrepreneur by instilling innovative concepts in the discipline of computer science.
III. Attain leadership abilities and apply them with integrity, discipline and ethics in the technical scenario.

Programme outcome

a) An ability to apply mathematical, scientific, analytical and engineering knowledge to develop solutions for specialized complex engineering problems.
b) An ability to identify, formulate and solve computing problems by analyzing and interpreting data to design and implement component or process to meet desired needs in the area of research and development.
c) An ability to interact and communicate effectively in diverse teams which uplifts the leadership qualities.
d) An ability to indulge in life-long learning process of various research aspects to withstand / adapt latest trends in the field of computer science.
e) An ability to create, select and use suitable techniques, skills and modern software engineering tools to explore the research gaps necessary for engineering practices.
f) An ability to become a good professional with high ethical responsibilities aiming towards sustainable development in environmental and societal contexts.
g) An ability to understand, manage and execute complex computing projects with emphasis on performance constraints aiming towards entrepreneurs.
h) An ability to conduct investigative research to tackle identified issues and contributes with effective communication in multidisciplinary scenarios.

Scheme of M. Tech Programme
In Computer and Information Science

SEMESTER 1 (Credits 23)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	02CS6211	Mathematical Foundations of Computer Science	4-0-0	40	60	3	4
B	02CS6221	Advanced Data Structure and Algorithms	4-0-0	40	60	3	4
C	02CS6231	Advanced Software Engineering	4-0-0	40	60	3	4
D	02CS6241	Topics in Database Technology	3-0-0	40	60	3	3
E	02CS6251	Elective I	3-0-0	40	60	3	3
	02CA6001	Research Methodology	1-1-0	100	0	0	2
	02CS6261	Seminar	0-0-2	100	0	0	2
	02CS6271	Algorithm Design Laboratory	0-0-2	100	0	0	1

L-Lecture T -Tutorial P-Practical

ELECTIVE I

02CS6251.1 Information Security
02CS6251.2 Modern Computing Paradigms
02CS6251.3 Image Processing
02CS6251.4 Advances in Computer Networks
02CS6251.5 Advanced Computer Graphics

Note: 8 hours/week is meant for departmental assistance by students.

Scheme of M. Tech Programme
In Computer and Information Science

SEMESTER 2 (Credits 19)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	02CS6212	Advanced Data Mining	4-0-0	40	60	3	4
B	02CS6222	Information Retrieval	3-0-0	40	60	3	3
C	02CS6232	Advanced Operating System Design	3-0-0	40	60	3	3
D	02CS6242	Elective II	3-0-0	40	60	3	3
E	02CS6252	Elective-III	3-0-0	40	60	3	3
	02CS6262	Mini Project	0-0-4	100	0	0	2
	02CS6272	Advanced DBMS Laboratory	0-0-2	100	0	0	1

L-Lecture T-Tutorial P-Practical

ELECTIV II

02CS6242.1 Computer Vision
02CS6242.2 Wireless Communication and Networking
02CS6242.3 Advanced Topics in Distributed Systems
02CS6242.4 Parallel Algorithms
02CS6242.5 Soft Computing

ELECTIV III

02CS6252.1 Advanced Graph Theory
02CS6252.2 Computational Linguistics
02CS6252.3 Network security
02CS6252.4 Advanced Compiler Design
02CS6252.5 Decision Support Systems

Note: 8 hours / week is meant for departmental assistance by students.

Scheme of M. Tech Programme
in Computer and Information Science

SEMESTER 3 (Credits 14)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	02CS7213	Elective-IV	3-0-0	40	60	3	3
B	02CS7223	Elective-V	3-0-0	40	60	3	3
	02CS7233	Seminar	0-0-2	100	0	0	2
	02CS7243	Project(Phase-1)	0-0-8	50	0	0	6

L-Lecture T-Tutorial P-Practical

ELECTIVE IV

02CS7213.1 Cloud Computing
02CS7213.2 Machine Learning
02CS7213.3 Advanced Numerical Techniques
02CS7213.4 Ad hoc and sensor networks
02CS7213.5 Bio informatics

ELECTIV V

02CS7223.1 Software Quality Assurance and Testing
02CS7223.2 Data Compression
02CS7223.3 Computational Geometry
02CS7223.4 Medical Imaging
02CS7223.5 Big Data Analytics

Note: 8 hours/week is meant for departmental assistance by students.

Scheme of M. Tech Programme
In Computer and Information Science

SEMESTER 4 (Credits 12)

Exam Slot	Course code	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
	02CS7214	Project(Phase-2)	0-0-21	70	30	0	12

L-Lecture T-Tutorial P-Practical

Note: 8 hours/week is meant for departmental assistance by students.

Total credits for all semesters: 68

SEMESTER 1

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CS6211	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	4-0-0	2015

Course Objectives

To give the students understanding of the fundamental concepts in theorem proving, recurrence relations and to give the student knowledge regarding the counting and probability ,probability distributions, special graphs and circuits, important algebraic structures .

Syllabus

Techniques for theorem proving; Linear time temporal logic and branching time logic; Adequate sets of connectives; Principles of mathematical induction and complete induction; Recursive definitions; Generating functions; Solution methods for recurrence relations; Fundamental principles of counting; Probability theory; Mathematical expectation; Discrete distributions; Continuous distributions; Graphs; Euler's formula; Groups and sub groups; Rings; Quadratic residues; Reciprocity; Elliptic curve arithmetic

Course Outcome

Students after the completion of the course understand the 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. Richard Johnson, "*Probablity and Statistics for Engineers*", 7/e, Prentice-Hall India Private Limited, 2005.
4. Robert V. Hogg, Elliot A. Tanis, Meda J. M. Rao, "*Probability and Statistical Inference*", 7/e,, Pearson Education India, 2006.
5. Michael Huth, Mark Ryan "*Logic in Computer Science*", 2/e, Cambridge University Press, 2004.
6. J. Truss, "*Discrete Mathematics for Computer Scientists*", 2/e, Addison Wesley, 1999.
7. Bernard Kolman, Robert C Busby,SharonKutler Ross, "Discrete Mathematical Structures", 2/e, Prentice-Hall India Private Limited, 1996.

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	Techniques for theorem proving: Direct Proof, Proof by Contra position, Proof by exhausting cases and proof by contradiction, Linear-time temporal logic and Branching-time logic-Syntax, Semantics, Practical patterns of specifications, Important equivalences, Adequate sets of connectives, Principle of mathematical induction, principle of complete induction.	8	15
II	Recursive definitions, Generating functions, function of sequences calculating coefficient of generating function, solving recurrence relation by substitution and generating functions Solution methods for linear, first-order recurrence relations with constant coefficient, characteristic roots.	8	15
FIRST INTERNAL EXAM			
III	Fundamental principles of counting, pigeonhole principle, countable and uncountable sets, principle of inclusion and exclusion – applications, derangements, permutation and combination, Pascal's triangles, binomial theorem.	7	15
IV	Probability 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.	8	15
SECOND INTERNAL EXAM			
V	Graphs, Terminology, Euler tours, planar graphs, Hamiltonian graphs, Euler's formula (proof), four colour problem (without proof) and the chromatic number of a graph, five colour theorem, chromatic polynomials, Warshall's algorithm, Decision Trees, weighted trees.	8	20
VI	Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, rings , finite fields, polynomial arithmetic, quadratic residues, reciprocity, discrete logarithms, elliptic curve arithmetic.	11	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6221	ADVANCED DATA STRUCTURES AND ALGORITHMS	4-0-0: 4	2015

Course Objectives

To give the students understanding about advanced data structures. and how to analyze and establish correctness of algorithms and also to understand theory behind various classes of algorithms.

Syllabus

Amortized analysis; Advanced data structures; Network flow algorithms and their analysis; Probabilistic algorithms; Monte-Carlo algorithms; Geometric algorithms; Convex hull algorithms; Finding closest pair of points; Number theoretic algorithms; Integer factorization; String matching; Overview of complexity classes; Complexity classes in randomized algorithms.

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Course Outcome

The students are able to

- Explain the concepts of advanced data structures and their applications
- Compare various classes of algorithms.
- Design 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. SartajSahni, "*Data Structures, Algorithms, and Applications in C++*", Mc-GrawHill, 1999.
3. Gilles Brassard and Paul Bratley, "Fundamentals of algorithms", Prentice-hall of India Private Limited, New Delhi, 2001.
4. R.C.T. Lee, S.S. Tesng, R.C. Cbang and Y.T. Tsai "*Design and Analysis of Algorithms, A strategic Approach*", TMH, 2010
5. Rajeev Motwani, PrabhakarRaghavan, "*Randomized Algorithms*", Cambridge University Press, 2000.
6. Dexter C. Kozen, "*The Design and Analysis of Algorithms*", Springer.
7. Jon Kleinberg and Eva Tardos, "*Algorithm Design*", Pearson Education, 2006.
8. M. H. Alsuwaiyal, "*Algorithms Design Techniques and Analysis*", World Scientific Publishing Co. Beijing, 1999.
9. S. K. Basu, "*Design Methods and Analysis of Algorithms*", Prentice Hall India, 2005.

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	Amortized Analysis – aggregate, accounting, potential methods- Case studies. Advanced data structures: binomial heap, Fibonacci heap, disjoint sets - applications.	7	15
II	Network flow algorithms: properties, Ford-Fulkerson method, maxflow-mincut theorem, Edmonds-Karp heuristics, push-relabel, relabel-to-front algorithms, maximum bipartite matching - analysis of associated algorithms - applications.	8	15
FIRST INTERNAL EXAM			
III	Probabilistic algorithms: Numerical algorithms, integration, counting, Monte-Carlo algorithms - verifying matrix multiplication, min-cut in a network. Las Vegas algorithms, selection, quicksort, Dixon's factorization	8	15
IV	Geometric Algorithms: Plane sweep technique, role of *sweep- line - status* and *event-point-schedule*, line segment intersection problem. Convex Hull: Graham's scan algorithm, Jarvismarch algorithm. Finding closest pair of points, proof of correctness.	9	15
SECOND INTERNAL EXAM			
V	Number-Theoretic algorithms: GCD algorithm, primality testing, Miller-Rabin test, integer factorization - Pollard Rho heuristic, string matching: Rabin-Karp, Knuth-Morris-Pratt algorithms.	10	20
VI	Overview of Complexity classes – P, NP, Co-NP, NP-hard, NP complete, Space complexity. Complexity classes in randomized algorithms – RP, PP, ZPP, BPP.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6231	ADVANCED SOFTWARE ENGINEERING	4-0-0: 4	2015

Course Objectives

To gain knowledge about the issues and approaches in modeling, analyzing and testing software systems.

Syllabus

Introduction to software engineering; Role of software engineer; Modelling the process and life cycle; Software process models; Agile methods; Tools and techniques for process modelling; Process models and project management; Project personnel and organization; Effort and schedule estimation; Risk management; Capturing, eliciting, modelling, and reviewing requirements; Software architectures and their evaluation; Software architecture documentation; Object oriented design; Types of testing; Reliability, availability, and maintainability; predictive accuracy; Test documentation; Maintaining the system.

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Course Outcome

- Explain different software architectures.
- Use the principles of software engineering in modeling and testing.

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. 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.
6. K.K Aggarwal&Yogesh Singh, "*Software Engineering*", New Age International 2007.
7. Norman E Fenton, Shari Lawrence Pfleeger, "*Software Metrics: A Rigorous and Practical Approach*."1998

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	Introduction: Role of Software Engineer- Quality of software process and product – Systems Approach to Software Engineering – An Engineering Approach to Software Engineering – How has Software Engineering Changed? Modeling the Process and Life Cycle – Software Process Models – Waterfall Model – V Model - Prototyping Model – Spiral Model – Agile methods..	8	15
II	Tools and Techniques for Process Modeling – Planning and Managing the Project - Tracking project progress - Project personnel and organization – Effort and schedule estimation – Risk Management – Process Models and Project Management .	8	15
FIRST INTERNAL EXAM			
III	Capturing the Requirement – Eliciting Requirements – Modelling requirements – Reviewing requirements to ensure quality – Documenting requirements – Designing the architecture – Views of Software Architecture – Common Architectural Patterns – Architecture Evaluation and Refinement Criteria for evaluating and comparing design alternatives - Software architecture documentation.	9	15
IV	Designing Modules – Design Methodology – Design Principles – Object Oriented (OO) design – Representing designs using UML – OO Design Patterns - OO Measurement - Design Documentation Programming Standards and Procedures – Programming Guidelines – Documentation.	9	15
SECOND INTERNAL EXAM			
V	Testing the Programs - Principles of System Testing - Function Testing - Performance Testing – Reliability - Availability and Maintainability - Basics of reliability theory - The Software Reliability Problem - Parametric reliability growth models	8	20
VI	Predictive accuracy - The recalibration of software-reliability growth predictions - Acceptance Testing - Installation Testing – Automated System Testing - Test Documentation - Testing Safety Critical Systems - Maintaining the System – Evaluating Products, Processes, and Resources.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6241	TOPICS IN DATABASE TECHNOLOGY	3-0-0: 3	2015

Course Objectives

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

Syllabus

Query processing algorithms; Transaction management; Concurrency control; Deadlocks; Database security and access control; Database system architectures; Parallel systems; IO parallelism; Distributed database; Distributed transactions; Distributed query processing; Concepts of object databases; Semi-structured data and XML databases; Temporal databases; Multimedia databases; Mobile data management.

Course Outcome

- Discuss about various implementation issues in databases.
- Explain about distributed databases.
- Apply object based database concept in designing database systems.
- Discuss about recent technological trends in databases.

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, Cambridge, Massachusetts, 2003
8. Jules J. Berman, "*Principles of Big Data: Preparing, Sharing and Analyzing Complex Information*", Morgan Kufmann, 2013.
9. Pete Warden, "*Big Data Glossary*", O'Reilly Media Inc, 2011

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	Query Processing Algorithms – Query Optimization Techniques – Transaction Management: Transaction Processing Concepts - Concurrency Control – Deadlocks – Recovery Techniques.	6	15
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.	7	15
FIRST INTERNAL EXAM			
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.	7	15
IV	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.	7	15
SECOND INTERNAL EXAM			
V	Semi-structured Data and XML Databases: XML Data Model – DTD – XPath and XQuery – Example Queries. Storing, RDF (Fundamental Concepts only). 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	7	20
VI	Multimedia Databases: data formats, continuous media data, similarity-based retrieval, Mobile data management: Mobile computing architecture – data management issues - location-based services – peer-to-peer systems and applications – application platforms.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CS 6151 .1	INFORMATION SECURITY	3-0-0-3	2015

Course Objectives

To understand the requirement and fundamental principles of Information security.

Syllabus

OS security; DB security; Software vulnerabilities; Malware viruses, worms, and Trojans; Topological worms; Symmetric encryption principles; Public Key cryptography principles; SHA1; Discrete log Diffie Hellman; Digital signature; Digital certificates; Steganography and watermarking; Symmetric key distribution; One way and two way authentication; Needham Schroeder protocol; Kerberos; Network layer security; Transport layer security; Web security consideration; Law and ethics.

Course Outcome

To discuss about information security, its significance and the domain specific security issues.

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. Dieter Gollmann. "*Computer Security*", John Wiley and Sons Ltd., 2006.
5. Whitman and Mattord, "*Principles of Information Security*", Cengage Learning, 2006.
6. D. Bainbridge, "*Introduction to Computer Law*", 5/e, Pearson Education, 2004.
7. C. Kaufman, R. Perlman and M. Speciner, "*Network Security: Private Communication in a public World*", 2/e, Prentice Hall, 2002.
8. W. Mao, "*Modern Cryptography: Theory & Practice*", Pearson Education, 2004.
9. H. Delfs and H. Knebl, "*Introduction to Cryptography: Principles and Applications*", Springer Verlag, 2002.

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
1	Security Models as basis for OS security, Introduction to DB Security, Software vulnerabilities, Buffer and stack overflow, Phishing. Malware Viruses, Worms and Trojans. Topological worms. Internet propagation models for worms. Symmetric Encryption Principles, Public-Key Cryptography Principles	7	15
II	Cryptography Topics: Introduction to Secure Hash Function and Digital Signature , Cryptographic hash SHA1, Discrete Log Diffie Hellman, Digital certificates. Steganography, watermarking. Symmetric Key Distribution Using Symmetric Encryption	7	15
FIRST INTERNAL EXAM			
III	Protocol topics: One way and two way authentication, Needham Schroeder protocol, Kerberos basics, Biometrics for authentication.	6	15
IV	Network security topics: Network layer security – IPSec – overview,IP and IPv6, AH, ESP. Transport layer security SSL. Attacks DoS, DDoS, ARP spoofing - firewalls.	7	15
SECOND INTERNAL EXAM			
V	Web Security Consideration, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, Secure Shell (SSH), Pretty Good Privacy (PGP), S/MIME	7	20
VI	Law and ethics: Intellectual property rights, computer software copyrights, security policy, ethical hacking, security tools.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6251.2	MODERN COMPUTING PARADIGMS	3-0-0-3	2015

Course Objectives

- *The ability to work with various computing revolutions like HPC, Cluster, Grid and Cloud computing.*
- *Ability to use virtualization techniques to implement computing approaches like cloud computing.*

Syllabus

High performance computing; Programming models; Introduction to PVM and MPI; Cluster computing; Grid Computing – Fundamentals, Grid security, Grid architecture, Grid topologies; Cloud computing – Cloud architecture, Cloud storage, Cloud services, EUCALYPTUS, CloudSim; Virtualization types; Virtual machines.

Course Outcome

- Use appropriate computing paradigms in real time business
- Discuss about various tools and methods to implement Grid and Cloud computing

References

1. Rajkumar Buyya, "*High Performance Cluster Computing* – Architecture and Systems", Pearson Education.
2. Bart Jacob, Michael Brown, et al," *Introduction to Grid Computing*", IBM Red Books
3. Kris Jamsa, "*Cloud Computing*", Jones and Bartlett Learning, LLC
4. Michael Miller, "*Cloud Computing: Web-Based Applications that Change the Way You Work and Collaborate Online*", Que Publishing.
5. William von Hagen, Professional Xen Virtualization, Wrox Publications, January, 2008.

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	High performance computing - cluster, grid, meta-computing, middleware. Programming models: shared memory, message passing, peer-to-peer, broker-based. Introduction to PVM and MPI.	7	15
II	Cluster Computing – Cluster Computing at a Glance – Cluster Setup and its Administration – Cluster Architectures – Detecting and Masking Faults – Recovering from Faults.	6	15
FIRST INTERNAL EXAM			
III	Grid Computing – Fundamentals – Benefits of Grid Computing – Grid Terms and Concepts – Grid Security – Grid Architecture Models – Grid Topologies.	6	15
IV	Cloud Computing – Cloud Architecture – Cloud Storage – Cloud Services. Types of Cloud Service Development. Software as a Service – Platform as a Service – Infrastructure as a Service, Identity as a Service – Data Storage in the Cloud – Collaboration in the Cloud – Securing the Cloud – Service Oriented Architecture	7	15
SECOND INTERNAL EXAM			
V	Familiarization of EUCALYPTUS – an open source software framework for cloud computing. Familiarization of CloudSim: A Toolkit for Modeling and Simulation Cloud Computing Environments. Virtualization - Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization	7	20
VI	Virtual Machine Basics – Hypervisor - Server Consolidation. Virtual machines products-Xen Virtual machine monitors- Xen API – VMware – VMware product-Vmware Features – Microsoft Virtual Server – Features of Microsoft Virtual Server Software framework for distributed computing - MapReduce - Hadoop.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6251.3	IMAGE PROCESSING	3-0-0-3	2015

Course Objectives

- *To impart understanding of the methodologies in digital image processing.*
- *To get knowledge about the principles, techniques and algorithms for digital image processing*

Syllabus

Digital image representation; Fundamental steps in image processing; Elements of digital image processing systems; Sampling and quantization; Relationship between pixels; Image enhancement – Basic grey level transformations, Histogram equalization, Spatial filtering; Image transforms; Image enhancement in frequency domain; Image restoration; Point detection, line detection, and edge detection in images; Image segmentation; Image compression; Image reconstruction from projections.

Course Outcome

- Explain digital image processing systems.
- Discuss about Image transforms, restoration, segmentation and compression techniques

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

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	Introduction digital image representation: fundamental steps in image processing, elements of digital image processing systems, digital image fundamentals, simple image model, sampling and quantization.	6	15
II	Relationship between pixels , image geometry, Image enhancement - Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging – Spatial filtering – Smoothing and sharpening filters – Laplacian filters	7	15
FIRST INTERNAL EXAM			
III	Image transforms : Introduction to Fourier transform – discrete Fourier transform, properties of 2d-fourier transform (DFT), other separable image transforms, Hotelling transform	7	15
IV	Image enhancement in the frequency domain. Image restoration: degradation/restoration model, Noise models, inverse filtering, least mean square filtering.	7	15
SECOND INTERNAL EXAM			
V	Point detection, line detection and edge detection in images. Image segmentation. Image compression: image compression, elements of information theory, error-free Compression, lossy compression, image compression standards.	7	20
VI	Image reconstruction from projections: basics of projection, parallel beam and fan beam projection, method of generating projections, Fourier slice theorem, filtered back projection algorithms	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6251.4	ADVANCES IN COMPUTER NETWORKS	3-0-0: 3	2015

Course Objectives

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

Syllabus

Building a Network; Cost-Effective Resource sharing; Protocol layering; Bandwidth and Latency; Concurrent Logical Channels; Switching and Bridging; Virtual Circuit Switching; Virtual Networks and Tunnels; sub netting and classless addressing; Distance Vector(RIP), Link State(OSPF); Mobility and Mobile IP; End-to-End Protocols; Congestion Control and Resource Allocation

Course Outcome

The students should be able to:

- List and classify network services, protocols and architectures, explain why they are layered.
- Choose key Internet applications and their protocols, and apply to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.
- Explain develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery Etc.
- Explain various congestion control techniques.

References

1.Larry Peterson and Bruce S Davis "*Computer Networks :A System Approach*" 5th Edition , Elsevier -2014

2.Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI - 2014

3.Uyless Black "Computer Networks, Protocols , Standards and Interfaces" 2nd Edition – PHI

4.Behrouz A Forouzan "TCP/IP Protocol Suite" 4th Edition – Tata McGraw-Hill

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	**Foundation:** Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product,	7	15
II	**Internetworking** : Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork ?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless.	7	15
FIRST INTERNAL EXAM			
III	**Advanced networking** : addressing, Address Translation(ARP), Host Configuration(DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels Network as a Graph, Distance Vector(RIP), Link State(OSPF), Metrics.	6	15
IV	**End-to-End Protocols**: The Global Internet, Routing Areas, Routing among Autonomous systems(BGP), IP Version 6(IPv6), Mobility and Mobile IP Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination.	6	15
SECOND INTERNAL EXAM			
V	Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery.	7	20
VI	**Congestion Control and Resource Allocation:** Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System(DNS),Electronic Mail(SMTP,POP,IMAP,MIME),World Wide Web(HTTP),Network Management(SNMP) .	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6251.5	ADVANCED COMPUTER GRAPHICS	3-0-0: 3	2015

Course Objectives

- *To introduce geometric modelling and modelling transformations*
- *To learn different techniques for representing Solids*
- *To learn visible surface determination algorithms*
- *To learn concepts of global illumination modeling using advanced Ray tracing algorithms and Radiosity methods*

Syllabus

Geometric modelling - Modelling transformations, Hierarchical models, Interaction, Output features, Optimizing display of hierarchical models, SPHIGS; User interface software; Solid modelling – Regularized Boolean set of operations, Sweep representations, Boundary representations, Edge representations; Visible surface determination algorithms; Illumination and shading; Radiosity methods; Image manipulation and storage; Clipping polygons; Animation; Advanced raster graphics architecture; Multiprocessor rasterization architecture; Image parallel rasterization.

Course Outcome

- 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.

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
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, Interaction, Output features, Implementation issues, Optimizing display of hierarchical models, Limitations of SPHIGS.	7	15
II	User Interface Software: Basic interaction handling models, Window management systems, Output handling in window systems, Input handling in window systems, User Interface Management systems.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
FIRST INTERNAL EXAM			
III	Visible surface determination algorithms: Scan line algorithm, Area subdivision algorithm, visible surface ray tracing. Algorithm for Octree, algorithm for curved surface.	6	15
IV	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.	7	15
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. Animation: Conventional and computer assisted animation, Methods of controlling animation.	7	20
VI	Advanced Raster graphics architecture. Display processor system, Standard graphics pipeline, Multiprocessor Graphics System. Multi processorRasterization Architectures. Image parallel rasterization.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6261	RESEARCH METHODOLOGY	1-1-0: 2	2015

Course Objectives

- To formulate a viable research question
- To distinguish probabilistic from deterministic explanations
- To analyze the benefits and drawbacks of different methodologies
- To understand how to prepare and execute a feasible research project

Syllabus

Introduction to research methodology; Objectives and types of research; Research formulation; Selecting a problem; Literature review; Research design and methods; Development of models and research plan; Data collection and analysis; Data processing and analysis strategies; Report and thesis writing; Presentation; Application of results of research outcome; Commercialization of the work; Ethics; Trade related aspects of Intellectual property rights.

Course Outcome

- Students are exposed to the research concepts in terms of identifying the research problem, collecting relevant data pertaining to the problem, to carry out the research and writing

References

1. C.R Kothari, Research Methodology, Sultan Chand & Sons, New Delhi,1990.
2. Panneerselvam, “Research Methodology”, Prentice Hall of India, New Delhi, 2012.
3. J.W Bames,” Statistical Analysis for Engineers and Scientists”, McGraw Hill, New York.
4. Donald Cooper, “Business Research Methods”, Tata McGraw Hill, New Delhi.
5. Leedy P D, "Practical Research: Planning and Design", MacMillan 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 of India, New Delhi, 2012.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction to Research Methodology - Objectives and types of research: Motivation towards research - Research methods *vs.* Methodology. Type of research: Descriptive *vs.* Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, and Conceptual *vs.* Empirical.	6	15

II	Research Formulation - Defining and formulating the research problem -Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem. Literature review: Primary and secondary sources - reviews, treatise, monographs, patents. Web as a source: searching the web. Critical literature review - Identifying gap areas from literature review - Development of working hypothesis.	7	15
FIRST INTERNAL EXAM			
III	Research design and methods: Research design - Basic Principles- Need for research design — Features of a good design. Important concepts relating to research design: Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction. Development of Models and research plans: Exploration, Description, Diagnosis, Experimentation and sample designs.	7	15
IV	Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection - Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-Testing -Generalization and Interpretation.	6	15
SECOND INTERNAL EXAM			
V	Reporting and thesis writing - Structure and components of scientific reports -Types of report - Technical reports and thesis - Significance - Different steps in the preparation, Layout, structure and Language of typical reports, Illustrations and tables, Bibliography, referencing and footnotes. Presentation; Oral presentation - Planning - Preparation -Practice - Making presentation - Use of audio-visual aids - Importance of effective communication.	6	20
VI	Application of results of research outcome: Environmental impacts –Professional ethics – Ethical issues -ethical committees. Commercialization of the work - Copy right - royalty - Intellectual property rights and patent law - Trade Related aspects of Intellectual Property Rights - Reproduction of published material - Plagiarism - Citation and acknowledgement - Reproducibility and accountability.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6261	SEMINAR	0-0-1-0	2015

Course Objectives

- Review and increase their understanding of the specific topics tested
- Inculcating presentation and leadership skills among students
- Offering the presenter student an opportunity of interaction with peer students and staff

Syllabus

Each student is required to select a topic on advanced technologies in Computer Science and allied subject domains and get it approved by the faculty-in-charge of seminar. He/she should give a presentation with good quality slides. An abstract of the seminar should be submitted to the faculty members well in advance before the date of seminar. He/she should also prepare a well documented report on the seminar in approved format and submit to the department

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6271	ALGORITHM DESIGN LABORATORY	0-0-2-2	2015

Course Objectives

- To learn to implement iterative and recursive algorithms.
- To learn to design and implement algorithms using hill climbing and dynamic programming techniques.
- To learn to implement shared and concurrent objects.
- To learn to implement concurrent data structures.

Syllabus

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency.

Lab Exercises

- Implementation of graph search algorithms.
- Implementation and application of network flow and linear programming problems.
- Implementation of maximum bipartite matching.
- Implementation of Fibonacci heap algorithms.
- Implementation of verifying matrix multiplication algorithms.
- Implementation of *sweep- line - status* and *event-point-schedule.*
- Implementation of GCD algorithm.
- Implementation of NP-hard, NP complete.

SEMESTER 2

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6212	ADVANCED DATA MINING	4-0-0: 4	2015

Course Objectives

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

Syllabus

Data warehousing; OLAP operations; Data warehousing architecture; Data warehousing to data mining; Data mining tasks; Data mining issues; Data pre-processing; Concept hierarchy generation; Introduction to DMQL; Similarity measures; Classification algorithms; Clustering algorithms; Association rules; Web mining; Spatial mining; Temporal mining.

Course Outcome

Conceptual understanding of:

- Data cleaning, analysis and visualization
- Data mining techniques
- 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.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
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. Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective, Knowledge Discovery in Database Vs Data mining.	9	15
II	Data Preprocessing**:** Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization, Concept Hierarchy Generation, Introduction to DMQL.	8	15
	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	9	15
IV	Clustering algorithm – Hierarchical algorithm – Dendrograms- Single link algorithm, Partitional algorithm-Minimum spanning tree, squared error, K-means, PAM algorithm.	8	15
SECOND INTERNAL EXAM			
V	Association Rules : Apriori algorithm, Sampling algorithm, Partitioning algorithm, Parallel and distributed algorithms	8	20
VI	Web mining-web content mining, web structure mining, web usage mining, Spatial mining- spatial queries, spatial data structures, Generalization and specialization, spatial classification, spatial clustering, Introduction to temporal mining.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6222	INFORMATION RETRIEVAL	3-0-0-3	2015

Course Objectives

- To understand the principles and techniques of information retrieval

Syllabus

Goals and history of IR; Impact of web on IR; Role of Artificial Intelligence in IR; Basic IR models; Basic tokenizing indexing; Implementation of vector space retrieval; Experimental evaluation of IR; Query operations and languages; Metadata and markup languages; Web search engines; Text categorization and clustering; Clustering algorithms; Applications to information filtering, organization, and relevance feedback; Recommender systems; Information extraction and integration.

Course Outcome

- Students gain in-depth theoretical and practical knowledge of information retrieval techniques and ability to apply them in practical scenarios.

References

1. Manning, Raghavan, and Schutze, "*Introduction to Information Retrieval* ", Cambridge University Press, 2008.
2. R. Baeza-Yates, B. Ribeiro-Neto, "*Modern Information Retrieval: The Concepts and Technology behind Search*", Pearson Education India, 1/e, 2009.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction: Goals and history of IR. The impact of the web on IR. The role of artificial intelligence (AI) in IR. Basic IR Models: Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.	7	15
II	Basic Tokenizing Indexing, and Implementation of Vector-Space Retrieval: Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors; python implementation.	7	15
FIRST INTERNAL EXAM			
III	Experimental Evaluation of IR: Performance metrics: recall, precision, and F-measure; Evaluations on benchmark text collections. Query Operations and Languages: Relevance feedback; Query expansion; Query languages.	6	15

IV	Text Representation: Word statistics; Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. Metadata and markup languages (SGML, HTML, XML). Web Search, Search engines; spidering; metacrawlers; directed spidering; link analysis (e.g. hubs and authorities, Google PageRank); shopping agents.	7	15
SECOND INTERNAL EXAM			
V	Text Categorization and Clustering: Categorization algorithms: naive Bayes; decision trees; and nearest neighbor. Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).	6	20
VI	Applications to information filtering; organization; and relevance feedback. Recommender Systems: Collaborative filtering and content-based recommendation of documents and products. Information Extraction and Integration: Extracting data from text; XML; semantic web; collecting and integrating specialized information on the web.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6232	ADVANCED OPERATING SYSTEM DESIGN	3-0-0-3	2015

Course Objective

To understand the configuration and functions of a typical OS Kernel

Syllabus

Introduction to Linux kernel; Linux versus Unix kernels; Process management; Process scheduling – Linux's process scheduler, Scheduling algorithms; System call handling and implementation; Interrupts and interrupt handlers; Kernel synchronization; Kernel synchronization methods; Timers and time management; Memory management; Virtual file system; Block IO layer; Process address space; Devices and modules.

Course Outcome

- In-depth knowledge in Design and implementation of Kernel modules.

References:

1. Robert Love, "*Linux Kernel Development*", 3/e, Addison-Wesley, 2010.
2. Daniel Bovet, Marco Cesati, "*Understanding the Linux Kernel*", 3/e, OReilly Media Inc., 2005.
3. Reilly Christian Benvenuti, "*Understanding Linux Network Internals*", 1/e, OReilly Media Inc.,2005.
4. Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman, "*Linux Device Drivers*", 3/e, OReilly Media Inc., 2005.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Overview of basic concepts. Introduction to the Linux Kernel - History of Unix, Introduction to Linux, Overview of Operating Systems and Kernels, Linux Versus Classic Unix Kernels, Linux Kernel Versions.	6	15
II	Process Management - Process Descriptor and the Task Structure, Process Creation, The Linux Implementation of Threads, Process Termination. Process Scheduling - Linux's Process Scheduler, Policy, Linux Scheduling Algorithm, Preemption and Context Switching, Real-Time Scheduling Policies.System Calls - Communicating with the Kernel, Syscalls, System Call Handler, System Call Implementation.	7	15
FIRST INTERNAL EXAM			
III	Interrupts and Interrupt Handlers - Registering an Interrupt Handler, Writing an Interrupt Handler, Interrupt Context, Interrupt Control, Bottom Halves – Task Queues, Softirqs, Tasklets, Work Queues.	7	15

IV	Kernel Synchronization – Introduction, Critical Regions and Race Conditions, Locking, Deadlocks, Contention and Scalability. Kernel Synchronization Methods – Atomic Operations, Spin Locks, Semaphores, Mutexes, Completion Variables, BKL: The Big Kernel Lock, Sequential Locks, Preemption Disabling. Timers and Time Management - Kernel Notion of Time, Jiffies, Hardware Clocks and Timers, Using Timers, Delaying Execution.	7	15
SECOND INTERNAL EXAM			
V	Memory Management - Pages and Zones, Slab Layer, Static Allocation on the Stack, High Memory Mappings, Per-CPU Allocations. The Virtual Filesystem - Filesystem Abstraction Layer, Unix Filesystems, VFS Objects and Data Structures, Superblock Object, Inode Object, Dentry Object, File Object.	6	20
VI	The Block I/O Layer - Buffers and Buffer Heads, Request Queues, I/O Schedulers. Process Address Space - Address Spaces, Memory Descriptor, Virtual Memory Areas, Page Tables. Devices and Modules - Device Types, Modules, Device Model.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6242.1	COMPUTER VISION	3-0-0-3	2015

Course Objectives

- *To understand processing of digital images.*
- *To familiarize different mathematical structures*
- *To study detailed models of i mage formation*
- *To study image feature detection, matching, segmentation and recognition*
- *To understand classification and recognition of objects.*
- *To familiarize state-of-the-art problems in computer vision*

Syllabus

Image formation –feature detection and matching- singular value decomposition –Harr,Walsh and Hadamard transforms – Discrete Fourier Transform - Photometric image formation –Statistical description of images. Feature detection and matching - Segmentation – Mean shift and mode finding – K-means and mixture of Gaussians – Graph cuts and energy-based methods – feature based alignment. Image restoration – Inverse filtering – Classification – Minimum distance classifiers – Cross validation – SVM – Ensembles – Bagging and boosting. Recognition – Object classification and detection – Face recognition – Instance recognition – Category recognition– Human motion recognition. State-of-the-art and the future - Content based Search – Digital morphology. Computation Photography - Image & video annotation-image stitching

Course Outcome

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of imaging techniques; Apply the basic concepts of image processing methods such as filtering, edge detection segmentation and classification; Use the ability to understand various vision tasks; use ability to formulate and solve computer vision problems

References

1. *"Computer vision: Algorithms and Applications"* (1st Ed): Richard Szeliski , Springer (2010)
2. "*Algorithms for Image Processing and Computer Vision* " (2nd Ed): J. R. Parker, Wiley (2010)
3. "*Learning OpenCV: Computer Vision with the OpenCV Library* "(1st Ed): Gary Bradski, O'Reilly (2008)
4. " *Image Processing: The Fundamentals* "(2 edition): Maria Petrou and Costas Petrou, Wiley (2010)
5. "*Mathematical Elements of Computer Graphics"* (1st Ed): David F. Rogers and J. Alan Adams, McGraw Hill (1989)

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	Image formation –Geometric primitives and transformations -Photometric image formation --feature detection and matching-Points and patches - Edges - Lines -singular value decomposition –Harr,Walsh and Hadamard transforms – Discrete Fourier Transform - Photometric image formation –Statistical description of images.	8	15
II	Feature detection and matching - Segmentation –Active contours - Split and merge - Mean shift and mode finding -Normalized cuts - Graph cuts and energy-based methods -	7	15
	Mean shift and mode finding – K-means and mixture of Gaussians – Graph cuts and energy-based methods – feature based alignment-2D and 3D feature-based alignment -Pose estimation Geometric intrinsic calibration		
FIRST INTERNAL EXAM			
III	Image restoration – Inverse filtering methods– Classification – Minimum distance classifiers – Cross validation – SVM – Ensembles – Bagging and boosting concepts	7	15
IV	Recognition – Object classification and detection – Face recognition – Instance recognition – Category recognition– Human motion recognition-Context and scene understanding - Recognition databases and test sets	8	15
SECOND INTERNAL EXAM			
V	State-of-the-art and the future - Content based Search – Digital morphology-Concepts-Methods.	6	20
VI	Computation Photography -Photometric calibration -High dynamic range imaging - Super-resolution and blur removal - Image matting and compositing - Texture analysis and synthesis- Image & video annotation-image stitching-Motion models - Global alignment - Compositing	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6242.2	WIRELESS COMMUNICATIONS AND NETWORKING	3-0-0-3	2015

Course Objectives

- *Comprehend and demonstrate command in the principles of wireless networking. Describe the networking technologies including Cellular networks, WLANs and WWANs.*
- *Understand the functions of TCP/IP and the organization of the Internet. Design and evaluate a wireless network in terms of cost, performance, privacy and security.*
- *Plan and design a small and practical network for home or small business applications under a specified set of constraints*
- *To understand new trends and emerging technologies*

Syllabus

Overview of wireless systems , Radio propagation ,Digital communication over radio channels – Modeling of a Wireless Channel - Capacity of wireless channels . Cellular , Cell splitting, Narrowband and Wideband systems. Random access and Wireless LANs Association in WLANs Wide-Area Wireless Networks - Wireless MANs and PANs . GSM evolution for data – UMTS architecture –HSDPA – FOMA . CDMA evolution Design of a wireless network , Link budget for GSM and CDMA. HSPA+, WiMAX and LTE– SCTP IEEE 802.21handoff management.

Course Outcome

Students gain in-depth theoretical knowledge of wireless networking technologies including Cellular networks and ability to apply them in practical scenarios.

References

1."*Wireless Communications & Networking"* (1st Ed): Vijay K Garg, Morgan Kaufmann (2007)

2. "*Wireless Networks"*: Anurag Kumar, D. Manjunath, Joy Kuri, (1st Ed.), Morgan Kaufman (2008)

3. "*An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications* "(2nd Ed): Christopher Cox, Wiley (2012)

4. Web Resources: ieee.org

COURSE PLAN			
Module	**Contents**	**Contact Hours**	**Sem.Exam Marks ;%**
I	Overview of wireless systems – teletraffic engineering – Radio propagation – Pathloss models – Digital communication over radio channels – Modeling of a Wireless Channel - Capacity of wireless channels – AWGN channel -Fading channels	6	15
II	Cellular concepts – Frequency reuse – Cell splitting - Multiple access and interfernce management- Narrowband and Wideband systems- GSM, CDMA and OFDM - Channel reuse analysis- spread spectrum and CDMA systems.	7	15
FIRST INTERNAL EXAM			
III	Random access and Wireless LANs – Data and voice sessions over 802.11 – Association in WLANs Wide-Area Wireless Networks - Wireless MANs (IEEE802.16) and PANs (IEEE802.15.1,IEEE802.15.4).	7	15
IV	GSM evolution for data – UMTS architecture – QoS in UMTS – HSDPA – FOMA	7	15
SECOND INTERNAL EXAM			
V	CDMA evolution Design of a wireless network – radio design for a cellular network – Link budget for GSM and CDMA	6	20
VI	Beyond 3G – HSPA+, WiMAX and LTE – Cognitive radio networks – SCTP IEEE 802.21handoff management.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6242.3	Advanced Topics in Distributed Systems	3-0-0-3	2015

Course Objectives

To impart deeper understanding in:

- Architecture and issues of distributed systems
- Distributed algorithms
- Hadoop system

Syllabus

Distributed system definition; Types of distributed systems; System architecture; Communication; Naming; Consistency and replication; Distributed object based systems; Distributed algorithms; Hadoop; Scaling out; Hadoop distributed file system; Administering Hadoop.

Course Outcome

- The student gains insight into conceptual and practical aspects of distributed 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.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Definition of Distributed System, Goals, Types of Distributed Systems, System Architecture : Centralized, Decentralized & Hybrid Architecture. Processes: Threads, Virtualization, Clients, Servers, Code migration. Communication: Message Oriented, Stream Oriented and Multicast Communication. Naming**:** Names, Identifiers and Addresses, Flat Naming, Structured Naming and Attribute Based Naming. Consistency and Replication: Reasons for Replication, Data Centric and Client Centric Consistency Models, Replica Management, Consistency Protocols.	7	15

II	Distributed Object Based Systems: Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication, Fault Tolerance, Security.	6	15
FIRST INTERNAL EXAM			
III	Distributed Algorithms**:** Models of Distributed Computation, Preliminaries, Causality, Distributed Snapshots, Modeling a Distributed Computation, Failures in a Distributed System.	6	15
IV	Algorithms in General Synchronous Networks: Leader Election, Breadth First Search, Minimum Spanning Tree, Shortest Path, Maximal Independent Set.	7	15
SECOND INTERNAL EXAM			
V	Hadoop: Introduction, Comparison with Other Systems. Analyzing Data with Hadoop- Map and Reduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed Map Reduce Job. Map Reduce Types and Formats, Features.	7	20
VI	Hadoop Distributed File System: Concepts and Basic Operations. Administering Hadoop.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6242.4	PARALLEL ALGORITHMS	3-0-0-3	2015

Course Objectives

To Understand the principles and applications of parallel algorithms

Syllabus

Parallel computer; Analyzing algorithms; Searching a sorted sequence; Searching a random sequence; Sorting; Matrix transposition; Matrix operations; Linear array multiplication; Tree multiplication; Solving numerical problems; Solving systems of linear equations SIMD and MIMD algorithms; Numerical problems; Graph theoretical problems; Minimal Alpha Beta tree; MIMD Alpha Beta tree algorithms.

Course Outcome

- 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. V. Kumar, A. Grama, A. Gupta, and G. Karypis, "*Introduction to Parallel Computing*", San Francisco: Benjamin Cummings / Addison Wesley, 2002.
6. B. Wilkinson, M. Allen, "*Parallel Programming*", 2/e, Pearson Education Inc, 2007.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Parallel computer. Need of parallel computers, models of computation, Analyzing algorithms, expressing algorithms. Broadcast, All sums and selection algorithms on SIMD.	9	15
II	Searching a sorted sequence – EREW, CREW SMSIMD algorithms. Searching a random sequence – SMSIMD, tree and Mesh interconnection super computers. 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.	9	15
FIRST INTERNAL EXAM			
III	Matrix Transposition, Mesh transpose, shuffle transpose, EREW transpose. Matrix operations – matrix-by-matrix multiplications, mesh multiplications, cube multiplication, Matrix by vector multiplication.	8	15

IV	Linear array multiplication, tree multiplications. Solving numerical problems, solving systems of linear equations SIMD algorithms and MIMD algorithms.	8	15
SECOND INTERNAL EXAM			
V	Numerical problems – finding roots of nonlinear equations – SIMD and MIMD algorithms, solving partial differential equations, computing eigen values.	8	20
VI	Graph theoretical problems – solving graph theoretical problems, computing connectivity matrix, finding connected components, all pairs shortest path, traversing combinatorial spaces, sequential tree traversals, Minimal Alpha-Beta tree , MIMD Alpha-Beta algorithms, parallel cutoff storage requirements, recent trends and developments.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6242.5	SOFT COMPUTING PARALLEL ALGORITHMS	3-0-0-3	2015

Course Objectives

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

Syllabus

Artificial neural network based concept of soft computing; Architectures; Different learning methods; Models of neural network; Fuzzy sets and logic; Fuzzy versus crisp; Fuzzy relations; Crisp logic; Predicate logic; Genetic algorithm based concept; Travelling salesman problem; Graph coloring problem; Hybrid systems; Neuro fuzzy systems.

Course Outcome

- Understand advantages and disadvantages of soft computing.
- Students will be 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. Simon Haykin, "*Neural Networks- A Comprehensive Foundation*", 2/e, Pearson Education.
3. T.S. Rajasekaran, G.A. Vijaylakshmi Pai, "*Neural Networks, Fuzzy Logic & Genetic Algorithms – Synthesis and Applications*", Prentice-Hall India
4. Sanchez, Takanori, Zadeh, "*Genetic Algorithm and Fuzzy Logic System*", World Scientific
5. Goldberg David, "*Genetic Algorithms*", Pearson Education
6. Zimmermann H. J , "*Fuzzy Set Theory & Its Applications*", Allied Publishers Ltd.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Artificial Neural Network Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model, Properties of neural network, Typical architectures: single layer , multilayer, competitive layer	6	15
II	Different learning methods: Supervised, Unsupervised & reinforced; Common activation functions; Feed forward, Feedback & recurrent N.N; Application of N.N; Neuron.	6	15
FIRST INTERNAL EXAM			

III	Models Of Neural Network:Architecture, Algorithm & Application of – McCullo h-Pitts, Hebb Net, Perceptron (with limitations & Perceptron learning rule Convergence theorem), Back propagation NN, ADALINE, MADALINE, Discrete Hopfield net, BAM, Maxnet , Kohonen Self Organizing Maps, ART1,ART2.	7	15
IV	Fuzzy Sets & Logic : Fuzzy versus Crisp; Fuzzy sets—membership function, linguistic variable, basic operators, properties; Fuzzy relations—Cartesian product, Operations on relations; Crisp logic—Laws of propositional logic, Inference; Predicate logic— Interpretations, Inference; Fuzzy logic—Quantifiers, Inference; Fuzzy Rule based system; Defuzzification methods; FAM	7	15
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; Genetic Programming; Schema theorem; Multiobjective & Multimodal optimization in GA; Applications: Travelling Salesman Problem, Graph Coloring problem.	7	20
VI	Hybrid Systems : GA based BPNN(Weight determination, Application); Neuro Fuzzy Systems—Fuzzy BPNN--fuzzy Neuron, architecture, learning, application; Fuzzy Logic controlled G.A.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6252.1	ADVANCED GRAPH THEORY	3-0-0-3	2015

Course Objectives

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

Syllabus

Graphs – Paths and connectedness, Cutnodes and blocks, Graph classes and graph operations; Connectivity and edge connectivity; Hamiltonicity; Centers; Extremal distance problems; Distance sequences; Matrices; Convexity; Symmetry; Digraphs; Graph algorithms; Networks.

Course Outcome

- 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.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	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	6	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	7	15
	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.	7	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	7	15
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 - Centers - Maximum Matchings - Two NP-Complete Problems.	7	20
VI	Networks: The Max- Flow Min-Cut Theorem - Minimum Spanning Trees - Traveling Salesman Problem - Shortest Paths - Centers - Critical Path Method.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6252.2	COMPUTATIONAL LINGUISTICS	3-0-0-3	2015

Course Objectives

To give Students:-

- *The fundamentals of Language processing from computational Viewpoint.*
- *Ability to conceptualize problems from the perspective of computational linguistics.*
- *The way of finding solutions for real world problems like spell-checking, Parts-of Speech Tagging, Corpus development, document retrieval etc.*

Syllabus

Introduction to computational linguistics; Regular Expressions and automata; Morphology and Finite-state transducers; Probabilistic models of pronunciation and spelling; N-grams; HMMs and speech recognition; Word classes and part-of-speech tagging; Parsing with context free grammars; Lexicalized and probabilistic parsing; Representing meaning; Lexical semantics; Word sense disambiguation; Natural language generation; Machine Translation.

Course Outcome

Students who successfully complete this course will be able to understand the core theoretical aspects of computational linguistics and use them to strengthen the formal base of any applications that involve the processing of human language.

References

1. Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Jurafsky, D. and J. H. Martin, Prentice-Hall, 2012.
2. Lexical-Functional Syntax. Bresnan, Joan. 2001. Oxford: Blackwell Publishers
3. Foundations of Statistical Natural Language Processing: C.D. Manning and H. Schubert: MIT Press, 2003
4. Natural Language Understanding (2ndEd): James Allen, The Benjamin/Cummings Publishing Company Inc.(2008).

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Regular Expressions- Finite state automata- applications in linguistics- Words, Noun phrases, verb phrases, Adjective phrases, Adverbial phrases, Finite state morphological Parsing-combining FST Lexicon and rules.	6	15
II	Probabilistic Models of Pronunciation and Spelling- Spelling Error patterns-Probabilistic Models, Applying Bayesian method to Spelling- Minimum Edit Distance- Weighted Automata, N-grams- Smoothing- Backoff, Entropy.	6	15

FIRST INTERNAL EXAM			
III	HMM and Speech Recognition- Speech Recognition Architecture, HMM, Advanced Methods for Decoding, Word Classes and Part-of-Speech Tagging – Rule based part of speech Tagging, Stochastic part of speech tagging, Transformation based Tagging, Context-Free Rules for English.	8	15
IV	Parsing with Context-Free Grammars- Top-Down Parsing, Bottom-up Parsing, Problems with Basic Top-Down Parser-The Early algorithm, finite state parsing methods, Probabilistic Context-Free Grammars- Problems with PCFGs-Probabilistic Lexicalized CFGs.	7	15
SECOND INTERNAL EXAM			
V	Representing Meaning-Computational Desiderata for representations, Meaning Structure of Language, First order predicate calculus, Lexical Semantics- Relations among Lexemes and their senses- WordNet- Word Sense Disambiguation- Selectional Restriction-based Disambiguation- Robust Word Sense Disambiguation	8	20
VI	Natural Language Generation-Introduction, Architecture for Generation, Surface Realization, Machine Translation-Language Similarities and Differences-The Transfer Metaphor -The Interlingua Idea: Using Meaning -Direct Translation- Using Statistical Techniques	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6252.3	NETWORK SECURITY	3-0-0-3	2015

Course Objectives

- *To impart understanding of various hardware and software aspects of security in networks.*

Syllabus

Security trends, security attacks and security mechanisms; Network security model; Review of intrusion detection systems; Review of cryptographic algorithms and protocols; Kerberos v4; Kerberos v5; PKI; Real time communication security; IPSec; Email security; PEM & S/ MIME; PGP; Web security; SSL/ TLS; Secure electronic transaction; Network management security; Wireless security; Firewalls.

Course Outcome

The student gains knowledge in problems and approaches related to secure network management.

References

1. C. Kaufman, R. Perlman and M. Speciner, "*Network Security: Private communication in a public World*", 2/e, PHI, 2002.
2. W. Stallings, "*Cryptography and Network Security Principles and practice*", 3/e, Pearson Education Asia, 2003.
3. William Stallings, "*Network Security Essentials*", 2e, Prentice Hall, 2003.
4. Schiller J., "*Mobile Communications*", Pearson Education Asia,2/e, 2009.
5. Roberta Bragg et. al., "*Network Security: The Complete Reference*", TMH, 2008.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction: Security trends, security attacks, security mechanisms, Network Security model, Review of intrusion detection systems. Review of cryptographic algorithms and protocols: cryptanalysis, Message authentication, secure hash functions, Digital signatures.	6	15
II	Standards: Kerberos v4 – configuration, authentication, encryption, message formats. Kerberos v5 – cryptographic algorithms, message formats. PKI – trust models, revocation. Real-time communication security, IPSec overview, AH, ESP, IKE – phases.	7	15
	FIRST INTERNAL EXAM		
III	Email security, Security services for Email, establishing keys, privacy, authentication, message integrity. PEM & S/MIME – structure of messages, encryption, source authentication and integrity protection, message formats. PGP encoding, anomalies, object formats.	7	15

IV	Web security: Web security considerations, SSL/TLS – attacks, exportability, encoding. Secure electronic transaction.	6	15
SECOND INTERNAL EXAM			
V	Network management security: SNMP, Basic concepts of SNMPv1, SNMPv3. Wireless security: Wireless LAN Specifications, Wireless network security stack, WEP.	7	20
VI	Firewalls: Firewall design principles, trusted systems, packet filters, application level gateways, encrypted tunnels.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6252.4	ADVANCED COMPILER DESIGN	3-0-0-3	2015

Course Objectives

- *To understand various compiler optimization techniques.*
- *To understand back end design of compilers.*

Syllabus

Introduction to advanced topics; Review of compiler phases; Intermediate representations; Control flow analysis; Data flow analysis; Review of optimizations; Redundancy elimination; Value numbering; Loop optimization; Procedure optimization; Machine dependent tasks; Local and global instruction scheduling; Code scheduling; Low level optimizations; Inter procedural analysis and scheduling; Machine code generation.

Course Outcome

- Conceptual understanding of theory behind compiler design.
- 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. Keith D. Cooper, Linda Torczon, "Engineering a Compiler", 2/e, Morgan Kauffmann, 2011.
4. Andrew W. Appel, "*Modern Compiler Implementation in Java*", Cambridge University Press, 2009.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction to Advanced Topics Review of compiler phases, Informal Compiler Algorithm Notation, Symbol Table Structure – local and global symbol tables, Intermediate Representations – HIR, MIR and LIR. Run Time Issues.	7	15
II	Control Flow Analysis – basic blocks, DFS, dominators and post dominators, loops, dominator tree, dominance frontier.	6	15
	FIRST INTERNAL EXAM		
III	Data Flow Analysis – reaching definitions, available expressions, live variable information. Dependency analysis, Alias analysis.	6	15

IV	Review of Optimizations – constant folding, constant and copy propagation, dead code elimination. Redundancy Elimination – common sub expression elimination, loop invariant code motion, partial redundancy elimination. Value numbering. Loop Optimizations – induction variable elimination. Procedure Optimization, Static Single Assignment (SSA) form.	7	15
SECOND INTERNAL EXAM			
V	Machine Dependent tasks: Register Allocation - graph coloring, coalescing.	7	20
VI	Local and Global Instruction Scheduling, Advanced Topics in Code Scheduling, Low Level Optimizations, Introduction to inter-procedural analysis and scheduling, Machine code generation. .	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6252.5	DECISION SUPPORT SYSTEMS	3-0-0-3	2015

Course Objectives

- To understand the theory and applications of various types of DSS

Syllabus

Concepts of data, information, information systems, and end users; Systems concepts; Building information system; Systems development cycle; Prototyping evolution of information systems; Decision making; Making decisions in groups; Knowledge management systems; Knowledge representation techniques; Business Intelligence; Data warehousing concepts; Data mining concepts; Business Analytics.

Course Outcome

- 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.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction to 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 Decision Making, From GDSS to GSS	7	15
IV	Knowledge Management System: Definition and types of Knowledge, Frame work for Knowledge Management Knowledge Representation Techniques: Rules, Frames, Semantic Networks.	6	15
SECOND INTERNAL EXAM			
V	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	20
VI	Data Warehousing Definitions and Concepts, Types of Data warehouse. Business Analytics - Online Analytical Processing (OLAP), Reporting and Queries, Multidimensionality Knowledge Discovery in Databases (KDD), framework of KDD.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 6272	ADVANCED DBMS LABORATORY	0-0-2: 2	2015

Course Objectives

- To learn the implementation of query optimizer
- To learn the implementation of parallel databases
- To learn the implementation of active databases
- To learn the implementation of deductive databases
- To learn the implementation of object oriented databases

Syllabus

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. It is recommended that all implementations are carried out in Oracle.

Course Outcome

LAB EXERCISES

- Implementation of an efficient query optimizer
- Implement deadlock detection algorithm using wait for graph
- Implement object oriented database – Extended entity relationship (EER)
- Implementation of parallel join and parallel sort
- Implementation of triggers and assertions for bank database
- Design XML schema for company database

SEMESTER 3

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7213.1	CLOUD COMPUTING	3-0-0;3	2015

Course Objectives

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

Syllabus

Cloud computing; Cloud architecture; Cloud storage; Advantages and disadvantages of cloud computing; Cloud service development; Centralizing email communications; Cloud computing for the corporation; Schedules and task management; Collaborating on event management, project management, and contact management; Collaborating on databases; Collaborating on web-based communication tools; Evaluation of web conference tools; Collaborating via blogs and wikis.

Course Outcome

- Design and develop cloud services for everyone.
- 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.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
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	6	15
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 – Discovering Cloud Services Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds.	7	15
FIRST INTERNAL EXAM			

III	Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation.	7	15
IV	Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management	6	15
SECOND INTERNAL EXAM			
V	Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files.	7	20
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.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7213.2	MACHINE LEARNING	3-0-0;3	2015

Course Objectives

- *To impart a deeper understanding of machine language techniques, tools and applications.*

Syllabus

Introduction to learning; Types of learning; Why machine learning; Types of problems in machine learning; Machine learning as a classifier; Machine learning applications; Neural networks; Artificial Neural Networks; Association learning; Statistical learning; Hidden Markov Models; Decision trees; Bayesian networks; Supervised learning; Support vector machines; Case Base Reasoning; Fuzzy network; Unsupervised network; Clustering; Markov decision problem; Q-learning algorithms; On-Policy and Off-Policy learning; Learning automata.

Course Outcome

- Students gain understanding of conceptual and practical aspects of machine learning and ability to apply the techniques in real-world scenarios.

References

1. Anderson J.A., "*An Introduction to Neural Networks*", Prentice Hall India, 1999.
2. Hertz J. Krogh, R.G. Palmer, "*Introduction to the Theory of Neural Computation*", AddisonWesley,, 1991.
3. Stephen Marsland Machine Learning: *An Algorithmic Perspective, CRC Press*, 2009
4. Vojislav Kecman, "*Learning and Soft Computing",* 1/e, Peason Education, 2004.
5. Stuart Russell and Peter Norvig "*Artificial Intelligence: A Modern Approach*, 3/e, Peason Education., 2011.
6. Shakhnarovish, Darrell, and Indyk,, "*Nearest-Neighbor Methods in Learning and Vision*". *MIT Press*, 2005.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction to learning. Types of Learning, Rote learning, Learning by parameter adjustment, Learning by general problem solving, Concept learning, Learning by analogy. Introduction to machine learning, Why machine learning. Types of problems in machine learning, History of machine learning, Aspects of inputs to training, Learning systems, Machine learning as a classifier, Intelligent agents, Machine learning applications.	7	15
II	Evaluation of machine learning algorithms. Neural Networks. Artificial Neural Nets, ANN Basics, ANN - Learning Process , Types of Networks, Perceptron, Multilayer Perceptron, Error back Propagation Algorithm, RBF Networks.	6	15
FIRST INTERNAL EXAM			

III	Association Learning, Basics of Association , Apriori Algorithm , Eclat Algorithm , FP Growth Algorithm, Tertius Algorithm. Statistical Learning, Stochastic Processes, Markov Process, Hidden Markov Models, Three Basic Problems for HMMs, Forward – Backward Procedure , Viterbi Algorithm, Baum-Welch Algorithm	6	15
IV	Linear Classifiers , Quadratic Classifiers, Decision Trees, C 4.5 Algorithm, ID3 Algorithm, Random Forest, Bayesian Networks, Bayesian Networks Learning, Limitation of Bayesian Networks, Expectation Maximization (EM), EM Algorithm, Self Organising Maps, Learning Process of SOM, Adaptive Resonance Theory, Important ART Networks, ART Architecture, ART Algorithms	7	15
SECOND INTERNAL EXAM			
V	Supervised Learning, Support Vector Machines, Inductive Logic Programming, Generic ILP Algorithm, Principal Approaches to ILP, Characteristics of ILP System, Case Base Reasoning, How CBR Works?, Case Representation, CBR Issues, Ensemble Classifiers, AdaBoost algorithm, Bayes Optimal Classifier , Nearest Neighborhood techniques, Fuzzy Network, Fuzzy Systems, Info Fuzzy Networks, Fuzzy Neural Systems. Unsupervised learning.	7	20
VI	Clustering, K-Means Clustering , Fuzzy Clustering, Hierarchical Clustering ,Agglomerative and Divisive Clustering, Hierarchical Agglomerative Clustering, Cluster Similarity, Reinforcement Learning, Markov Decision Problem, Q-learning, Q-Learning Algorithms, Temporal Difference Learning, On-Policy and Off-Policy Learning, Advantages of TD Prediction Methods, Learning Automata.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7213.3	ADVANCED NUMERICAL TECHNIQUES	3-0-0;3	2015

Course Objectives

- *To impart a deeper understanding of various advanced numerical techniques.*

Syllabus

Linear Algebra, Approximation of functions, Nonlinear system of differential equations, Boundary Value Problems, and Partial Differential Equations.

Course Outcome

- Students are able to use the concepts of linear algebra, approximation of functions and partial differential equations in solving real life problems.

References

1. Gene H. Golub and James M. Ortega.. "*Scientific Computing and Differential Equations*", Academic Press NewYork.
2. M. K. Jain.."*Numerical Solution of Differential Equations",* John Wiley & Son.
3. M. G. Ancona .."*Computational Methods for Applied Science and Engineering*". Rinton Press..
4. Kendall E. Atkinson, " *An Introduction to Numerical Analysis*", John Wiley & Son.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Linear Algebra: Matrices: Matrix norm. Spectral decomposition, Singular value decomposition, convergence and perturbation theorem .	7	15
II	Matrix eigen-value problem, Gerschgorin's theorem, Perron's theorem, Collatz theorem, Eigen-value by iteration, Tridiagonalization, Q-R Factorization, Generalized inverse of matrices.	7	15
	FIRST INTERNAL EXAM		
III	Approximation of functions: General function spaces, Least square approximation, Minimax approximation, orthogonal polynomials, approximation with rational functions, Pade's approximation.	7	15
IV	Differential equations: Nonlinear system of differential equations- method of successive approximations, Use of Pade's approximation	7	15
	SECOND INTERNAL EXAM		

V	Boundary Value Problems: Method of undetermined coefficients, Difference scheme based on quadrature formulas, solution of tridiagonal system, moving boundary conditions, boundary conditions at infinity, Non-linear boundary value problems, convergence of difference schemes, linear eigen value problems.	6	20
VI	Partial Differential Equations: Parabolic, Elliptic and Hyperbolic differential equations subject to Dirichlet's, Neumann (or flux) and mixed (or Robin or Radiation) conditions, Stefan problem .	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7213.4	AD HOC AND SENSOR NETWORKS	3-0-0;3	2015

Course Objectives

- *The primary objective of this course is to introduce to the area of wireless sensor networks and learn the concepts and principles behind WSN.*
- *To learn WSN network design, sensor node embedded system design and implementation.*
- *On WSN network management, the focus is mainly on wireless network security which is a very important issue in WSN.*

Syllabus

Fundamentals of wireless communication technology; Introduction to ad hoc/ sensor networks; Advantages of ad hoc/ sensor networks; Issues in ad hoc wireless networks; Issues in the design of sensor networks; Sensor network architecture; MAC protocols; Routing Protocols; QoS and energy management

Course Outcome

- After passing the course, a student comprehends the Wireless Sensor Networks (WSN) as a new technology area in research and industry.
- A student is familiar with the main standards and specifications of WSNs and identifies the key building blocks for them.
- A student can define and explain the essential challenges of resource constrained WSN design and implementation, including applications, interfaces, energy-efficient protocols and platform functionalities.
- A 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, Leonides Guibas, "*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.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction : Fundamentals of wireless communication technology, the electro magnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques,multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.	7	15
II	Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wirelesss networks, issues in design of sensor network, sensor network archeitecture, data dissemination and gathering.	7	15
FIRST INTERNAL EXAM			

III	MAC Protocols : Issues in desiging MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.	7	15
IV	Routing Protocols : Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.	7	15
SECOND INTERNAL EXAM			
V	QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions	6	20
VI	QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes. .	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7213.5	BIOINFORMATICS	3-0-0;3	2015

Course Objectives

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

Syllabus

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

Course Outcome

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

References

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

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction to molecular biology , Gene structure and information content, Molecular biology tools , Algorithms for sequence alignment, Sequence databases and tools.	7	15
II	Phylogenetic trees (6 hours), Molecular Phylogenetics, Phylogenetic trees, Algorithms for Phylogenetic tree construction.	7	15
	FIRST INTERNAL EXAM		
III	Randomized algorithms (6 hours), Introduction to Perl programming for Bioinformatics, Introduction to Protein structure, Algorithms for Protein structure prediction	7	15

IV	Micro Arrays Gene expression analysis, Micro Arrays, Pathway analysis,Pattern Matching algorithms	6	15
SECOND INTERNAL EXAM			
V	Bio-data analysis, Data Mining in Bioinformatics, Algorithms and data structures for efficient analysis of biological data.	6	20
VI	Drug Discovery – components, Perspectives, Numeric considerations, Algorithms, Heuristic methods, Systems Biology Tools	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7223.1	SOFTWARE QUALITY ASSURANCE AND TESTING	3-0-0;3	2015

Course Objectives

- *Understand the theoretical aspects of software testing*
- *Demonstrate the knowledge of the existing testing methods*
- *Demonstrate the knowledge of static and dynamic analysis methods*
- *Demonstrate the knowledge of applying testing and analysis methods in software development and maintenance*

Syllabus

Software quality assurance framework; Standards SQA framework; Components of software quality assurance; Software quality assurance plan; Quality standards; Software quality metrics; Software testing strategy; Environment establishing testing policy; Database; Exception; Gray box; Histograms; Inspections; JADs; Pareto analysis; Prototyping; Software testing tools; Taxonomy of testing tools; JAVA testing tools; JUNIT and Cactus.

Course Outcome

- Students get in-depth skill to quantitatively assess the quality of software; they also understand the fundamental principles and tools for software-testing and quality assurance.

References

1. William E. Perry, “Effective Methods for Software Testing”, 2/e, Wiley
2. Mordechai Ben Menachem, Garry S. Marliss, “Software Quality”, Thomson Learning

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Software Quality Assurance Framework and Standards SQA Framework: Software Quality Assurance, Components of Software Quality Assurance Software Quality Assurance Plan: Steps to develop and implement a Software Quality Assurance Plan a€“ Quality Standards: ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, Malcom Balridge, 3 Sigma, 6 Sigma	7	15
II	Software Quality Metrics: Product Quality metrics, In-process Quality Metrics, Metrics for Software Maintenance, Examples of Metric Programs Software Quality metrics methodology: establishing quality requirements, Identifying Software quality metrics, Implement the software quality metrics, analyze software metrics results, validate the software quality metrics Software quality indicators, Fundamentals in Measurement theory.	7	15
FIRST INTERNAL EXAM			

III	Software Testing Strategy and Environment Establishing testing policy, structured approach to testing, test factors, Economics of System Development Life Cycle (SDLC) Testing Software Testing Methodology Defects hard to find, verification and validation, functional and structural testing, workbench concept, eight considerations in developing testing methodologies, testing tactics checklist, Software Testing Techniques Black Box, Boundary value, Bottom up, Branch coverage, Cause Effect graphing, CRUD	7	15
IV	Database, Exception, Gray Box, Histograms, Inspections, JADs, Pareto Analysis, Prototyping, Random Testing, Risk based Testing, Regression Testing, Structured Walkthroughs, Thread Testing, Performance Testing, White Box Testing	6	15
SECOND INTERNAL EXAM			
V	Software Testing Tools Taxonomy of Testing tools, Methodology to evaluate automated testing tools, Load Runner, Win runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.	6	20
VI	Testing Process Eleven Step Testing Process: Assess Project Management Development Estimate and Status, Develop Test Plan, Requirements Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results, Acceptance Test, Report test results, testing software installation, Test software changes, Evaluate Test Effectiveness. Testing Specialized Systems and Applications Testing Client/Server Web applications, Testing off the Shelf Components, Testing Security, Testing a Data Warehouse	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7223.2	DATA COMPRESSION	3-0-0;3	2015

Course Objectives

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

Syllabus

Compression techniques; lossy and lossless compression; Huffman coding; Adaptive coding; Arithmetic coding; Dictionary based compression; Sliding window compression; LZ77, LZ78, LZW compression; Predictive coding; Speech compression and synthesis; Image compression; Image standards; Video compression; Comparison of compression algorithms; Implementation of compression algorithms.

Course Outcome

- Awareness about various data compression techniques and their practical significance.

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.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Compression techniques, Compression ratio, lossless & lossy compression, Huffman coding, Non binary Huffman Algorithms, Adaptive Coding, Applications, Arithmetic Coding, Applications, Finite Context Modeling.	7	15
II	Dictionary based Compression, Sliding Window Compression, LZ77, LZ78, LZW compression. Predictive Coding - prediction and partial match, move to front coding, Run Length encoding.	7	15
	FIRST INTERNAL EXAM		
III	Speech Compression & Synthesis: Digital Audio concepts, Sampling Variables, Lossless compression of sound, lossy compression & silence compression.	6	15
IV	Image Compression, Transform based techniques, Wavelet Methods, adaptive techniques. Images standards, JPEG Compression, Zig Zag Coding.	6	15
	SECOND INTERNAL EXAM		

V	Video Compression- motion compensation, MPEG standards, recent development in Multimedia Video compression, packet video, Fractal techniques.	7	20
VI	Comparison of compression algorithms, Implementation of compression algorithms.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7223.3	COMPUTATIONAL GEOMETRY	3-0-0;3	2015

Course Objectives

- *To fill the gap between geometric properties and algorithm design*
- *To familiarize data structures used for developing efficient algorithms*
- *To learn efficient techniques for solving geometric problems*

Syllabus

Geometric preliminaries; Data structures for geometric problems; Geometric searching; Plane sweep technique; Slab method; Monotone polygons; Kd-trees; Convex hulls; Triangulation; Post office problem; Voronoi diagrams; Introduction to visibility problems; Kernel of a simple polygon; Visibility graph; Shortest path for a point robot.

Course Outcome

- Awareness about various data compression techniques and their practical significance.
- Capable to develop efficient algorithms by exploiting geometric properties
- Capable in identifying properties of objects, expressing them as lemmas and theorems and proving their correctness.
- Capable in applying learned algorithm in diversified fields like data base Searching, data mining, graphics, image processing pattern recognition, 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

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Geometric Preliminaries, Data Structures for geometric problems : DCEL (Doubly Connected Edge List), Quad trees, Kd-trees and BSP (Binary Space Partition) trees. Geometric Searching - Planar Straight Line Graph (PSLG)	7	15
II	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.	7	15
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.	6	15
IV	Triangulation— Polygon Triangulation, *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	7	15
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	6	20
VI	Kernel of a simple polygon , Linear time algorithm for computing Kernel. Visibility graph, Shortest path for a point Robot	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7223.4	MEDICAL IMAGING	3-0-0;3	2015

Course Objectives

- *Identify and describe in qualitative terms the principles of x-ray generation, x-ray-tissue interaction, and x-ray imaging*
- *Describe the principles of Computed Tomography (CT) and the 2D/3D image reconstruction methods involved*
- *Describe in qualitative terms the principles of ultrasound, PET, SPECT and MRI imaging*
- *Identify and describe image contrast, image resolution, and signal-to noise ratio involved in biomedical imaging 5. Identify and describe the complementary nature of various imaging techniques*

Syllabus

X-ray imaging , computed tomography, ultrasonic imaging, Magnetic Resonance Imaging, Nuclear Medicine and Infrared Imaging –principles, image characteristics, image acquisition, clinical applications

Course Outcome

- Fundamental knowledge in different aspects and application areas of Medical Imaging modalities
- Capability to effectively and efficiently utilize the knowledge gained in one of the current research areas in biomedical imaging for the final thesis work.

References

1. *"Handbook of Medical Image Processing and Analysis"* (Second Edition), Issac N Bankman, 2008 Elsevier Inc
2. *"Medical Image analysis"*, second edition, Atam P Dhawan, IEEE Press, 2011
3. *"Physics of Medical Imaging"*, S Webb , Adam Highler, Bristol,
4. *"The Essential Physics of Medical Imaging"*, 3rd edition, Jerrold T. Bushberg, J. Anthony Seibert Lippincott Williams & Wilkins, 2011
5. *"Medical Imaging Signals and Systems"*, 2 edition , Jerry L. Prince, Jonathan, pearson education, 2015

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	General Principles of Imaging with X-Rays, X-Ray Production, Interactions of X-Rays with Tissue, Linear and Mass Attenuation Coefficients of X-Rays in Tissue, X-Ray Image Characteristics. X-Ray Imaging Methods. Clinical Applications of X-Ray Imaging.	6	15

II	Computed Tomography- Image Processing for Computed Tomography, Spiral/Helical Computed Tomography. Multislice Spiral Computed Tomography. Image Reconstruction- Backprojection and Filtered Backprojection. Clinical Applications of Computed Tomography.	7	15
FIRST INTERNAL EXAM			
III	General Principles of Ultrasonic Imaging-Wave Propagation and Characteristic Acoustic Impedance-Wave Reflection and Refraction-Instrumentation-Diagnostic Scanning Modes. Artifacts in Ultrasonic Imaging - Image Characteristics, Blood Velocity Measurements Using Ultrasound, Clinical Applications of Ultrasound.	7	15
IV	General Principles of Magnetic Resonance Imaging, Nuclear Magnetism, Gradient coils, RF pulses, Instrumentation, Imaging Sequences, Image Characteristics, Concepts in Magnetic Resonance Angiography, Diffusion Weighted Imaging and Functional MRI. Clinical Applications of MRI	8	15
SECOND INTERNAL EXAM			
V	General Principles of Nuclear Medicine, Radioactivity, The Production of Radionuclides, Types of Radioactive Decay, The Gamma Camera, Image Characteristics, Single Photon Emission Computed Tomography, Positron Emission Tomography, Clinical Applications of Nuclear Medicine.	6	20
VI	Infra red Imaging-Physics of thermography-Imaging systems-Pyroelectric vidicon camera, clinical themography-liquid crystal thermography..	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02 CS 7223.5	BIG DATA ANALYTICS	3-0-0;3	2015

Course Objectives

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

Syllabus

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

Course Outcome

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

References

1.David Dietrich, Barry Heller, Biebie Yang, "*Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data"*, EMC Education Services, John Wiley &Sons, Inc

2.Frank J Ohlhorst," *Big Data Analytics: Turning Big Data into Big Money"*, Wiley and SAS Business Series, 2012.

3.Colleen Mccue, "*Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis"*, Elsevier, 2007

4.Anand Rajaraman and Jeffrey David Ullman, "*Mining of Massive Datasets*, Cambridge University" Press, 2012.

5.Bill Franks, "*Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics"*, Wiley and SAS Business Series, 2012.

6.Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, "*Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data"*, McGraw Hill, 2011.

7.Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan, "*Harness the Power of Big data – The big data platform"*, McGraw Hill, 2012.

8.Pete Warden, "*Big Data Glossary"*, O'Reilly, 2011.

9.M Sudheep Elayidom, "*Datamining and Warehousing"*, 1st Edition, Cengage Learning India Pvt Ltd

10.Jiawei Han, Micheline Kamber "*Data Mining Concepts and Techniques"*, Second Edition, Elsevier, Reprinted 2008.

COURSE PLAN

Module	Contents	Contact Hours	Sem.Exam Marks ;%

I	Introduction To Big Data: Nuances of big data – Value – Big data characteristics - Volume, Veracity, Velocity, Variety. Features of Big Data - Security, Compliance, auditing and protection – Evolution of Big data Analyst Perspective on Data Repositories , State of the Practice in Analytics, BI Versus Data Science, Current Analytical Architecture, Drivers of Big Data, Keyroles for new big data ecosystem, Examples .	7	15
II	Big Data Analytics : Data Analytics Lifecycle Overview-Phases: Discovery ,data Preparation, Model planning, model building, communicate results, operationalize .Case Study: Global Innovation Network and Analysis (GINA)	7	15
FIRST INTERNAL EXAM			
III	Review of basic data analytic methods using R : Introduction to R, R graphical user interface-data import and export-attribute and data type. Exploratory data analysis-Visualization, Dirty data, single and multiple variables, data exploration vs presentation. Statistical methods for evaluation-Hypothesis testing, difference of means Wilcoxon rank sum test, type I and II errors, power and sample size, ANNOVA	7	15
IV	Advanced analytical theory and methods: Time Series Analysis- Overview of Time Series Analysis, Box-Jenkins Methodology ARIMA Model, Autocorrelation Function (ACF), Autoregressive Models, Moving Average Models, ARMA and ARIMA Models Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions.	6	15
SECOND INTERNAL EXAM			
V	Text Analysis : Text Analysis Steps, A Text Analysis Example, Collecting Raw Text, Representing Text , Term Frequency Inverse Document Frequency (TFIDF) Categorizing Documents by Topics, Determining Sentiments, Gaining Insights.	7	20
VI	Advanced Analytics-technology and tools: MapReduce and Hadoop, Analytics for Unstructured Data , MapReduce Framework ,Apache Hadoop,The Hadoop Ecosystem, Pig , Hive , HBase, Mahout , NoSQL.	8	20
END SEMESTER EXAM			

Course No: 02CS 7233
Course Title: Seminar
Credits: 0-0-2: 2
Year: 2015

Each student is required to select a topic on advanced technologies in Computer Science and allied subject domains and get it approved by the faculty-in-charge of seminar. He/she should give a presentation with good quality slides. An abstract of the seminar should be submitted to the faculty members well in advance before the date of seminar. He/she should also prepare a well documented report on the seminar in approved format and submit to the department

SEMESTER 4 (Credits 12)

Exam Slot	Course code	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
	02CS7214	Project(Phase-2)	0-0-21	70	30	0	12