Department of Computer Science
University *of* Kerala

M.Sc Programme in Computer Science

(Under Credit and Semester System w.e.f 2016 Admission)

Syllabus

AIM

This programme aims to strengthen the students' knowledge and deepen their understanding of key issues of specific application domains and areas in computer science and thereby enable them to effectively and systematically strengthen and upgrade their technical capabilities in meeting increasing demands in computer software systems and research & development.

OBJECTIVES

1. To allow graduates to increase their knowledge and understanding of computers and their systems, to prepare them for advanced positions in the workforce.
2. To expose graduates to cutting edge developments in computing technology and contemporary research.
3. To encourage graduates to take up advanced innovative development work in the industry as well as to pursue higher research degree qualifications.
4. To make the graduates responsible, socially committed ,communicative citizens
5. To provide graduates with great flexibility through extensive choices of electives to respond to rapidly changing industry needs as well as their interests
6. To give graduates an introduction to industrial-style methods of analysis, design, implementation, testing and documentation in software development;
7. To produce a new breed of computer science graduates that have a broad background in information technology along with project management and people skills
8. To mould Graduates with strong technical expertise, and ability to work effectively in interdisciplinary teams and be able to tackle problems that require both technical and non-technical solutions.

Structure of the Programme

Semester	Course No	Course Title	Credit
I	COS-C-411	Mathematical Foundations of Computer Science	3
	COS-C-412	Advanced Operating Systems	3
	COS-C-413	Data Structure and Algorithms Using Python	3
	COS-C-414	Computer Networks and Information Security	3
	COS-C-415	Lab-I	2
	COS-C-416	Case Study-I	2
II	COS-C-421	System Software and Compiler Design	3
	COS-C-422	Machine Learning Techniques	3
	COS-C-423	Advanced Database Management Systems	3
	COS-C-424	Object Oriented Software Engineering	2
	COS-C-425	Lab-II	2
	COS-C-426	Case Study-II	2
	COS-E-427(i)	Network Administration and Management Using Linux	3
	COS-E-427(ii)	Digital Image Processing	3
	COS-E-427(iii)	Distributed Computing	3
	Semester III		
	COS-C-431	Parallel Computing	3
	COS-C-432	Pattern Recognition	3
	COS-C-433	Data Analytics	3
	COS-C-434	Lab-III	2
	COS-C-435	Case Study-III	2
	COS-E-436(i)	Wireless Sensor Network	3
	COS-E-436(ii)	Cloud Computing	3
	COS-E-436(iii)	Medical Image Processing	3
	COS-E-436(iv)	Internet of Things	3
	COS-E-437(i)	Social Network Analysis	3
	COS-E-437(ii)	Agent Technology	3
	COS-E-437(iii)	Fractals and Applications	3
	COS-E-437(iv)	Cyber Security and Cyber Law	3
	Semester IV		
	COS-D-441	Project & Viva-Voce	16

List of External Electives

Course No	Subject	Credit
COS-X-421	Computational Social Science	2
COS-X-431	Introduction to Scientific Programming	2

SEMESTER : I
COUSE CODE : COS-C-411
COURSE TITLE : MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE
CREDITS : 3

AIM

To familiarize the students with the foundations in discrete mathematics commonly required in many areas of Computer Science.

OBJECTIVES

- To discuss the fundamental concepts and tools in discrete mathematics with emphasis on their applications to Computer Science.
- To develop computational thinking and problem-solving skills of students.
- To understand the theoretical foundations of Mathematics those are used for problem solving in Computer Science.

COURSE CONTENT

MODULE I: Probability: Definition, random variables, types, random experiments,events,sample space,rules, CDF,PDF,PMF distributions, Bayes theorem, combinatorics, conditional probability Statistics: Introduction, parameters descriptive and graphic statistics, parameter estimations, hypothesis testing and inferences

MODULE II: Review of Set theory , Relations:Definition,Properties of binary Relations, equivalence, transitive closure,compatibility and partial ordering relations. Functions: Inverse Function Compositions of functions, recursive ,hashing functions and mathematical inductions.

MODULE III: Linear algebra:Matrices,vectors,Determinants,linear systems,Matrix eigen value problems,vector differential calculas-gradient of a scalar field,divergence and curl of a vector field, Vector integral calculas-Introduction to line integrals and double integrals, Green's theorem in the plane, ,Divergence theorem of Gauss,Stoke's thorem

MODULE IV: Fourier Analysis: Fourier series,Even and odd functions,complex fourier series,forced oscillations,approximation by trigonometric polynomials,fourier integrals,Fourier cosine and sine transforms,Discrete and fast fourier transforms

MODULE V: Numeric Analysis: Introduction, solution of equations by iteration, interpolation, numeric integration and differentiation, numeric linear algebra-Linear Systems: Gauss Elimination, LU factorization, matrix inversion, III conditioning norms, Least squares method.

MODULE VI: Introduction to formal languages: Concepts of automata theory, Finite automata: Deterministic finite automata, Non- Deterministic finite automata, Conversion: Regular Expression to NFA and NFA to DFA

REFERENCES

- Erwin Kreyszig, ”Advanced Engineering Mathematics” (9th Edition), 2006 John Wiley & Sons , ISBN-13: 978-0-471-72897-9
- John.E.Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, “Introduction to Automata Theory, Languages, and Computation”(3rd Edition) ,2006 Prentice Hall, ISBN: 978-0321455369
- Lipschutz & Seymour, Schaum’s outlines “Discrete Mathematics”(revised 3rd Edition), 2017, Pu McGraw Hill Education, ISBN-13: 978-1259062537
- Michael Baron ,”Probability and statistics For computer scientists” (2nd edition), Chapman and Hall/CRC, ISBN-13: 978-1439875902

SEMESTER : I
COURSE CODE : COS-C-412
COURSE TITLE : ADVANCED OPERATING SYSTEMS
CREDITS : 3

AIM

The purpose of this course is to impart knowledge on the advanced concepts in operating systems and to study about message passing, distributed shared memory, synchronizations, and distributed file systems.

OBJECTIVES

- To identify the significance of operating systems in the computing device.
- To provide the fundamentals of distributed operating systems.
- Recognize critical resources and explain the behaviour of semaphores.

COURSE CONTENT

MODULE I: Distributed Computing System – Distributed Computing System Models – Distributed Operating System – Issues in Designing a Distributed Operating System – Distributed Computing Environment (DCE).

MODULE II: Message Passing: Desirable Features of a Good Message-Passing System – Issues in IPC by Message Passing – Synchronization – Buffering – Multidatagram Messages – Encoding and Decoding of Message Data – Process Addressing – Failure Handling – Group Communication.

MODULE III: Distributed Objects and Remote Invocation -Introduction-Communication between distributed objects-Remote procedure calls - Events and notifications. Introduction to Name Services- Name services and DNS - Directory and directory services.

MODULE IV: Distributed Shared Memory: General Architecture of DSM Systems – Design and Implementation Issues of DSM – Granularity – Structure of Shared Memory Space – Consistency Models – Replacement Strategy – Thrashing – Other Approaches to DSM – Heterogeneous DSM – Advantages of DSM.

MODULE V: Synchronization: Clock Synchronization – Event Ordering - Mutual Exclusion – Deadlock – Election Algorithms.

MODULE VI: Distributed File Systems: Desirable Features of a Good Distributed File System – File Models – File Accessing Models – File Sharing Semantics – File Caching Schemes – File Replication – Fault Tolerance – Atomic Transactions – Design Principles.

REFERENCES

- Siberschartz A and Galvin P, Operating system Concepts, 8thEd Addision Wesley,2009.
- Pradeep K. Sinha, Distributed Operating Systems Concepts and Design, PHI Pvt. Ltd, 2008.
- Andrew S. Tanenbaum, Modern Operating Systems, PHI Pvt. Ltd., Third Edition, 2010
- William Stallings, Operating Systems, 5ed, Pearson Education, 2007

SEMESTER : I
COURSE CODE : COS-C-413
COURSE TITLE : Data Structure and Algorithms Using Python
CREDITS : 3

AIM

This course covers the advanced data structures and algorithms, concentrating on the design and implementation of efficient algorithms. The aim of the course is to append the knowledge of advanced data structures and algorithms, hence provide a solid background in design of algorithms with the help of hands on experiments using Python.

OBJECTIVES

- To introduce the concept of nonlinear data structures – tree and graphs.
- To explain the need for *efficiency* in data structures and algorithms.
- To apply methods to analyze running time and estimate the efficiency of the algorithms.
- To understand and apply the concept of various bio-inspired algorithms.
- To find appropriate data structures and design efficient algorithm for any kind of problems.
- To write programs using Python.

COURSE CONTENT

MODULE I: Nonlinear Data Structures-Concepts and terminologies of Trees, binary tree implementation and traversals; AVL tree-importance, left and right rotations of tree;

MODULE II: B trees and B+ trees; Red Black Tree; Graphs – representations and traversals, Spanning Tree, Minimum Spanning Tree;

MODULE III: Analyzing Algorithms- Asymptotic notations, Recurrences; Dynamic Programming- Multistage Graphs, All Pairs Shortest Path;

MODULE IV: Randomized Algorithms; String Matching algorithms, Branch and Bound – Travelling Salesman Problem

MODULE V: Network Flows-Max flow, min-cut theorem; Ford-Fulkerson, Edmonds-Karp algorithm, Bipartite Matching. P and NP-class problems

MODULE VI: Bio inspired Algorithms-Concepts and Basics of - Genetic algorithms, Swarm intelligence, Particle swarm optimization, Ant colony optimization, Evolutionary algorithm

REFERENCES

- Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Introduction To Algorithms, MIT Press, 2001, ISBN 9780262032933
- Alfred V. Aho, Data Structures and Algorithms, Addison-Wesley, ISBN 9780201000238
- Stephan Olariu, Albert Y. Zomaya, Taylor & Francis, Handbook of Bioinspired Algorithms and Applications, ISBN 9781584884750
- Nancy Arana-Daniel, Carlos Lopez-Franco, Alma Y. Alanis, Butterworth-Heinemann, Bio-inspired Algorithms for Engineering, ISBN 9780128137895
- Peter Brass, Advanced Data Structures, Cambridge University Press, ISBN 9780511437533
- Rance D. Necaise, Data Structures and Algorithms Using Python, Wiley, ISBN 9780470618295
- Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python; John Wiley & Sons, Incorporated; ISBN 9781118476734

SEMESTER : I
COURSE CODE : COS-C-414
COURSE TITLE : COMPUTER NETWORKS AND INFORMATON SECURITY
CREDITS : 3

AIM

The aim of the course is to impart knowledge on the functions and working of Computer Networks. The principles and algorithms used in data security will give an insight on the devolvement of security systems.

OBJECTIVES

- To get an overview of TCP/IP reference model.
- To study in detail about Internet Protocols- IPV4 and IPV6.
- To learn about Internet routing protocols.
- To know about wireless LANs and WiMAX.
- To understand about basic cryptographic concepts and various security measures.

COURSE CONTENT

MODULE I: TCP/IP Reference model- an overview, TCP: features, segment structure, connection management, IP: functions, IPV4 datagram format, Addresses, IPV6, Network Programming – Sockets, TCP, UDP.

MODULE II: Routing Algorithms: Optimality principle, Shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Anycast Routing, multicast routing. Routing in the Internet- Interior gateway routing protocols: OSPF, RIP, Exterior gateway Routing Protocols: BGP.

MODULE III: Error detection and correction: Error detection codes- Parity, Checksums, Cyclic Redundancy Checks (CRCs). Error correction codes- Hamming codes, Binary convolutional codes, Reed-Solomon codes, Low-Density Parity Check codes.

MODULE IV: Wireless LAN(802.11)-Architecture, Frame structure, Services- WEP (Wired Equivalent Privacy),WPA2, Broadband Wireless- WiMAX(802.16), Architecture, Frame structure, Bluetooth – Architecture, Applications, Frame structure.

MODULE V: Cryptography: Encryption, Symmetric and Asymmetric cryptography, DES, AES, RSA, Key Management-Diffie-Hellman Key Exchange.

MODULE VI: Network Security Authentication Applications- Kerberos, X.509 Authentication Service, Email Security, PGP, S/MIME, IP Security, Web Security, SSL and TSL Security, Firewall Design Principles.

REFERENCES

- Andrew S. Tanenbaum; David J. Wetherall, Computer networks 5th ed., ISBN: 978-0-13-212695-3
- Kurose,James F, Ross,Keith W , Computer networking: a top-down approach 6th ed., Addison-Wesley ISBN: 9780132856201
- Behrouz A. Forouzan Data Communications & Networking (sie) 4th ed., Tata Mc Graw-Hill 2009, ISBN- 9780070634145
- William Stallings, Cryptography and Network Security–7th ed., Principles & Practice., Pearson Education ISBN: 9780134444284
- Atul Kahate Cryptography and Network Security 3rd ed., Tata Mc Graw-Hill 2013, ISBN: 9781259029882
- Prakash C. Gupta, Cryptography and Network Security, PHI Learning 2015, ISBN: 9788120350458

SEMESTER : I
COURSE CODE : COS-C-415
COURSE TITLE : Lab-I
CREDITS : 2

AIM

To provide practical knowledge in implementing various algorithms using Python language.

OBJECTIVES

- To understand programming concepts including object oriented features.
- To implement non-linear data structures like trees etc.
- To study working of different algorithms such as Multistage Graphs, All Pairs Shortest Path, Ford-Fulkerson, Edmonds-Karp algorithm using various algorithm design techniques.

COURSE CONTENT

The exercises related with the following are given for hands-on experiments

- Binary trees and its traversals
- AVL trees
- Minimum spanning trees
- B trees
- B+ trees
- Red black tree
- Multi stage graphs
- All Pairs shortest path problem
- Ford-Fulkerson
- Edmonds-Karp algorithm

SEMESTER : I
COURSE CODE : COS-C-416
COURSE TITLE : CASE STUDY-I
CREDITS : 2

AIM

To conduct a detailed investigation of any of the courses studied in the classroom through the practical implementation of an existing work.

OBJECTIVES

- Capture all of the details of the above subjects which are relevant to the purpose of the study, within a real life context.
- Learn the principles or the theory behind the concept through simulated problem solving and decision-making.
- Learn actively (by doing) rather than passively (by simply listening to lecturers or reading), and reinforcing the applicability of theory to practical situations

COURSE CONTENT

A case study is a detailed investigation done by a single individual or group on a specific topic that is covered in the first semester. Case studies can be qualitative or quantitative in nature, and often combine elements of both. Case studies allow students to fully understand how an intervention worked, or why an intervention had an effect in a particular case.

SEMESTER : II
COURSE CODE : COS-C-421
COURSE TITLE : SYSTEM SOFTWARE AND COMPILER DESIGN
CREDITS : 3

AIM

The aim of this course is to give an in-depth knowledge on system software especially on the working of compilers.

OBJECTIVES

- To study in detail about assemblers.
- To learn about loaders and linking.
- To introduce about grammars.
- To develop an understanding of various phases of compilers.

COURSE CONTENT

MODULE I: Introduction to System Software, Assemblers- Basic Assembler Function- Machine dependent and independent features- Control sections and program linking, Assembler Design Options- One pass and Multi pass Assemblers.

MODULE II: Loading-Basic Loader Functions, Simple Bootstrap Loader, Machine Dependent Loader Features: Relocation, Linking, Linking Loader, Loader Design Option: Linkage editors, Dynamic Linking.

MODULE III: Grammars -Types of grammars-type 0, type 1, type 2, type 3. The relationship between types of grammars.

MODULE IV: Compilers- Compiler structure, Phases of compiler, Lexical analysis: Specification and recognition of tokens, regular expressions and regular languages.

MODULE V: Syntax Analysis:- Role of Parser and parse trees. Representation of parse (derivation) trees as rightmost and leftmost derivations. Top-down parsers-Recursive descent parser. Bottom up parsers-shift reduce parsing, operator precedence parsing.

MODULE VI: Semantic Analysis:-Static and Dynamic Type checking, Syntax Directed Translation: Types Of Syntax Directed Definition. Intermediate Codes-Quadruples, triples. Intermediate code generation: Three Address Codes Generation, Code Optimization-Principal Sources Of Optimization, Code generation- Concepts and definitions, Directed acyclic graph representation.

REFERENCES

- Beck, Leland L, System Software: An introduction to system programming, 3ed ADDISON WESLEY Publishing Company Incorporated, 1997, ISBN: 9780201423006
- Aho, Alfred V; Ullman, Jeffrey D.,Principles of compiler design.5 ed. - Narosa, 2002 ISBN : 9788185015613
- D.M. Dhamdhere, System Programming Tata Mcgraw Hill, 1st ed.,2011 ISBN: 9780071333115
- Anuradha A Puntambekar, Compiler Design, 1st ed., Technical Publications, 2011 ISBN: 9789350380871
- Alfred V. Aho, Compilers: principles, techniques, & tools, 2nd ed., Pearson/Addison Wesley, 2007 ISBN: 978-0321486813

SEMESTER : II
COURSE CODE : COS- C-422
COURSE TITLE : MACHINE LEARNING TECHNIQUES
CREDITS : 3

AIM

Machine learning is the science of getting the computer to act without being explicitly programmed. This course covers the fundamental techniques of machine learning and their application.

OBJECTIVES

- To introduce the fundamental problems of machine learning.
- To provide understanding on the basic algorithms and techniques in machine learning.
- To learn and understand the limitations of various machine learning algorithms.
- To understand the fundamental theory of neural networks and its applications.

COURSE CONTENT

MODULE I: Introduction to Machine Learning- Components of learning, learning models, Types of Machine Learning, Introduction to Supervised Learning and Unsupervised Learning- Reinforcement learning.

MODULE II: Supervised Learning- Regression - Classification, Classifiers: Support Vector Machines- K Nearest Neighbour, Kernel- Decision Trees.

MODULE III: Unsupervised Learning - K Means algorithm- Dimensionality Reduction, Principal components analysis - Linear Discriminant Analysis.

MODULE IV: Artificial Neural Networks – Introduction, Neuron model, Single layer, Multi layer feed forward network, Learning algorithm, Back propagation network.

MODULE V: Fuzzy Logic - Fuzzy sets, Membership function, Fuzzification - Defuzzification– Fuzzy Inference systems, Fuzzy Rule-Based System, Overview of fuzzy expert system - fuzzy decision making.

MODULE VI: Introduction to Neuro fuzzy systems - An adaptive neuro-fuzzy inference system or adaptive network-based fuzzy inference system (ANFIS),

REFERENCES

- N.P.Padhy,"Artificial Intelligence and Intelligent Systems" Oxford University Press,2005
- S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic
- Algorithm: Synthesis and Applications" Prentice Hall of India, 2003.
- Stephen Marslland Machine Learning"- An Algorithmic Approach", CRC Press, 2009.
- Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
- Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill,1997.
- Stephen R. Schach, Introduction to Object Oriented Analysis and Design , Tata
- McGraw-Hill, 2003.
- S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.
- Simon Haykin, 'Neural Networks', Pearson Education, 2003.
- M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.

SEMESTER : II
COURSE CODE : COS-C-423
COURSE TITLE : ADVANCED DATABASE MANAGEMENT SYSTEMS
CREDITS : 3

AIM

To make the students familiar on the principles of advanced DBMS such as OODBMS and data warehousing.

OBJECTIVES

- To know about basic database concepts.
- To identify the essentials of database transactions and concurrency control systems.
- To know and understand the basics of OODBMS and DDBMS.
- To understand the concepts of data mining and data warehousing.

COURSE CONTENT

MODULE I: Review of basic concepts, Transaction Processing Concepts, Desirable Properties of Transactions, Schedules and Recoverability, Characterizing Schedules Based on Serializability, Transaction Support in SQL

MODULE II: Concurrency Control Techniques, Two-Phase Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering, Multiversion Concurrency Control Techniques, Validation (Optimistic) Concurrency Control Techniques.

MODULE III: Object Oriented Database Management Systems: Concepts, Composite objects, Issues in OODBMSs, Advantages and Disadvantages of OODBMSs.

MODULE IV: Distributed Databases-concepts, Advantages and Disadvantages of DDBMS, homogeneous and Heterogeneous DDBMS, Function of DDBMS.

MODULE V: Introduction: Data mining- Functionalities, Technologies, Applications, Major issues in Data Mining, Classification of DM systems.

MODULE VI: Data Warehouse: Basic Concepts, Data Warehouse Architecture, Design and Usage, Data Warehouse Implementation, Data warehouse schemas – OLAP, OLAM.

REFERENCES

- Connolly, Thomas M; Begg, Carolyn E, Database systems: a practical approach to Design, Implementation, and Management.6th ed., Pearson Education, 2015 ISBN: 978-0132943260.
- C.J. Date, Introduction to Database Systems, Pearson Education 8th ed., 2009 ISBN: 9780321197849.
- M. Tamer Ozsu, Patrick Valduriez, Principles of Distributed Database Systems, 3rd ed, Springer, 2011 ISBN: 9781441988348.
- Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann, 2nd Ed., 2005 MK Publishers ISBN: 9780123814791.
- Building the DataWarehouse- W. H. Inmon, 4th ed.,Wiley Dreamtech India Pvt. Ltd 2009 ISBN: 9788126506453.
- Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Prentice Hall, 1st ed., 2006 ISBN: 9788177587852.

SEMESTER : II
COURSE CODE : COS-C-424
COURSE TITLE : OBJECT ORIENTED SOFTWARE ENGINEERING
CREDITS : 2

AIM

Object oriented development is a way to develop software by building the self contained and reusable modules that can be easily modified and replaced. Object oriented analysis provides us with a world of cooperating and collaborating classes and objects. The aim is to familiarize the students with the concepts of object oriented analysis, development and UML diagrams.

OBJECTIVES

- To introduce the Object Oriented Concepts and the Unified Approach.
- To develop a foundation for Object Oriented Analysis and Object Oriented Design.
- To impart an idea about Object Oriented Methodologies.
- To introduce Agile Software development methodology.
- To discuss Agent Oriented Software Engineering (AOSE) concepts.

COURSE CONTENT

MODULE I: Introduction – Object Oriented Systems development life cycle. Object oriented Methodologies- Booch's Methodology - Rambaugh's Methodology , Jacobson's Methodology- Patterns and Frameworks

MODULE II: Fundamentals of Object Oriented design using Unified Modeling Language, UML- Use case diagram- Class diagram- Sequence diagram- collaboration diagram-State chart diagram- Activity diagram- Component diagram- deployment diagram

MODULE III: Object oriented analysis: Use Case Model- Identifying use cases Identifying actors- Documentation- Object analysis - Classification-different approaches- Identifying Classes- Identifying Object relationships – Attributes and Methods.

MODULE IV: Object oriented design: Design process- Design axioms - Colloraries- Design Patterns- Designing Classes - Designing Protocols and Class visibility - Defining Attributes- Designing Methods-Guidelines for identifying bad design

MODULE V: Agile Software Development - Agile Practices & Principles- Extreme Programming- Practices- Planning- Initial Exploration- Release and Iteration Planning- Defining "Done"- Task Planning- Iterating - Tracking, Testing- Test-Driven Development- Acceptance Tests, Serendipitous Architecture

MODULE VI: Software Quality Assurance- Bugs and Debugging- Testing Strategies- Developing test cases- Developing test plans- Debugging Principles- Introduction to Agent Oriented Software Engineering:

REFERENCES

- Ali Bahrami, Object Oriented Systems Development, Tata McGraw-Hill, 1999
- Martin Fowler, UML Distilled , Second Edition, PHI/Pearson Education, 2002.
- James Rumbaugh, Ivar Jacobson, Grady Booch The Unified Modeling Language
- Reference Manual , Addison Wesley, 1999.
- Roger Pressman. S., Software Engineering : A Practitioner s Approach, (4th Edition),McGraw Hill, 1997.
- Stephen R. Schach, Introduction to Object Oriented Analysis and Design , Tata McGraw-Hill, 2003.
- Hans-Erik Eriksson, Magnus Penker, Brain Lyons, David Fado, UML Toolkit , OMG Press Wiley Publishing Inc., 2004.
- A survey of Agent-Oriented Software Engineering. Amund Tveit.. Norwegian University of Science and Technology. May 8, 2001.
- Teach Yourself UML in 24 Hours, Joseph Schmuller, 3rd Edition, ISBN 81-297-0609-1, Pearson Education, 2004
- Grady Booch, James Rumbaugh, Ivar Jacobson, “UML User Guide”, Addison Wesley, 2002.
- Craig Larman (2005) Applying UML and Patterns. An Introduction to Object-Oriented Analysis and Design and Iterative Development, Third Edition,
- Lethbridge and Laganiere, "Object-Oriented Software Engineering: Practical software development using UML and Java"

SEMESTER : II
COURSE CODE : COS-C-425
COURSE TITLE : Lab-II
CREDITS : 2

AIM
To provide practical knowledge in SQL and drawing UML diagrams.

OBJECTIVES
- To understand basic SQL commands.
- To know how to draw various UML diagrams.

COURSE CONTENT
Lab exercises related with the following should be implemented in this course.
1. Familiarize basic SQL commands.
2. Queries for joining multiple relations.
3. Nested queries.
4. Implementing UML diagrams
    a. Class diagram
    b. Use case diagram
    c. Activity diagram
    d. State chart diagram
    e. Sequence diagram
    f. Collaboration diagram

SEMESTER : II
COURSE CODE : COS-C-426
COURSE TITLE : CASE STUDY-II
CREDITS : 2

AIM

To understand the detailed investigation of any of theory courses studied in the second semester through the practical implementation of an existing work.

OBJECTIVES

- Capture all of the details of the above subjects which are relevant to the purpose of the study, within a real life context.
- Learn the principles or the theory behind the concept through simulated problem solving and decision-making.
- Learn actively (by doing) rather than passively (by simply listening to lecturers or reading), and reinforcing the applicability of theory to practical situations.

COURSE CONTENT

A case study is a detailed investigation done by a single individual or group on a specific topic that covers in the second semester. Case studies allow students to fully understand how an intervention worked, or why an intervention had an effect in a particular case.

SEMESTER : II
COURSE CODE : COS-E-427(i)
COURSE TITLE : NETWORK ADMINISTRATION AND MANAGEMENT USING LINUX
CREDITS : 3

AIM

To familiarize the students in the tools and techniques used for network administration and management.

OBJECTIVES

- To identify the essentials of network administration, management and security
- To know about networking concepts.
- To understand more about Unix and Linux.
- To learn about routing mechanisms, firewall and gateway configuration.

COURSE CONTENT

MODULE I: Global Concepts for Administration and Management & Security and Administration; Hardware, switches routers and gateways; Hardware interfaces: ethernet, ADSL and modems; Networking software - network configuration: TCP/IP, port mapping; Classfull and classless network addressing;

MODULE II: System Backup, and Software Installation. system backup and utilities, compiling source code into programs and installing programs using Red Hat Package Manager.

MODULE III: Introduction to Unix and Windows server; DHCP and Bootp servers; Network Information Services - Configuring Network Services and Security. Discussed types of network services, configuring DNS, DHCP, Apache, Samba, NFS, FTP, NIS, and SSH.

MODULE IV: Networked file systems: Linux File system Administration. the File system Hierarchy Standard, file and directory management commands, finding files, linking files, file and directory permissions and ownership and special permissions, the /dev directory and device files, file system types, mounting, working with floppy disks, working with CD-ROMS, working with hard disks, hard disk partitioning, monitoring disk usage, checking file systems for errors, and hard disk quotas

MODULE V: Basic routing mechanisms, routing protocols and strategies; Domain Name Servers; Network monitoring and traffic flows; Securing Your Server and Network.- restricting user access to the network, password properties, and intruder lockout. restricting administrative access to the network, protecting servers and workstations from viruses, common internal security problems, and firewall technologies.

MODULE VI: Firewall and Gateway configuration - iptables, fwbuilder; Caching servers and proxy servers - squid. Network Performance- Queuing, Buffering, Error Rates, Retransmission. Fault Discovery, Fault Analysis, Fault Resolution, Backup/Recovery

REFERENCES

- Terry Dawson, Gregor Purdy, Tony Bautts, Linux Network Administrator's Guide, Infrastructure, Services, and Security 3rd ed., O'Reilly Media Publication ISBN: 9780596005481
- Kurose,James F ; Ross,Keith W , Computer networking: a top-down approach featuring the internet. – Pearson Education Limited, 2017 ISBN: 978-0133594140.
- Murphy, IP version 6.0 network Administration, Shroff Publishers 1st ed., 2005 ISBN: 9780596009342
- Andrew S. Tanenbaum; David J. Wetherall, Computer networks 5th ed., ISBN: 9780132126953

SEMESTER : II
COURSE CODE : COS-E-427(ii)
COURSE TITLE : DIGITAL IMAGE PROCESSING
CREDITS : 3

AIM

This course covers the fundamental principles of Image Processing. The aim of this course is to expose the various applications of digital image processing.

OBJECTIVES

- To learn digital image fundamentals.
- To study image enhancement and restoration techniques.
- To understand the segmentation techniques.

COURSE CONTENT

MODULE I: Digital Image Fundamentals-Elements of Digital Image Processing Systems, color Image fundamentals, RGB, HSI Color Models, Image sampling, Quantization.

MODULE II: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering.

MODULE III: Frequency Domain**:** Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

MODULE IV: Morphological operations: Dilation, Erosion, Opening and Closing; Applications: Boundary extraction - Boundary representation – Chain Code – Boundary descriptors - Regional Descriptors– Shape number – Fourier Descriptor.

MODULE V: Image Restoration: Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

MODULE V1: Image Segmentation-Edge detection, Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and Merging –Watershed segmentation algorithm.

REFERENCES

- Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2017.
- Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.
- Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw Hill Pvt. Ltd., 2011.
- Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.
- D,E. Dudgeon and RM. Mersereau, , Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
- William K. Pratt, , Digital Image Processing' , John Wiley, New York, 2002
- Milan Sonka et aI, 'IMAGE PROCESSING, ANALYSIS AND MACHINE VISION',Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

SEMESTER : II
COURSE CODE : COS-E-427(iii)
COURSE TITLE : DISTRIBUTED COMPUTING
CREDITS : 3

AIM

To provide an understanding of the principles on which the Internet and other distributed systems are working.

OBJECTIVES

- To understand the core ideas behind modern coordination, communication paradigms and distributed data structures.
- To understand the basic building blocks of distributed computing systems.
- To understand the fundamental issues of designing and engineering distributed systems and its importance.

COURSE CONTENT

MODULE I: Distributed computing: Introduction, characteristics, Architectural Models, Examples of Distributed Systems, application areas, primitives for distributed communication, synchronous versus asynchronous executions.

MODULE II: Distributed Computations: Model of distributed execution, Global state of distributed system, cuts of distributed computation, snapshot algorithm for FIFO and non FIFO channels, Message ordering paradigms in distributed computing

MODULE III: Distributed Algorithms-Introduction, Kinds, Timing Models., Synchronous Network Algorithms: Synchronous Network Model, Resource Security and Protection - Introduction ,The Access Matrix Model Advanced Models of protection and Data Security

MODULE IV: Distributed Mutual Exclusion :Introduction to algorithms, Lamport's algorithm, Singhal's dynamic information structure algorithm, Distributed Deadlock Detection and Issues ,Centralized Deadlock Detection , Distributed Deadlock-Detection Algorithms: Mitchell and Merit algorithm for single resource model, Kshemkalyani-Singal algorithm for the P-Out-Of-Q Model

MODULE V: Check pointing and rollback recovery: Introduction, issues, Check point based and Log based recovery, Failure detectors, Consensus Problem, Atomic broadcast, An adaptive failure detection protocol. Authentication in distributed systems: Definition, background, protocols based on symmetric and asymmetric crypto systems, password based authentication, protocol failures

MODULE VI: Distributed Multimedia Systems: Definition,Components of a multimedia system,Different configuration nodes,Qos andQoE,modes of delivery. New challenges in distributed computing, Basic concepts of Mobile and Ubiquitous Computing,grid computing,peer-to-peer computing.

REFERENCES

- Ajay D. Kshemkalyani and Mukesh Singhal,"Distributed Computing: Principles, Algorithms, and Systems "(Reissue edition),2011, Cambridge University Press, ISBN-13: 978-0521189842
- George Coulouris, Jean Dellimore and Tim KIndberg, "Distributed Systems Concepts and Design"(, 4th Edition) ,Pearson Education,
- Gerald Friedland, Ramesh Jain,"Multimedia Computing" (1 Edition),Cambridge University Press, 2014, ISBN-13: 978-0521764513
- Kai Hwang,Jack Dongarra and Geoffrey C Fox "Distributed and cloud computing:clusters,grids,clouds,and the future internet ",Morgan Kaufmann , 2011 ,ISBN 13: 9780123858801

SEMESTER : III
COURSE CODE : COS-C-431
COURSE TITLE : PARALLEL COMPUTING
CREDITS : 3

AIM

To provide students with a deep knowledge of Parallel Computing and its applications in various fields.

OBJECTIVES

- To study parallel programming platforms and principles of parallel algorithm design.
- To learn the importance and application areas of Parallel Computing and correctly apply the information for computational and experimental techniques.
- To familiarize the concept of cross platform computing and help to expand the research of Computer Science to nontraditional areas.

COURSE CONTENT

MODULE I: Parallel Computers: History ,classification and need. Performance metrics - speedup, utilization, efficiency, scalability. Parallel computer architecture, Fundamental design issues

MODULE II: Parallel Computation Models SIMD, MIMD, PRAM (EREQ, CREW, CRCW), NC. Parallel Computer Organization, Pipelining and Throughput, Latency and Latency hiding. Memory Organization.

MODULE III: Introduction to Parallel algorithms, Principles for designing parallel algorithms, Performance and scalability, Basic Parallel Algorithmic Techniques: Pointer Jumping, Divide-and-Conquer, partitioning, pipelining Accelerated Cascading, Symmetry Breaking, Synchronization (Locked, Lock-free)Parallel Algorithms.

MODULE IV: Cluster based distributed computing: Hardware technologies, Software and software architectures for cluster computing: Shared memory (OpenMP). Dynamic process creation, one-sided communication, Parallel I/O.

MODULE V: GPUs: overview and architecture, features and Programming model. System issues:cache and data management, GPU-CPU load balancing., GPU-Compute Architecture.

MODULE VI: Parallel computing platforms,CUDA,Memory organization in CUDA, Multi-Core CPU programming, MPI, PVM, Performance evaluation and scalability, Image Processing using GPU and Cluster Computing.

REFERENCES

- Joseph Jaja, “Introduction to Parallel Algorithms”, (1st Edition),1992, Addison-Wesley Professional, ISBN-13: 978-0201548563
- Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, “Introduction to Parallel
- Computing”(2nd Edition), 2003, Addison-Wesley Professional ,ISBN: 0201648652
- Michael Quinn, “Parallel Programming in C with MPI and OpenMP”(1st Edition),2003,McGraw-Hill, ISBN-13: 978-0072822564
- Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General-Purpose GPU Programming”(1st Edition),2010, ISBN-13: 978-0131387683
- David Culler, J.P. Singh, Anoop Gupta, “Parallel Computer Architecture: A Hardware/Software Approach”, Morgan Kaufmann,. 1999, ISBN-13: 978-1558603431
- Michel Dubois, MuraliAnnavaram, and Per Stenstrom,” Parallel Computer Organization and Design”(3rd Edition), 2012, Cambridge University Press,ISBN: 9780521886758

SEMESTER : III
COURSE CODE : COS-C-432
COURSE TITLE : PATTERN RECOGNITION
CREDITS : 3

AIM

The aim of this course is to give an introduction to the graduates on pattern recognition methods and its importance in machine vision.

OBJECTIVES

- To understand the different paradigms of pattern recognition.
- To introduce the major components in a pattern recognition system.
- To understand the different data structures for pattern representation.
- To provide the student with the knowledge of various feature extraction and feature selection techniques.
- To introduce the concept of classifiers and classification algorithms.
- To develop skills to solve the pattern recognition problems.

COURSE CONTENT

MODULE I: Introduction to Pattern Recognition- Different Paradigms for Pattern Recognition- Statistical Pattern Recognition - Syntatic Pattern Recognition- Machine Perception- Fish Classification system- Example- Components of Pattern Recognition System- Design Cycle

MODULE II: Data Structures for Pattern Representation -Vectors- Strings- Logical Descriptions- Fuzzy and Rough Pattern sets- Trees and Graphs- Representation of Clusters- Proximity Measures- Size of Patterns- Abstractions of the data Set

MODULE III: Feature Extraction- Fisher's Linear Discriminant- Principal Component Analysis- Feature Selection-Exhaustive Search- Branch and Bound Technique- Stochastic Search Techniques- Evaluation of Clustering

MODULE IV: Classifers- Adaboost Classifier- Random Forest Classifier- Logistic Regression- Bayesian Belief Network- Evaluation of Classifiers

MODULE V: Introduction to clustering- Stages in Clustering- Hierarchical Algorithms- Divisive Clustering- Agglomerative Clustering- Partitional Clustering- K Means Algorithm- Soft Partitioning

MODULE VI: Application- Hand Written Digit Recognition- Description of Digit Data- Preprocessing of Data- Classification of Algorithms- Selection of Representative Patterns- Results and discussions

REFERENCES

- R.O. Duda, P.E. Hart, D.G. Stork, “Pattern Classification”, John Wiley and Sons,
- 2000.
- V. S. Devi, M. N. Murty, “Pattern Recognition: An Introduction”, Universities Press, Hyderabad, 2011.
- Earl Gose , Steve Jost, “Pattern Recognition and Image Analysis”, PHI Publishers, 1997.
- Robert J. Schalkoff, “Pattern Recognition : Statistical Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992.
- Tou and Gonzales, “Pattern Recognition Principles”, Wesley Publications Company, London 1974.

SEMESTER : III
COURSE CODE : COS-C-433
COURSE TITLE : Data Analytics
CREDITS : 3

AIM

The aim of this course to give a comprehensive idea on the techniques and algorithms that are widely used in the data analytics.

OBJECTIVES

- To introduce the importance of data analytics in the present digital world
- To give an overview of different kinds of data and its properties
- To give exposure to the different data analysis techniques
- To develop practical skills of data analysis using R programming language

COURSE CONTENT

MODULE I: Introduction to data analytics: Need for data analytics, types of data analytics, challenges of data analytics, real life examples. Data analysis vs Data mining, Evolution of analytic processing.

MODULE II: Types of data: Univariate data, Multivariate data, Cross sectional data, Time Ordered data. Data structuring: De-duplication, Standardization. Data normalization: z-score normalization, min-max normalization, decimal scaling.

MODULE III: Random variable, distributions, two dimensional Random variable, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang.

MODULE IV: Multivariate normal distribution - Sampling distribution – Estimation - point, confidence –Test of significance, uses of t-distribution, F-distribution,$\chi 2$ distribution.

MODULE V: Predictive modeling and Analysis -Regression Analysis, Correlation analysis, Rank correlation coefficient, least square, Curve fitting and goodness of fit.

MODULE VI: Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - data distribution.

REFERENCES

- Brian Steele, John Chandler, Swarna Reddy; "Algorithms for Data Science" Springer, 2016, ISBN 3319457977, 9783319457970
- Peter X. -K. Song, "Correlated Data Analysis: Modeling, Analytics, and Applications" Springer Science & Business Media, ISBN 038771393X, 9780387713939
- Walter W. Piegorsch, "Statistical Data Analytics: Foundations for Data Mining, Informatics, and Knowledge Discovery, Solutions Manual", John Wiley & Sons, ISBN 1119043638, 9781119043638
- Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc.
- Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications
- Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press

SEMESTER : III
COURSE CODE : COS-C-434
COURSE TITLE : Lab-III
CREDITS : 2

AIM

The aim of this course is to provide practical knowledge in Pattern Recognition and Data Analytics using 'R' language.

OBJECTIVES

- To understand basic dimensionality reduction methods.
- To know the working of linear classifiers.
- To study about various unsupervised learning algorithms.

COURSE CONTENT

Experiments that cover the following areas in pattern recognition should be carried out in this course.

- Dimensionality Reduction
    - Regression and correlation
    - Principal Component Analysis
    - Linear discriminant Analysis
- Classifier
    - Random Forest Classifier
    - Adaboost Classifier
- Clustering
    - k - means Algorithm
    - Aglomerative Clustering
    - Partitional clustering
- Data analysis
    - probability distributions - Binomial, Poison, Geometric, uniform, exponential, normal
    - T test
    - chi square test

SEMESTER : III
COURSE CODE : COS- C-435
COURSE TITLE : CASE STUDY-III
CREDITS : 2

AIM

To conduct a detailed investigation of the course(s) studied in the third semester through the practical implementation of an existing work.

OBJECTIVES

- Capture all of the details of the above subjects which are relevant to the purpose of the study, within a real life context.
- Learn the principles or the theory behind the concept through simulated problem solving and decision-making
- Learn actively (by doing) rather than passively (by simply listening to lecturers or reading), and reinforcing the applicability of theory to practical situations

COURSE CONTENT

A case study is a detailed investigation done by a single individual or group on a specific topic in the courses studied in the third semester. Case studies allow students to fully understand how an intervention worked, or why an intervention had an effect in a particular case.

SEMESTER : III
COURSE CODE : COS-E-436(i)
COURSE TITLE : WIRELESS SENSOR NETWORKS
CREDITS : 3

AIM

The aim of this course is to get knowledge about architecture and design principles of wireless sensor networks and also to get idea about various sensor management protocols.

OBJECTIVES

- To know about sensor networks and its architectures in detail.
- To study in detail about wireless sensor networks, its hardware components and various architectures.
- To learn about the design principles and service interfaces of wireless sensor networks.
- To explain about the sensor management protocols and routing protocols and the issues related to the designing of these protocols.

COURSE CONTENT

MODULE I: Introduction: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETworks (MANETs) and Wireless Sensor Networks.

MODULE II: Enabling technologies for Wireless Sensor Networks Sensor Node, Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.

MODULE III: Deployment and Configuration: Localization and positioning, Coverage and connectivity, Single-hop and multihop localization, Self configuring localization systems.

MODULE IV: Sensor management Network Protocols: Issues in designing MAC protocol for WSNs, Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and Zig Bee, Dissemination protocol for large sensor network.

MODULE V: Routing protocols: Issues in designing routing protocols, Classification of routing protocols, Energy-efficient routing, Unicast, Broadcast and multicast, Geographic routing.

MODULE VI: Data Storage and Manipulation: Data centric and content based routing, storage and retrieval in network, Compression technologies for WSN: Image and Video compression.

REFERENCES:

- Holger Kerl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Network", John Wiley and Sons 1st Ed., 2005 ISBN: 978-0-470-09511-9.
- Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, "Wireless Sensor Network", Springer 1st Ed., 2004 ISBN: 978-4020-7883-5.
- Feng Zhao, Leonidas Guibas, " Wireless Sensor Network", Elsevier, 1st Ed., 2004 ISBN: 9781558609143
- Kazem, Sohraby, Daniel Minoli, Taieb Zanti, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2007.

SEMESTER : III
COURSE CODE : COS-E-436(ii)
COURSE TITLE : CLOUD COMPUTING
CREDITS : 3

AIM
To provide graduates with the basic concepts and technologies related to Cloud Computing.

OBJECTIVES
- To give basic knowledge about Cloud Computing, its services and applications.
- To learn how Cloud Computing helps to reduce spending on technology, infra structure, and globalize workspace.
- To familiarize distributed computing, cloud computing properties, deployment models-services and challenges.

COURSE CONTENT
MODULE I: Overview of Distributed Computing - Trends of computing, Introduction to distributed computing, History of distributed computing, deployment models used in distributed computing

MODULE II: Cloud computing: Introduction, Properties & Characteristics, Types and Service models, Deployment models, Merits and demerits of cloud computing, Application areas

MODULE III: Infrastructure as a Service (IaaS)- Resource Virtualization(Server, Storage, Network), Platform as a Service (PaaS) - Cloud platform & Management (Computation, Storage), Software as a Service (SaaS) - Web services, Web 2.0, Web OS,cloud architecture

MODULE IV: Cloud issues and challenges- Cloud provider Lock-in, Cloud Security-Infrastructure Security, Data security and Storage.

MODULE V: Identity & Access Management in cloud computing Access Control, Trust, Reputation, Risk, Authentication in cloud computing. Client access in cloud, Cloud contracting Model, Commercial and business consideration

MODULE VI: Understand different cloud programming platforms and tools, Basics of developing cloud applications using AWS

REFERENCES

- Barrie Sosinsky ,"Cloud Computing Bible", 2011, Wiley-India ,ISBN: 978-0-470-90356-
- Rajkumar Buyya, James Broberg, Andrzej M. Goscinski," Cloud Computing: Principles and Paradigms", 2011,Wiley,ISBN 978-0-470-88799-8
- Nick Antonopoulos ,Lee Gillam ,"Cloud Computing: Principles, Systems and Applications" 2012, Springer, ISBN-13: 978-1849962407

SEMESTER : III
COURSE CODE : COS-E-436(iii)
COURSE TITLE : MEDICAL IMAGE PROCESSING
CREDITS : 3

AIM

The aim of this course is to provide an overview of the computational and mathematical methods in medical image processing. This course covers the various medical image acquisition, storage, and processing techniques.

OBJECTIVES

- To learn all the components of various medical imaging modalities.
- To understand the theoretical foundations of medical image processing techniques.
- To study about medical image registration.

COURSE CONTENT

MODULE I: Introduction to medical imaging technology, systems, and modalities. Brief history; importance; applications; trends; challenges. Medical Image Formation Principles: X-Ray, Basic principles of Computed Tomography(CT).

MODULE II: Medical Image Storage, Archiving and Communication Systems and Formats. Picture archiving and communication system (PACS), Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS).

MODULE III: Medical Image Processing, Enhancement, Filtering Basic image processing algorithms Thresholding; contrast enhancement; SNR characteristics; filtering; histogram modeling.

MODULE IV: Medical Image Visualization - Fundamentals of visualization; surface and volume rendering/visualization. Magnetic Resonance Imaging (MRI): imaging principles and hardware; image artifacts.

MODULE V: Medical Image Segmentation: Histogram-based methods, Region growing and watersheds; active contours, model-based segmentation, clustering-based methods, classification-based methods.

MODULE VI: Medical Image Registration: Intensity-based methods; cost functions; optimization techniques. PET and SPECT Ultrasound Imaging methods; 3D imaging; positron emission tomography; single photon emission tomography; ultrasound imaging; applications.

REFERENCES

- Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2017.
- Anil K. Jain, “Fundamentals of Digital image Processing”, Prentice Hall, US Ed.,1989.
- Bankman I.N. “Hand book of Medical Imaging-Processing and Analysis”, Academic Press, 2000.
- Bovik A.I. “Handbook of Image and Video processing”, Academic Press, 2005.
- Jiri Jan, “Medical Image Processing, Reconstruction and Restoration- Concepts and Methods”, CRC Tayler & Francis, 2006.
- William K. Pratt, “Digital Image Processing: PIKS Scientific Inside”, Wiley Interscience, 4th Ed., 2007.
- Azriel Rosenfield, Avinash C. Kak, "Digital Picture Processing", Morgan Kaufmann, 2nd Ed., 1982.
- Bernd Jahne, “Digital Image Processing”, Springer, 6th Ed., 1997.

SEMESTER : III
COURSE CODE : COS-E-436(iv)
COURSE TITLE : INTERNET OF THINGS
CREDITS : 3

AIM

The aim of this course is to introduce the concepts and working of Internet of Things. The focus will be more on the possibilities offered by the different technologies, and on the creative thinking techniques to find innovative applications of combinations of such technologies in real-life scenarios.

OBJECTIVES

- To introduce the importance of Internet of things technology in the modern digital world.
- To provide awareness of the technologies behind IoT.
- To introduce the architecture of basic IoT Systems.
- To introduce the real life applications of IoT.

COURSE CONTENT

MODULE I: Concepts and Terminology of The Internet of Things (IoT) – Definition, Characteristics, Design and Functional blocks of IoT, Communication models & APIs

MODULE II: IoT & Machine to Machine, Difference between IoT and M2M, Software defined Network; Technologies - Sensors, Actuators, Gateways, Local & Global Connectivity

MODULE III: IoT Architecture- Introduction to Sensor Networks, IoT Architecture Reference Model; Reference Architecture and Functional groups-Device and Application, Communication, IoT Services, Virtual Entity.

MODULE IV: IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

MODULE V: Real world Design Constraints- Technical Design, Data representation and visualization, Challenges in IoT - Design challenges, Development challenges, Security challenges, Other challenges

MODULE VI: Domain specific applications of IoT Home automation, Industry applications, Surveillance applications, Other IoT applications; Web of Things to the Cloud of Things.

REFERENCES

- From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence; Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle; Academic Press; ISBN 0080994016, 9780080994017
- The Internet of Things: Connecting Objects, Hakima Chaouchi, John Wiley & Sons, ISBN 1118600177, 9781118600177

SEMESTER : III
COURSE CODE : COS-E-437(i)
COURSE TITLE : SOCIAL NETWORK ANALYSIS
CREDITS : 3

AIM

The aim of this course is to introduce the concepts of Social Networks Analysis and importance of it in the real life applications.

OBJECTIVES

- To introduce the basic notation and terminology used in social network data sets.
- To provide knowledge on how to visualize, summarize and compare networks.
- To understand basic principles behind social network analysis algorithms.
- To develop practical skills of network analysis in R programming language.

COURSE CONTENT

MODULE I: Introduction to Semantic Web; Social Network analysis- concepts and measures in network analysis; Applications of Social Network Analysis. Ontology and Semantic Web- Ontology based knowledge Representation;

MODULE II: Resource Description Framework; Statistical network properties. Degree distribution, clustering coefficient. Frequent patterns. Network motifs.

MODULE III: Cliques and k- cores, Network structure. Nodes and edges, network diameter and average path length. Node centralities and ranking on network- Node centrality metrics: degree.

MODULE IV: Closeness and betweenness centrality, Eigenvector centrality and Page Rank. Algorithm HITS. Network communities.

MODULE V: Graph partitioning and cut metrics. Edge betweenness. Modularity clustering. Affiliation network and bipartite graphs.

MODULE VI: Information and influence propagation on networks, Social Diffusion; Basic cascade model; Influence maximization; Social media mining-sentiment mining;

REFERENCES

- Peter J. Carrington, John Scott, Stanley Wasserman; “Models and Methods in Social Network Analysis”; Cambridge University Press; ISBN 1139443437, 9781139443432
- Maksim Tsvetovat, Alexander Kouznetsov; ”Social Network Analysis for Startups: Finding Connections on the Social Web”; O'Reilly Media, Inc., ISBN 1449306462, 9781449306465
- Song Yang, Franziska B. Keller, Lu Zheng; “Social Network Analysis: Methods and Examples”; SAGE Publications; ISBN 1506362125, 9781506362120
- Peter Mika, “Social Networks and the Semantic Web”, , First Edition, Springer 2007.
- Borko Furht, “Handbook of Social Network Technologies and Applications”, 1st Edition, Springer, 2010.
- Guandong Xu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition Springer, 2011.
- Dion Goh and Schubert Foo, “Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively”, IGI Global Snippet, 2008.

SEMESTER : III
COURSE CODE : COS-E-437(ii)
COURSE TITLE : AGENT TECHNOLOGY
CREDITS : 3

AIM

This course gives a broad introduction to the agent-based computing. It introduces the key concepts and models of the agents, dealing with design and devolvement and working of agents.

OBJECTIVES

- To introduce the intelligent Agents and multiagent systems
- To understand agent communication and interaction protocols
- To impart an idea about Ontology and Knowledge Query and Manipulation Language
- To introduce agent cooperation and coordination

COURSE CONTENT

MODULE I: Introduction - Intelligent agents- Agents and Objects- Agents and Expert systems- Abstract architectures for intelligent agents - Concrete architecture for intelligent agents - Agent-Oriented Programming

MODULE II: Multi agent systems- characteristics - Agent communication- Ontology- KQML-KIF- Agent interaction protocols- Coordination Protocols- Cooperation Protocols- Negotiation-Contract Net

Module III: Distributed Problem solving - Task sharing- Tower of Hanoi problem-heterogeneous systems- Result sharing- functionally accurate cooperation- shared repositories-negotiated search

Module IV: Distributed Planning- Centralized Planning- Distributed Planning - distributed plan representations- distributed planning and exection- Post planning coordination- pre planning coordination

MODULE V: Search Algorithm- Constraint satisfaction- filtering algorithm- Hyper resolution based consistency algorithm- Asynchronous back tracking

Module VI: Learning in mutiagent systems- Introduction- General Categorization-Principal categories- Differencing features- Learning and Activity Coordination

REFERENCES

- Gerhard Weiss, Multi-agent systems A modern approach to Distributed Artificia lIntelligence, MIT press
- Michael Wooldridge, Introduction to Multi-agent systems, John Wiley & Sons, June 2002.
- Walter Brenner et al, Intelligent Software agents, Springer Verlag Nicholas R. Jennings, Michael Woodridge, Agent Technology : Foundations, Applications and markets, Springer Verlag Publishing.
- M. Luck, M. Marik, O. Stopenkova, R. Trappl, Multi-agent systems and Applications, Springer Verlag Publishing.
- Jeffery M. Bradshaw, Software Agents, AAAI press.
- Mark D Inverno, Michael Luck, Understanding Agent Systems, Springer Verlag.
- M.P. Singh, A.S. Rao, Formal Methods in Distributed Artificial Intelligence Logic based representation and reasoning.
- Michael Wooldridge, Reasoning about Rational Agents, MIT Press.
- M. Huhns, M.P. Singh, Morgan Kaufmann, Readings in Agents, Springer Verlag.

SEMESTER : III
COURSE CODE : COS-E-437(iii)
COURSE TITLE : FRACTALS AND APPLICATIONS
CREDITS : 3

AIM

This course is intended to give a broad introduction to the fractals and its applications in the advanced research and developments in the computer science.

OBJECTIVES

- To introduce the Fractal dimensions.
- To understand the properties of fractals.
- To impart an idea about different fractal dimension computing methods.
- To discuss how to generate different types of fractals.
- To introduce about Linder Mayer Systems.
- To introduce compression concepts and Fractal image compression.

COURSE CONTENT

MODULE 1: Introduction to fractals, fractal geometry, properties of fractals, Fractals in Nature-self similarity. Generation of Von Koch Curve, Koch Snowflake , Koch Star , Hilbert Curve , Sierpinski gasket , Cantor Set.

MODULE 2: Fractals and dimensions, methods of counting fractal dimension- walking divider, box counting, prism counting, fractional brownian motion. Similarity dimension, box counting dimension, mass dimension, area-perimeter relation.

MODULE 3: Algebra of Dimensions-Union, Intersection, Product, Projection. Iterated Function Systems, IFS for Sierpinski Gasket, Sierpinski Carpet, Koch Curve, Koch Snowflake.

MODULE 4: Lindermayer systems. Escape time fractals-The Mandelbrot Set and Julia Sets. Random fractals- fractional brownina motion, Cellular Automata, Applications of Cellullar Automata.

MODULE 5: Diffusion-Limited Aggregation, Generating Random Fractal Terrain, Fractal trees. Fractal music. Strange Attractors- Rossler Attractor, Lorenz Attractor.

MODULE 6: Introduction to basics of Image Compression- Fractal image compression- Iterated Function System, Partitioned Iterated Function System, encoding and decoding images.

REFERENCES

- Fractal Geometry in Digital Imaging, Martin J. Turner, Jonathan M. Blackledge, Patrick R. Andrews, Academic Press, ISBN 0127039708, 9780127039701
- Fractal Image Compression: Theory and Application,Yuval Fisher,Springer Science & Business Media, 2012, ISBN 1461224721, 9781461224723
- Fractals Everywhere, Michael F. Barnsley, Hawley Rising, Morgan Kaufmann, ISBN 0120790696, 9780120790692

SEMESTER : III
COURSE CODE : COS-E-437(iv)
COURSE TITLE : CYBERSECURITY AND CYBER LAW
CREDITS : 3

AIM

The scope and ambit of the course is very vast and covers every aspect of the Cyber Law related issues, which involve the use of computer or internet. This course highlights Cyber Laws in the areas of Electronic Commerce, e-Governance, Intellectual Property, Data Security and Cyber Crimes. The program enables students to understand the scope of Cyber Laws in India

OBJECTIVES

- The course aims to develop the skills to imbibe cyber security issues with a technological ground and then relate them to complex cyber world legal problems.
- It also aims to provide a detailed understanding of national and international regulatory paradigms and mechanics regarding cyber law.

COURSE CONTENT

MODULE I: Information System Threats and attacks, Classification of Threats and Assessing Damages, Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security.

MODULE II: Basic Principles of Information Security, Confidentiality, Integrity Availability. Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of Biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges

MODULE III: Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Policies Network Security- Basic Concepts, Dimensions, Perimeter for Network Protection

MODULE IV: Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

MODULE V: Security metrics- Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mining Security

MODULE VI: Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes

REFERENCES

- Godbole,“ Information Systems Security”, Willey
- Merkov, Breithaupt,“ Information Security”, Pearson Education
- Yadav, “Foundations of Information Technology”, New Age, Delhi
- Schou, Shoemaker, “Information Assurance for the Enterprise”, Tata McGraw Hill,“Cyber Laws Simplified”, Mc Graw HillFurnell, “Computer Insecurity”, Springer
- IT Act 2000 Jeffrey M. Bradshaw, Software Agents (Editor). MIT Press
- Luger., Artificial Intelligence. 4 ed.- Pearson Education.

SEMESTER : 4
COURSE CODE : COS- D-441
COURSE TITLE : PROJECT AND VIVA VOCE
CREDITS : 14

AIM: To impart hands on experience in the design and development of software solutions for a real life problem or a problem that have industry or research potential.

OBJECTIVES

- To put into practice theories and concepts learned on the programme.
- To provide an opportunity to study a particular topic in depth.
- To show evidence of independent investigation.
- To combine relevant theories and suggest alternatives.
- To show evidence of ability to plan and manage a project within deadlines.

COURSE CONTENT

All the students have to do a project work on a problem which has industry or research potential as part of this course. The project work can be done in any of the following - R&D institutions, MNC - IT companies and Department. At the end of the course, all the students should submit a project report with the details of the work done, findings and suggestions for evaluation. There will be internal and external evaluation of the work.

SEMESTER : I
COURSE CODE : COS-X-421
COURSE TITLE : COMPUTATIONAL SOCIAL SCIENCE
CREDITS : 2

AIM:
The aim of this course is to explain how the recent computational paradigms can be applied to the social science studies and research to solve the common problems in that domain.

OBJECTIVES:
The objective of this course is to:

- To understand the basic idea of grouping according to social behavior
- To understand the data sets in social science
- To covert the social science data sets into computational models
- To introduce the basic concepts of graph and its properties
- To basic principles of social network analysis
- To basic ideas to social media mining

COURSE CONTENT

Module I: Social Behaviour and its grouping. Introduction to the data sets in social science. Introduction to Semantic Web; Social Network analysis- concepts; Applications of Social Network Analysis.

Module II: Modelling Social Networks –Basic principles in graph theory, statistical properties of social networks.

Module III: Graph models - graph theory, matrix computations of properties. Information Networks and the Web- random walks, Social media mining-sentiment mining;

REFERENCE

- Riccardo Boero, Behavioral Computational Social Science, John Wiley & Sons, 2015 ISBN 1118657306, 9781118657300
- David Easley and Jon Kleinberg; Networks, Crowds, and Markets: Reasoning About a Highly Connected World. available at http://www.cs.cornell.edu/home/kleinber/ networks-book/
- R. Michael Alvarez, Computational Social Science: Discovery and Prediction Analytical Methods for Social Research, Cambridge University Press, 2016, ISBN 1316531287, 9781316531280
- Claudio Cioffi-Revilla, Introduction to Computational Social Science: Principles and Applications Texts in Computer Science, Springer, 2017, ISBN 3319501313, 9783319501314
- Bruno Gonçalves, Nicola Perra, Social Phenomena: From Data Analysis to Models Computational Social Sciences, Springer, 2015,ISBN 3319140116, 9783319140117

SEMESTER : III
COURSE CODE : COS-X-431
COURSE TITLE : Introduction to Scientific Programming
CREDITS : 2

AIM:
An introductory course for programming and problem solving. The main focus of the course is to give the basic knowledge for the design and coding of problems in the world of science. The course will be taught using C programming language, which is the basic of all modern programming languages.

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

- Design, write and debug small programs to solve practical problems of scientific nature.
- Have a practical understanding of the processing of scientific data.
- Be able to describe and design small computer programs using C language.
- Have an understanding of practical aspects of machine architecture including finite precision and rounding errors.

COURSE CONTENT
Module I: Problem solving-logic, algorithm, flowcharts. Programming languages – editor, compiler, process. Building blocks of C programming language

Module II: C language - Control flow and logical expressions, statements, blocks, iterative statements, functions. Return variables, external variables, scope, static variables

Module III: Introduction to Pointers and arrays in C - One-dimensional arrays vs. multidimensional arrays. File Handling -reading and writing. Basics of vectors and matrices, spares matrix and its processing.

REFERENCE

- W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice-Hall software series, ISSN 0891-4516
- Dennis Greg., Brian, The C Programming Language :: (Golden Beginner's To Experts Edition), Createspace LLC USA, ISBN 150048492X, 9781500484927
- Luciano Maria Barone and Enzo Marinari, Scientific Programming: C-language, Algorithms and Models in ScienceWorld Scientific, ISBN 9814513415, 9789814513418
- Rama Reddy and Carol Ziegler, C Programming for Scientists and Engineers with Applications, AJones & Bartlett Learning, ISBN 0763739529, 9780763739522
- David R. Brooks, C Programming: The Essentials for Engineers and Scientists, Springer Science & Business Media, ISBN 146121484X, 9781461214847
- Rama Reddy, Carol Ziegler, C Programming for Scientists and Engineers with Applications, Jones & Bartlett Learning, ISBN 0763739529, 9780763739522