MATS UNIVERSITY
MASTER OF COMPUTER SCIENCE(MCS)
REGULATIONS

Introduction

The course has been designed and updated by keeping the current demands and expectation of the industry in mind. The programme provides comprehensive training in various areas of computer science to equip the students for the industry as well as for further degree in computer science. The objective of the course is to mould students to acquire analytical, creative and problem solving skills to meet the industry standards and be well prepared for research activities. The research horizons also open up after completion of this course. To make students to be proficient in the use of mathematical tools including discrete mathematics, calculus, elementary statistics, and probability to understand the basics of science, and specifically the scientific method to possess sufficient fundamental knowledge of computer science to be a life-long learner to understand the social and ethical issues which face computer scientists, and thus be able to contribute to society in a positive and productive manner.. This production-oriented approach to training prepares students for a successful animation career in the entertainment industry.

Program Objective

- To prepare for advance educational in computer science
- To provide enough skill and applied knowledge of computing to produce effective designs and solutions for specific problems
- Student get computing paradigm to use software development tools and modern computing platforms.
- Demonstrate a sense of societal and ethical responsibility in all professional endeavors.

Program Outcome

Student get

- Knowledge of algorithms
- Knowledge of data structures
- Knowledge of computer organization and architecture
- Knowledge of contemporary and emerging issues in computer science
- An understanding of professional and ethical responsibility.
- An ability to design and conduct experiments, as well as analyze and interpret data.

1. Scope and Content

1. The regulations documented here are applicable to the M.Sc.(CS) programme offered by the university.
2. The applicability of the Regulations must be understood in the context of the given Scheme of study and the Syllabus of the programme.
3. The Regulations given here are in addition to the rules and regulations notified at the time of the admission.
4. The authorities of University may modify, add, delete, expand or substantiate any part of the Regulations and syllabi, at any time.

2. Course Content

The programme shall be for duration of six semesters, spread out in three years. Each semester of the programme shall consist of either all or some of the following components:

2.1 Core Subjects
2.2 AECC (AbilityEnhancenment Compulsory Course)
2.3 SEC(Skill Enhancment Course)
2.4 DSE (Discipline Specific Electives) /Choice Based
2.5 GE(Generic Electives)
2.6 Lab Course
2.7 Project Work

2.1 Core Subjects

Core subjects comprises of subjects that form an integral part of the programme. These subjects provide a strong ground in basic disciplines of study.

2.2 AECC (AbilityEnhancenment Compulsory Course)

The students who have not done English up to class XII are to opt for Hindi Communication. They can opt Environment studies and other languages also .

2.3 SEC(Skill Enhancment Course)

This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students.

2.4 DSE (Discipline Specific Electives) /Choice Based

Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study)

2.5 GE(Generic Electives)

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

2.6 Lab Courses

These subjects are totally practical-based subjects. The learning of these subjects will be performed in laboratories/practical sites with equipments/resources. These subjects shall support the practical implementation of the core/core-bracket subjects. The processes of evaluation of their subjects will depend on the nature of that individual subject.

2.7 Project Work

The project work shall be done for a duration as specified by the Coordinator, in the area, related to the main subject of study or the specialization. The project work shall give the student an insight to the situations existing in the field/marked/industries, etc.

3. Eligibility for Admission and Mode of Selection

3.1 The minimum qualification required to be eligible for admission is a pass in the Graduation examination in Computer or a course recognized as equivalent thereto buy the University, desirably with the relevant or related subjects as one of the subjects of study.

3.2 The method of selection for the course shall normally by means of a Personal interview. However, the admission might also by means of an entrance test.

4. Attendance and Examination

A student is eligible to appear for the term-end examinations, only if he/she has put in a minimum of 75% attendance in each subject individually.

5. Assessment and Examination

5.1 Credits

Credit Points will be awarded for all the subjects. One credit is equivalent to ten classroom contact hours.

Each core subjects will carry either 6 or 4 or 2 credits, each core bracket subject will carry 2 credits and practical courses will carry either 6 or 4or 2 credits depending on the number of hours of teaching and training.

5.2 Pattern of Assessment

Assessment of student's performance will be based on tow components i.e. Internal Assessment and Term-end Examination conducted at the end of each semester.

A six-credit subject will comprise of an Internal Assessment component of 30 marks and a Term-end Examination components of 70 marks.

A four-credit subject will comprise of an Internal Assessment component of 30 marks and a Term-end Examination components of 70 marks.

A two-credit subject will comprise of an Internal Assessment component of 15 marks and a Term-end Examination components of 35 marks.

5.3 Purpose of Internal Assessment

The Term-end Examination will be conducted as per the University regulations Sessional tests, assignment, mid-term examination, etc. will be conducted in each subject during the course of each semester, for the.

5.4 Assessment for Core Bracket Subjects

Depending on the participation and performance of students, the faculty of the Core Bracket subject will grad the student in term of a five-point scale as given below:

Marks Secured	Grade Point	Letter Grade
80 and above	10	Outstanding(O)
70 and above but below 80	9	Excellent (A+)
65 and above but below 70	8	Very Good (A)
60 and above but below 65	7	Good (B+)
55 and above but below 60	6	Above Average (B)
50 and above but below 55	5	Average (C)
45 and above but below 50	4	Pass(P)
Below 45	0	Fail (F)
	0	Absent (AB)

This assessment is purely based on internal assessment of the subject faculty/coordinator.

5.5 Assessment of Project Work

The project work will carry a total of 150 marks. Of this, 45% marks are for required to clear the examination.70% marks are for the external examination and 30% marks will be awarded for internal evaluation.

5.6 Eligibility to Appear for the Term-End Exam

Students, who have put in a minimum of 75% attendance in each subject, shall be eligible to appear for the Term-end examination.

6. Eligibility for Pass

6.1 A student shall be declared to have passed in a subject, if he/she secures at least 45% marks in the term-end examination and an aggregate of 45% including internal assessment.

6.2 When a student reappears for the failed subject(s), the internal assessment marks originally secured by him/her in the first appearance in the subject(s), if any, will be carried forward.

6.3 A student shall be declared to have passed in Core Bracket subject, if he/she secures at least a pass grade.

6.4 Promotion of the student to the next semester, is not automatic, but is dependent on certain other conditions.

7. Classification of Successful Students

7.1 On successful completion of the programme, the students will be classified as below:

Distinction	Those securing an aggregate marks of 75% and above in all the subjects;
First Class	Those securing an aggregate mark of less than 75%, but above 60% in all the subjects;
Second Class	Those securing an aggregate mark of less than 60%, but above 50% in all the subjects;
Pass	Those securing an aggregate mark of more than 45% in all the subjects;

7.2 Ranks

Only students who have passed each of the semester examination at the first appearance, s hall be eligible for award of Ranks. The first three ranks shall be notified.

8. Award of Qualification

Students will be awarded the Bachelor Degree of M.Sc (CS), upon fulfillment of the following criteria:

8.1 Must have passed all the subjects of thee six semester with a minimum of 45% om each subject including Internal assessment and secured 45% in aggregate;

8.2 Must have secured at least a pass grade in all the Core Bracket subjects.

8.3 Must have secured a minimum of 45% marks in the project work (wherever applicable).

8.4Must have complied with all other assessment guidelines and criteria notified during the conduct of the programme.

9. Maximum period for the complement of the Programme

The maximum period for the completion of the programme shall be five years from the date of joining the programme.

10. General Guidelines

10.1Academic Integrity and Ethics

1. A students who has committed an act of academic dishonesty will be deemed to have failed to meet a basic requirement of satisfactory academic performance. Thus, academic dishonesty is not only a basic for disciplinary action but also is relevant to the evaluation of student's level of performance and progress.
2. Where there has been violation of the basic ethos and principles of academic integrity and ethics, the Director/Board of Examiners/Course coordinator may use their discretion in terms of disciplinary action to be taken.
3. Academic dishonesty includes, but is not necessarily limited, to the following:
    1. Cheating or knowingly assisting another student in committing a act of cheating;
    2. Unauthorized possession of examination materials, destruction or hiding of relevant materials;
    3. Act of plagiarism;
    4. Unauthorized changing of marks or marking on examination records.

10.2Attendance

1. Student are required to attend and participate in all scheduled class sessions, guest lecturer, workshops, outbound learning programs and club/ forum activities of both academic and non-academic nature.
2. Students may be dropped from the programs due to excessive and non-intimated absences.
3. Students must notify the program coordinator in writing, the reasons for absence, if any, from class sessions, activities and assessment components.
4. On notification of absences (including anticipated absences) , the Director/ Programmer coordinator would determine whether the absences could be rectified or whether it is possible to satisfactorily complete the subject with the number of identified absences.

10.3General

1. The students are expected to spend a considerable amount of time in research, reading and practice.
2. All students are expected to develop and maintain a positive profession attitude and approach throughout the Programme and in conduct of all other activities.
3. Attendance alone is not sufficient. Students are expected to participate, to help the class learn and understand the topics under consideration.
4. Food and drinks are not permitted in the classroom / conference hall.
5. All students are expected to dress as per stipulated dress code.

M.Sc. (Computer Science)						
SEMESTER -I						
Subject Code	**Subject**	**Credit 1 Cr= 1 hrs**	**L+T+P**	**Univ. Exam Marks**	**Int. Marks**	**Total Marks**
CORE COURSES						
MCS 101	RDBMS	**4**	3+1+0	70	30	100
MCS 102	ComputerOrganization and Architecture	**4**	3+1+0	70	30	100
MCS 103	Operating System Architectures andConcepts	**4**	3+1+0	70	30	100
MCS 104	Data Structureusing C++	**4**	3+1+0	70	30	100
DSE (DISCIPLINE SPECIFIC ELECTIVES) /CHOICE BASED						
MCS 105	Elective I	**6**	4+2+0	70	30	100
GE(GENERIC ELECTIVES)						
LAB COURSES						
MCS 106	Data Structure using C++	**2**	0+0+2	35	15	50
		24		**385**	**165**	**550**

M.Sc. (Computer Science)						
SEMESTER -II						
Subject Code	**Subject**	**Credit 1 Cr= 1 hrs**	**L+T+P**	**Univ. Exam Marks**	**Int. Marks**	**Total Marks**
CORE COURSES						
MCS 201	DataCommunication and Networking	**4**	3+1+0	70	30	100
MCS 202	Data Mining and KnowledgeDiscovery	**4**	3+1+0	70	30	100
MCS 203	ResearchMethodology	**4**	3+1+0	70	30	100
MCS 204	Web Programming Extensible Markup language	**4**	3+1+0	70	30	100
DSE (DISCIPLINE SPECIFIC ELECTIVES) /CHOICE BASED						
MCS 205	Elective II	**6**	4+2+0	70	30	100
GE(GENERIC ELECTIVES)						
LAB COURSES						
MCS 206	Web Programming Extensible Markup language LAB	**2**	0+0+2	35	15	50
		24		**385**	**165**	**550**

M.Sc. (Computer Science)						
SEMESTER -III						
Subject Code	**Subject**	**Credit** **1 Cr= 1 hrs**	**L+T+P**	**Univ.** **Exam Marks**	**Int. Marks**	**Total Marks**
CORE COURSES						
MCS 301	Information Security	**4**	3+1+0	70	30	100
MCS 302	Big Data Management	**4**	3+1+0	70	30	100
MCS 303	Mobile Computing	**4**	3+1+0	70	30	100
MCS 304	Industrial/Company/Professional Training	**4**	3+1+0	70	30	100
DSE (DISCIPLINE SPECIFIC ELECTIVES) /CHOICE BASED						
MCS 305	Elective III	**6**	4+2+0	70	30	100
GE(GENERIC ELECTIVES)						
LAB COURSES						
MCS 306	Mobile Computing	**2**	0+0+2	35	15	50
		24		**385**	**165**	**550**

M.Sc. (Computer Science)						
SEMESTER -IV						
Subject Code	**Subject**	**Credit** **1 Cr= 1 hrs**	**L+T+P**	**Univ. Exam Marks**	**Int. Marks**	**Total Marks**
CORE COURSES						
MCS 401	Image Processing	**4**	3+1+0	70	30	100
MCS 402	Natural Language Processing	**4**	3+1+0	70	30	100
MCS 403	Artificial Intelligence	**4**	3+1+0	70	30	100
MCS 404	SystemDevelopment project(System Design andImplementation	**4**	3+1+0	70	30	150
DSE (DISCIPLINE SPECIFIC ELECTIVES) /CHOICE BASED						
MCS 405	Elective IV	**6**	4+2+0	70	30	100
GE(GENERIC ELECTIVES)						
		22		**385**	**165**	**550**

MCS 101
RDBMS

Course Objectives:

On completion of this course, a student will be familiar with fundamental knowledge of, and practical experience with, database concepts. Includes study of information concepts and the realization of those concepts using the relational data model. Practical experience gained designing and constructing data models and using SQL to interface to both multi-user DBMS packages and to desktop DBMS packages.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

1. Differentiate database systems from file systems by enumerating the features provided by database systems and describe each in both function and benefit.
2. Define the terminology, features, classifications, and characteristics embodied in database systems.
3. Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.
4. Demonstrate an understanding of the relational data model.
5. Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.
6. Formulate, using relational algebra, solutions to a broad range of query problems.
7. Formulate, using SQL, solutions to a broad range of query and data update problems.
8. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
9. Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.
10. Use a desktop database package to create, populate, maintain, and query a database.
11. Demonstrate a rudimentary understanding of programmatic interfaces to a database and be able to use the basic functions of one such interface.

Module-I

Relational Model: Introduction - Structure of Relational Data Base - Relational Algebra - Relational Calculus. Relational Query Languages - Introduction - Codd's Rules - Structured Query Language - Embedded Structured Query Language. ER Model - Basic Concepts - Conversion of ER Model into Relations - ER Diagram Symbols.

Module-II

Data Base Design: Database Development Life Cycle. Functional Dependency and Decomposition - Functional Dependency - Decomposition. Normalization - Introduction - Normalization - Normal Forms - BCNF - 4 NF - 5 NF.

Module-III

Query Processing and Optimization: Introduction - Query Processing - Syntax Analyzer - Query Decomposition - Query Optimization. Transaction Processing and Concurrency Control.

Module-IV

Data Base Recovery Systems: Introduction - Recovery Concepts - Types of Failures - Types of Recovery - Recovery Techniques. Data Base Security.

Module-V

Distributed Data Base Systems: Introduction - Distributed Data Bases - Architecture of Distributed Data Bases. Emerging Data Base Technologies: Internet Data Bases - Digital Libraries - Multimedia Data Bases - Mobile Data Bases - Spatial Data Bases.

Text Books

- S.K. Singh, "Database Systems Concepts, Design and Applications", Pearson Education Pte. Ltd., New Delhi: 2006.
- C.J. Date and others, "An Introduction to Database Systems", Eighth Edition, Pearson Education Pte. Ltd., New Delhi: 2006,
- Abraham Silberschatz, "Database Systems", McGraw Hill International, 1997.

MCS 102
Computer Architectures and Organization

Course Objectives:

This course introduces the principles of computer organization and the basic architecture concepts. The course emphasizes performance and cost analysis, instruction set design, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O systems. Basic technical writing skills are also taught in this class. student should grasp the basic concepts of computer architecture and organization, and understand the key skills of constructing cost-effective computer systems. A student should learn how to quantitatively evaluate different designs and organizations, and provide quantitative arguments in evaluating different designs. A student should be able to articulate design issues in the development of processor or other components that satisfy design requirements and objectives. In addition, a student should experience use of design tools to model various alternatives in computer design. A student should understand the basics of technical writing, and is able to construct a detailed tutorial paper on a selected topic related to computer engineering.

Course Outcomes:

After completion of the course, the student will gain:

1. Ability to understand basic structure of computer.
2. Ability to perform computer arithmetic operations.
3. Ability to understand control unit operations.
4. Ability to design memory organization that uses banks for different word size operations.
5. Ability to understand the concept of cache mapping techniques.
6. Ability to understand the concept of I/O organization.
7. Ability to conceptualize instruction level parallelism.

Module-I

BASICS: An introduction to computers with block diagram, Structure of a Digital Machine (VON-Neumann architecture). Data and Number Representation-Binary-Complement Representation, BCD-ASCII, Conversion of Numbers from one Number System to the other, (r-1)'s & r's Complement representation, Binary Arithmetic.

Module-II

Logic gates, Basic Logic Operations, Truth Tables, Boolean Expression, and Simplification. LOGIC DESIGN TECHNIQUES: Designing combinations logic using Karnaugh-Maps with building blocks of basic gates.

Module-III

Basic sequential logic blocks flip-flops, Triggering in Flip-Flops, Flip Flops – RS, JK, D and T. COMPUTER ARITHMETIC: Adder and Subtractor circuits, Booth Multiplication algorithm Performance bench marks. Registers, shift registers and counters, Multiplexers, de-multiplexer, decoders and encoders.

Module-IV

CONTROL PATH DESIGN: Sequence counter method, Micro programmed controllers address sequencing, symbolic micro – instructions codes. Register transfer & micro-operations, Central processing unit, timing and control, instruction cycle memory reference instruction.

Module-V

Bus Structure- Address bus, Data bus & DMA controller. Memory Hierarchy/organization, Main Memory, auxiliary memory, associative memory, cache memory, virtual memory. Static & Dynamic RAM, ROM, PROM, EPROM and other variants. Multiprocessors: Characteristics of Multiprocessors.

Text Books:

Morris Mano, "Computer System Architecture", PHI,3rd Ed

References:

1. Hamacher, Computer Organization, MGH
2. Carter, Schaum Outline Series, Computer Architecture, TMH

MCS 103
Operating System Architectures and Concepts

Course Objectives:

This course introduces the principles of computer organization and the basic architecture concepts. The course emphasizes performance and cost analysis, instruction set design, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O systems. Basic technical writing skills are also taught in this class. student should grasp the basic concepts of computer architecture and organization, and understand the key skills of constructing cost-effective computer systems. A student should learn how to quantitatively evaluate different designs and organizations, and provide quantitative arguments in evaluating different designs. A student should be able to articulate design issues in the development of processor or other components that satisfy design requirements and objectives. In addition, a student should experience use of design tools to model various alternatives in computer design. A student should understand the basics of technical writing, and is able to construct a detailed tutorial paper on a selected topic related to computer engineering.

Course Outcomes:

After completion of the course, the student will gain:

1. Ability to understand basic structure of computer.
2. Ability to perform computer arithmetic operations.
3. Ability to understand control unit operations.
4. Ability to design memory organization that uses banks for different word size operations.
5. Ability to understand the concept of cache mapping techniques.
6. Ability to understand the concept of I/O organization.
7. Ability to conceptualize instruction level parallelism.

Syllabus:

Module-I

Introduction to Operating Systems, Types of operating systems, Major components of OS, BIOS, IVT, BIOS versions, Dual booting, Various Operating system architectures, Design Principles, Operating Systems for tiny devices (like mobile, tablets, set-top boxes).

Module-II

Introduction to Unix, versions of Unix, Kernel architecture, Unix Shell and its types, File system, Structure of the inode, etc. Memory Management in Unix.Process States, Process State Transition, Process Control Block (PCB), Parent-child relationship, The different segments of a process, Internal and external commands.

Module-III

Introduction to Linux, versions of Linux, Kernel architecture, File system- ext2, ext3, ResierFS, Journaling capability, Linux Booting process. Memory Management in Linux. Linux Shell and its

types, concept of X-Window, KDE, Gnome. Understanding shells, batch commands, kill, ps, who, sleep.

Module-IV

Microsoft Windows families, Windows NT family, Windows File Systems, Booting Sequence, Windows 8 as Case Study: Architecture, aero and metro interfaces.Introduction to Apple's Mac OS X, basics, The Mac OS X File Structure, Units of Measure , storage, and organization methods.

Module-V

RealTime Operating System: Principles, Semaphores and Queues, Hard RealTime Scheduling Considerations, Saving Memory and Power, An example RTOS like uCOS (Open Source).

Text Books and References:

- "Operating Systems Design & implementation", Andrew S. Tanenbam, Albert S. Woodhull Pearson.
- Operating System Concepts (7_{th}Ed) by Silberschatz and Galvin, Wiley, 2000.
- Sumitabha Das, Unix : Concepts and Applications, Third Edition, 1998, Tata McGraw Hill.
- Refer Research Papers and Google Scholar.

MCS 104

Data Structure using C++

Course Objectives:

1.To teach efficient storage mechanisms of data for an easy access.
2.To design and implementation of various basic and advanced data structures.
3.To introduce various techniques for representation of the data in the real world.
4.To develop application using data structures.
5.To teach the concept of protection and management of data.
6.To improve the logical ability

Course Outcomes:

1. Student will be able to choose appropriate data structure as applied to specified problem definition.
2. Student will be able to handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
3. Students will be able to apply concepts learned in various do mains like DBMS, compiler construction etc.
4. Students will be able to use linear and non-linear data structures like stacks, queues , linked list etc.

Syllabus:

Module-I

Introduction to Data Structures, Abstract Data Types, Array- Row/Column major representation, sparse matrix, shifting

Module-II

Stacks - Introduction to Stack & Primitive Operation on Stack, Stack's Applications - Infix, Postfix & Prefix Expressions, Recursion, Multiple Stacks

Queues -Introduction to Queues, Primitive Operations on Queues, Circular Queue, Dequeue, Priority Queue, Linked List - Introduction to Linked List, Memory Representation of Linked List, Operations on Linked List, Linked List Representation of Stack and Queue, Header Nodes, Types of Linked List - Doubly Linked List, Circular Linked List, Application of Linked List

Module-III

Searching - Sequential Search, Binary Search and their Comparison (Complexity Analysis). Sorting - External & Internal Sorting, Insertion Sort, Selection Sort, Quick Sort, Bubble Sort, Heap Sort, Comparison of Sorting Methods (Complexity Analysis). Hashing.

Module-IV

Graphs - Introduction to Graphs, Basic Terminology, Directed, Undirected & Weighted Graph, Representation of Graphs, Graph Traversals - Depth First & Breadth First Search. Spanning Trees, Minimum Spanning Tree, Algorithm of Kruskal and Prim

Module-V

Trees - Basic Terminology of Trees, Binary Trees, Tree Representations as Array & Linked List. Binary Tree Representation. Traversal of Binary trees - Inorder, Preorder & Postorder, Application of Binary Tree, Threaded Binary Tree, Balanced tree, AVL tree, B-tree

Text Books and References:

- Seymour Lipschutg : Theory and practice of Data structure , Mc. Graw Hill 1998.
- Jean-Paul Trembly and Paul Sorenson, "An Introduction to Data structures with applications".
- Tannenbaum, Data Structure Using C & C++, PHI.

MCS 105

Elective I

- **Compiler Designing**
- **Principles of Communication System**

Compiler Designing

Course Objectives:

1. To make the student to understand the process involved in a compiler,
2. create an overall view of various types of translators, linkers, loaders, and phases of a compiler,
3. understand what is syntax analysis, various types of parsers especially the top down approach,
4. awareness among students the various types of bottom up parsers, understand the syntax analysis
5. and, intermediate code generation, type checking, the role of symbol table and its organization,
6. Code generation, machine independent code optimization and instruction scheduling.

Course Outcomes:

1. To introduce the major concept areas of language translation and compiler design
2. To develop an awareness of the function and complexity of compilers.
3. To provide practical, hands on experience in compiler design
4. Identify the similarities and differences among various parsing techniques and grammar transformation techniques

MODULE I

Introduction to Compiling and one pass compiler : Compilers and translators, phases of compilers, Structure of a compiler, compiler writing tools, bootstrapping, overview of one pass compiler, Error handling, **Finite Automata & Lexical Analysis :**Role of lexical analyzer, specification of tokens, recognition of tokens, regular expression, finite automata, DFA and NFA, implementation of lexical analyzer, tools for lexical analyzer, only introduction to LEX,FSM with output (mealy and Moore models), Minimization of finite automata, finite automata, equivalence of FA and regular expression.

MODULE II

Formal Languages: Definition & description, Phrase structured grammars & their classification, Chomsky classification of languages, closure properties of families of language, **Context-Free grammar:**Properties unrestricted grammar & their equivalence, derivation tree simplifying CFG, ambiguity in CFG, ε-productions, normal form for CFG

MODULE III

Syntax Analysis & Parsing Techniques:bottom up parsing and top down parsing, shift reduce parsing, operator precedence parsing, elimination of left recursion, recursive descent parsing, predictive parser construction, Transition diagram. LR parsers, constructing SL-R and canonical LR parsing tables using ambiguous grammar, Introduction to YACC, LR (1) & LALR Parsers.

MODULE IV

Syntax Directed Translation: Syntax directed translation scheme, construction of syntax trees, SDT with inherited and synthesized attributes, symbol tables, **Intermediate code generation :**Intermediate languages, prefix notation, three address code, quadruples and triples, translation of assignment statements, Boolean expression, procedural calls and iterative statements, **Run time Environment:**Source language issues, storage organization and allocation strategies, parameter passing, implementation of block structured languages.

MODULE V

Error Detection and Recovery: Errors, sources of errors, Lexical & syntactic phase error, semantic errors: panic mode error recovery & phrase level error recovery mechanisms.

Code Optimization: Optimization of basic blocks, loop optimization, global data flow analysis, loop invariant computations and other related optimization techniques.

Code Generation: Issues in design of code generation, simple code generation techniques. The DAG representation of basic blocks, generating code from DAG, dynamic programming code generation algorithm.

Books:

1. Alfred V. Aho, Ravi Sethi and J.D. Ullman "Compilers- Principles, Techniques and tools" Addison Wesley.
2. Alfred V.Aho and J.D. Ullman "Principles of Compiler Design" Narosa Publishing House.

3. Hopcroft & Ullman "Introduction to Automata theory, languages & Computation" , Narosh Publishing house.
4. Peter linz, "An Introduction to formal language and automata", Third edition, Narosa publication.
5. Dhamdhare D.M., "Compiler Construction Principles and Practice", Macmillan India.

Elective I

Principles of communication System

Course Objectives:

This course introduces students to: (i) the essential approaches, fundamental concepts and design issues in communication engineering. The course emphasizes the understanding of engineering principles. Mathematics is used only at a level that is absolutely necessary; (ii) basic concepts of modulation techniques including amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM) that are widely used in analogue communication systems, and basic techniques for analyzing such systems in the time and frequency domains; (iii) basic concepts of a digital communication system including sampling theorem, pulse code modulation (PCM) and principles of digital data transmission, and basic techniques for analyzing such systems in the time and frequency domains.

Course Outcomes:

On successful completion of this course students will be able to:

- Analyse communication systems in both the time and frequency domains.
- Have familiarity with amplitude modulated and angle modulated communication systems and be able to analyse their performance in the presence of noise.
- Understand source coding, information theory and Shannon's theorem.
- Have familiarity with various digital modulation systems and their properties, including bandwidth, channel capacity, transmission over bandlimited channels, inter-symbol interference (ISI), demodulation methods, and error performance in the presence of noise.
- Have knowledge of error correcting codes, including block codes.
- Understand engineering fundamentals of photogeneration, photodetection, lightwave propagation, for optical communications.

dule-I

Introduction to communications systems, analog and digital communication systems, Applications of communication systems, Introduction to Wireless/mobile/radio Communications Systems: Evolution, Analog-to-Digital Conversion: Sampling theorem, Pulse-Amplitude Modulation, Channel bandwidth for PAM signal, Quantization of signals, Pulse-code modulation (PCM), The PCM system, Companding, PCM signals, Differential PCM.

dule-II

Principles of amplitude modulation, AM envelope, frequency spectrum and bandwidth, modulation index and percent modulation, AM Voltage distribution, AM power distribution, Angle modulation - FM and PM waveforms, phase deviation and modulation index, frequency deviation and percent modulation.

dule-III

Examples of Wireless Communication systems: paging system, cordless systems, cellular systems, Comparison of common wireless communication systems, Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Block diagram of Transmitter and Receiver.

dule-IV

Digital Modulation Techniques: Binary Frequency-Shift Keying (BFSK), Binary Phase-Shift Keying (BPSK), Differential Phase-Shift Keying (DPSK), Quadrature Phase-Shift Keying (QPSK), Quadrature Amplitude Shift Keying (QASK), Spread spectrum modulation techniques: Pseudo-noise sequence, direct sequence spread spectrum (DS-SS), frequency hopped spread spectrum(FH-SS), performance of DS-SS, performance of FH-SS.

dule-V

Basic Principles of Satellite Communication: an overview of satellite system, satellite frequency bands for communication, Communications via satellite, characteristic features of communication satellites, Coverage area and satellite networks, Geometric distances, Communication time, and satellite visibility. Orbital Theory: Orbital mechanics, locating the satellite in the orbit w.r.t. earth look angle determination.

erences

1. Jordan Edwards C. and Balmain Keith G., "Electromagnetic Waves and Radiating Systems", Prentice Hall (India).
2. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson.
3. Haykin S & Moher M., "Modern wireless communication", Pearson, 2005.

MCS 201

Data Communication and Networking

Course Objectives:

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

1. Build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Independently understand basic computer network technology.
2. Understand and explain Data Communications System and its components.
3. Identify the different types of network topologies and protocols.
4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.

5. Identify the different types of network devices and their functions within a network

6. Understand and building the skills of subnetting and routing mechanisms.

7. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Module-I

Analog and Digital signals, Wired and Wireless transmission channels, Modulation - Analog and Digital, Multiplexing- Analog and Digital, Signal encoding techniques, Wireless Transmission: Frequency for radio transmission, Signals, Antennas, Signal propagation techniques.

Module-II

Circuit switching Networks and concepts – Asynchronous transfer mode – ATM Cells – routing in packet switching networks – effects of congestion-congestion control-traffic management.

Network Connectivity Devices: Amplifier, Repeater, Hub, Switch, Bridge, Router, Gateway, Intrusion Detection/Protection Systems, Firewall, DNS (Domain Name Server).

Module-III

Common Protocols and Interfaces in the LAN environment: Data link layers protocols, LLC and MAC sub layer protocols, Data Link Control Protocol – Flow and error control, HDLC, IEEE 802 Project and Layers, Ethernet, Token Ring, Token Bus and FDDI, Bridge protocols, Switching in the LAN environment.

Module-IV

Common Protocols and Interfaces in the Upper Layers (TCP/IP): Background (Routing protocols), TCP/IP suite, Network layer (Internetwork layer), Transport layer, Application layer, Addressing and routing design, FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), NTP (Network Time Protocol), Common WAN Protocol, ISDN, SONET.

Module-V

Medium Access Techniques: SDMA, FDMA, TDMA, CDMA, Spread Spectrum Concepts – Frequency Hopping, Infrastructure Based and Infrastructure-less (Ad hoc) networks, Cellular systems, Mobile IP Concept, Wireless LAN, IEEE 802.11: System architecture, Protocol architecture, Physical layer, Medium access control layer, MAC management, Future development, Satellite Systems: History, Applications, Basics: GEO, LEO, MEO; Routing, Localization, Handover, Examples.

Text Books and References:

- William Stallings, "Data computer communication", Prentice Hall India, 8th Edition.
- Andrew & Tanenbaum, "Computer Network ".
- Jochen Schiller, Mobile communications, Addison wisely , Pearson Education.
- Wiiliam Stallings, Wireless Communications and Networks.

MCS 202
Data Mining and Knowledge Discovery

Course Objectives:

We understand Data Mining (Knowledge Discovery) as a life-cycle process from data to information and insights. In times of Big data, Data Mining has become a central interest both for industry and academia. In this course, we discuss several data-related aspects like preprocessing as well as selected aspects of Machine Learning. An expansive definition of Data Mining, which is the derivation of insights from masses of data by studying and understanding the structure of the constituent data, and selected applications complete the course.

Course Outcomes:

- Explain the fundamental concepts of Data mining & Knowledge discovery.
- Understand the data preprocessing techniques.

- Understand Machine Learning algorithms and strategies to discovery and to deploy the discovered results.
- Argue the importance of domain knowledge during the data analysis.

MODULE I:

Introduction to KDD and Data Mining; Data Mining and Machine Learning; Machine Learning and Statistics; Generalization as Search; Data Mining and Ethics

Knowledge Representation: Decision Tables, Decision Trees, Classification Rules, Association Rules, Rules involving Relations, Neural Networks, Clusters

MODULE II:

Transformation: Attribute selection, discretizing numeric attributes: entropy based and error based discretization, converting discrete attribute to numeric attribute, Projection, Sampling, Cleansing.

MODULE III:

Learning: Supervised learning and unsupervised learning. Classification: regression, Bayesian, k nearest neighbor, ID3, C4.5, CART and NN supervised learning; Clustering: Similarity and distance measure, outlier, hierarchical, partitional algorithm.

MODULE IV

Association rule: Apriori, sampling, parallel and distributed algorithms, generalized association rule, multiple level association, correlation rule and Market basket analysis.

MODULE V

Applying Data Mining: learning from massive datasets, text Mining, web mining, spatial data mining, ubiquitous data mining

Reading Books:

1."Data Mining: Practical Machine Learning Tools and Techniques with Java Implementations", 2nd Edition, Ian Witten and Eibe Frank, Morgan Kaufmann Publishers, 2005.

2. Margaret H Dunham, "Data Mining: Introductory and Advanced Topics", ISBN: 978-81-7758-785-2, Pearson Education 2008.

3. Krzysztof J. Cios, Witold Pedrycz, Roman W. Swiniarski, "Data mining: a knowledge discovery approach", Springer, 2007

MCS 203
Research Methodology

Course Objectives:

The primary objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis. Some other objectives of the course are:

- To develop understanding of the basic framework of research process.
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of the ethical dimensions of conducting applied research.
- Appreciate the components of scholarly writing and evaluate its quality.

Course Outcomes:

At the end of this course, the students should be able to:

- understand some basic concepts of research and its methodologies
- identify appropriate research topics
- select and define appropriate research problem and parameters
- prepare a project proposal (to undertake a project)
- organize and conduct research (advanced project) in a more appropriate manner
- write a research report and thesis

• write a research proposal (grants)

MODULE I: Research Meaning, objective, Types of Research, research approach, significances of research, research process, criteria of good research, research problem, research design.

MODULE II: Sampling techniques: Sampling theory – types of sampling – Steps in sampling – Sampling and Non-sampling error – Sample size – Advantages and limitations of sampling. Collection of Data: Primary Data – Meaning – Data Collection methods – Secondary data

MODULE III: Statistics in Research – Measure of Central tendency – Dispersion – Skewness and Kurtosis in research, Hypothesis – Fundamentals of Hypothesis testing – Standard Error

MODULE IV: Para metric tests: Testing of significance – mean, Proportion, Variance and Correlation – testing for Significance of difference between means, proportions, Chi-square tests

MODULE V: Research Report: Types of reports – contents – styles of reporting – Steps in drafting reports - Editing the final draft – Evaluating the final draft.

Text/Reference Books:

- Statistical Methods - S.P. Gupta.
- Research Methodology Methods and Techniques - C.R. Kothari.
- Statistics (Theory and Practice) - B.N. Gupta.
- Research Methodology Methods and Statistical Techniques.

MCS 204
Web Programming and Extensible Markup language

Course objective:

A course focusing on the development of dynamic content and applications to facilitate information distribution. The course stresses development strategies for managing the rapidly changing information of corporations and organizations for just-in-time distribution, using authoring programs to create interactive multimedia products that utilize database management systems, file systems, and HTML/XML to provide a method for visualizing and manipulating that data. Significant time is spent on intermediate to advanced programming and scripting. Students are required to plan, design and implement a major project. Topics include intranets, networks, the World Wide Web, development languages (JSP,ASP dot net), and other newly developed technologies (e.g. AJAX).

Course Outcomes:

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

- Demonstrate understanding of (X)HTML(5)+CSS programming.
- Create and compile advanced dynamic web projects using client - JQuery(Javascript) and server – PHP technology.

- Demonstrate understanding of database applications with MySQL.
- Show understanding of the logic behind advanced web applications.
- Demonstrate an understanding of Content Management Systems

MODULE I:

Web architecture and HTTP, History of World Wide Web, Hyper Text Transfer Protocol, SMTP, FTP, Hyper Text Markup Language, Introduction to XML, Benefit of XML over HTML, Web Architecture Using XML, Difference Between SGML, HTML and XML, Advantage and Future of XML, Advantage of XML, Heterogeneity, Flexibility, Information Modeling Static Vs Dynamic Modeling, Component of an XML Document, Identifying the Rule for Creating XML Document, Displaying XML, Transforming XML.

MODULE II:

Electronic Data Interchange and EAI, Scope of EDI in E – Commerce, Processing Instruction, Element Content, Attribute Comment Data Types Available in XML ,CDDATA, PCDATA Well Formed and Valid Documents, XML Parser, Validating and Non Validating Parser, Element Attribute and Entity Declaration DTD's Documents type Declaration & Document type Definition Why DTD's Internal and External DTD's Building Our Own DTD, Declaration Style + * and Qualifier Attribute Data Type, #IMPLIED, #FIXED and # REQUIRED.

MODULE III:

Namespaces, Namespace syntax, use and benefit of it Issues With DTD's Advantages of XML schemas , Advantages of XSD over DTD's Support and Validation of XML using Version Parsers, Simple types, Complex type including Element Restrictions min Occurs Max Occurs available constraining facets in the XSD Schema and their Use Import and Include What is XSLT, XSLT Syntax , Cascading Style Sheet CSS Vs XSLT, Benefit and Difference of XSLT over XSLT, Templates, Style sheet values, Working of XSLT, Processor Element, Attribute, Text, Select, Template, Calling Template.

MODULE IV:X Path Overview Major Features of X Path Tree Structure, Path Expression, X Path in java, .NET and PHP Tools for X Path, What is X Query, X Query Use Cases, Advantages of X Query, Structure of X Query Expression, for, let, Order by and Return Clause, X Query Built in Function Built-in Aggregate and String Functions, X Query in java.

MODULE V: Implementation of DOM in MSXML Parser, Tree Structure of Document, XML DOM Object and Method, The Document Object in Script, Viewing and Adding Elements on XML tree Using XOM Handling Dom Events, Various types of DOM Nodes.

Text Books / References Books:

- "XML The Complete Reference" by Heather Williamson, McGraw-Hill.
- "XML Complete" by Steven Holzner, McGraw-Hill.
- "XML by Example : A Webmaster's Guide" by Sean McGrath, Prentice Hall.

MCS 205

Elective II

- **Graph Theory**
- **Cryptography**

Graph Theory

Course Objectives:

1. To understand and apply the fundamental concepts in graph theory
2. To apply graph theory based tools in solving practical problems
3. To improve the proof writing skills.

Course Outcomes:

The students will be able to apply principles and concepts of graph theory in practical situations. Students should possess the following skills:

1. Understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices.
2. Understand the properties of trees and able to find a minimal spanning tree for a given weighted graph.
3. Understand Eulerian and Hamiltonian graphs.

Module I

Graphs, Sub graphs, basic properties of graph, walks, path & circuits, connected graphs, disconnected graphs and component, Euler graphs, various operation on graphs, Hamiltonian paths and circuits, the travelling sales man problem.

Module II

Trees and fundamental circuits, distance diameters, radius and pendent vertices, rooted and binary trees, on counting trees, spanning trees, fundamental circuits, finding all spanning trees of a graph and a weighted graph, algorithms of primes, Kruskal and dijkstra Algorithms.

Module III

Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets , connectivity and separability, network flows, planer graphs, combinatorial and geometric dual

Module IV

Vector space of a graph and vectors, basis vector, cut set vector, circuit vector, circuit and cut set verses subspaces, orthogonal vectors and subspaces; incidence matrix of graph; circuit matrix, cut set matrix, path matrix and relationships; fundamental circuit matrix and rank; adjacency matrices; rank-nullity theorem.

Module V

Coloring and covering and partitioning of a graph, chromatic number, chromatic partitioning, chromatic polynomials, matching, covering, four color problem, Directed graphs, some type of directed graphs, Directed paths, and connectedness, Euler digraphs, trees with directed edges, fundamental circuits in digraph, matrices A, B and C of digraphs adjacency matrix of a digraph, enumeration, types of enumeration, counting of labeled and unlabeled trees.

Suggested Readings:

1. Deo, N: Graph theory, PHI
2. G. Chartrand and P. Zhang: Introduction to Graph Theory, McGraw Hill International Edition, 2005.
3. Harary, F: Graph Theory, Narosa
4. Bondy and Murthy: Graph theory and application. Addison Wesley.

Elective II
Cryptography

Course Objectives:

In today's cyber world, it is important for engineers to understand and appreciate computer/information security as it has becomes an essential aspects of our day life. This course provides students with concepts of computer security, cryptography, digital money, secure protocols, detection and other security techniques.

Course Outcomes:

Upon the completion of this course, students should be able to understand, appreciate, employ, design and implement appropriate security technologies and policies to protect computers and digital information.

Module-I

Introduction to cryptography, Conventional encryption model, classical encryption techniques-substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Need of cryptography, Various Modern Block Ciphers principals, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES.

Module-II

Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms, Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm.

Module-III

Message Authentication and Hash Function, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA), Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Module-IV

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

Module-V

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management, Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Books:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.
2. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.
3. Bruce Schiener, "Applied Cryptography".

MCS 301
Information security

Course Objectives:

Information Security is a comprehensive study of the principles and practices of computer system security including operating system security, network security, software security and web security. Topics include common attacking techniques such as virus, trojan, worms and memory exploits; the formalisms of information security such as the access control and information flow theory; the common security policies; the basic cryptography, RSA, cryptographic hash function, and password system; network intrusion detection; software security theory; web security; legal and ethical issues in computer security.

Course Outcomes:

The learning outcome is students shall be able to understand what are the common threats faced today, what are the foundational theory behind information security, what are the basic principles and techniques when designing a secure system, how to think adversarially, how today's attacks and defenses work in practice, how to assess threats for their significance, and how to gauge the protections and limitations provided by today's technology.

Module I

History of Information Systems and its Importance; Changing Nature of Information Systems, Need of Distributed Information Systems; Information System Threats and attacks, Classification of Threats and Assessing Damages.

Module II

Security in Mobile and Wireless Computing; Security Implication for organizations, Laptops Security; Basic Principles of Information Security, Confidentiality, Integrity Availability.

Module III

E Commerce and Security Threats; E Governance and EDI; Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls; Biometric Access Control- Factors, Criteria for selection, Design Issues, Economic and Social Aspects and Legal Challenges

Module IV

Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Finger Prints, Firewalls, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection; Virtual Private Networks- Need, Use and Types of VPNs.

Module V

Security metrics- Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mining Security, Cyber Crime Types & overview of Cyber Crimes

References:

1. Godbole," Information Systems Security", Willey
2. Merkov, Breithaupt," Information Security", Pearson Education
3. Yadav, "Foundations of Information Technology", New Age, Delhi
4. Schou, Shoemaker, " Information Assurance for the Enterprise", Tata McGraw Hill
5. Sood,"Cyber Laws Simplified", Mc Graw Hill
6. Furnell, "Computer Insecurity", Springer
7. IT Act 2000

MCS 302
Big Data Management

Course Objectives:

The main objective of this course is to teach students:

1. The basics of Hadoop , Mapreduce algorithm
2. The basics of Analytics– Concepts, Data preparation – merging, managing missing numbers sampling , Data visualisation, Basic statistics.
3. Lots of practise to ensure that we are very comfortable handling an Analytics project on Big Data

Course Outcomes:

At the end of the module, students will possess the skills necessary for utilizing tools (including deploying them on Hadoop/MapReduce) to handle a variety of big data analytics, and to be able to apply the analytics techniques on a variety of applications.

MODULE I – INTRODUCTION TO BIG DATA

Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

MODULE II – INTRODUCTION HADOOP

Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

MODULE- III HADOOP ARCHITECTURE

Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

MODULE-IV HADOOP ECOSYSTEM AND YARN

Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New FeaturesNameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

MODULE-V HIVE AND HIVEQL, HBASE

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying, Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase conceptsAdvanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

REFERENCES

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al., "Understanding Big data ", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide" , O Reilly 2012.
4. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packet Publishing 2013.
5. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
6. http://www.bigdatauniversity.com/
7. Jy Liebowitz, "Big Data and Business analytics",CRC press, 2013.

MCS 303
Mobile computing

Course Objectives:

1. To provide guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services
2. To develop an appreciation of interaction modalities with small, mobile devices (including interface design for non-standard display surfaces) through the implementation of simple applications and use cases.
3. To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices.
4. To understand the use of transaction and e-commerce principles over such devices to support mobile business concepts
5. To appreciate the social and ethical issues of mobile computing, including privacy.

Course Outcomes:

At the end of the module, the student will be able to demonstrate:

1. A working understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities
2. The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.
3. A comprehension and appreciation of the design and development of context-aware solutions for mobile devices.
4. An awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behaviour.

Module I

Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

Module II

Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

Module III

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations, security and fault tolerance, transaction processing in mobile computing environment.

Module IV

TCP over wireless networks, Indirect TCP, Snooping TCP, Mobile TCP, Fast transmit/Fast recovery, Transmission/timeout freezing, transaction oriented TCP, Mobile Routing protocols.

Module V

Ad Hoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

Books:

1. J. Schiller, Mobile Communications, Addison Wesley.
2. A. Mehrotra , GSM System Engineering.
3. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.
4. Charles Perkins, Mobile IP, Addison Wesley.
5. Charles Perkins, Ad hoc Networks, Addison Wesley.

MCS 305

Elective III

- **Neural Networks**
- **Network Security**

Neural Network

Course Objectives:

This course aims at introducing the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence. This can be summarized as:

1. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
2. To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic
3. To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

Course Outcomes:

At the end of the course, students should be able to understand and appreciate:

- The role of neural networks in engineering, artificial intelligence, and cognitive modelling.
- Feed-forward neural networks of increasing complexity, gradient descent learning and extensions, learning and generalization theory
- Hopfield model of content-addressable memory, Hopfield-Tank approach to optimisation, resistive networks for vision models, complex dynamical learning models.
- Generalization and function approximation
- Competitive learning, Self-organizing feature maps
- have an understanding of the concepts and techniques of neural networks through the study of the most important neural network models.
- have a knowledge of sufficient theoretical background to be able to reason about the behaviour of neural networks.
- be able to evaluate whether neural networks are appropriate to a particular application.
- be able to apply neural networks to particular applications, and to know what steps to take to improve performance.
- have knowledge of research literature on neural networks in one particular domain, and be able to put new work into context of that literature.

Module I

Introduction of Neural Network (ANN) , Motivation , Biological Neural Network , Single models , The artificial neuron model, Hopfield nets, Application of NN , Perception Network , Multilayer networks their variants and application , capacity of multilayer network.

Module II

Feedback network and feed forward networks their introduction, Back propagation Network (BPN); Introduction, aim, Learning Rule, Recurrent nets, Tree structure network, unsupervised learning, Hebbian learning

Module III

Competitive learning Feature mapping , self organizing maps, Adaptive Resonance Theory (ART); Introduction , ART fundamentals, basic architecture, ART1, ART2 , Conclusion recent trends and future directions

Module IV

Introduction to Genetic Algorithms (GA) – Applications of GA in Machine Learning – Machine Learning Approach to Knowledge Acquisition. Chromosome representation, encoding, decoding, Genetic operators:

Selection, Crossover, Mutation, Elitism, Schema Theorem, EGA, Convergence theorem, real-coded GA, Ordered GA, Steady-state GA, Multi-objective evolutionary algorithms.

Module V

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions- Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.

1. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn., 2003.
2. Simon Haykin - Neural Networks: A Comprehensive Foundation
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995.

Elective III

Network security

Course Objectives:

In today's cyber world, it is important for engineers to understand and appreciate computer/information security as it has becomes an essential aspects of our day life. This course provides students with concepts of computer security, cryptography, digital money, secure protocols, detection and other security techniques. This course tries:

1. To give a clear insight into cryptography, authentication and emerging security standards.
2. To impart knowledge on network security protocols.

Course Outcomes:

Upon the completion of this course, students should be able to understand, appreciate, employ, design and implement appropriate security technologies and policies to protect computers and digital information. This course Enables the students to develop security algorithms in the network.

Syllabus:

MODULE I

Web security problems Introduction, Basic concepts: confidentiality, integrity, availability, security policies, security mechanisms, assurance Basic Cryptography, Historical background, Caesar Cipher, Introduction to Symmetric and Asymmetric crypto primitives, and Hash functions

MODULE II

Secret Key Cryptography Applications, Data Encryption Standard (DES) Encrypting large messages (ECB, CBC, OFB, CFB, CTR)Multiple Encryption DES (EDE) Message Digests Applications, Strong and weak collision resistance, MD5, SHA-1 , Public Key Cryptography Applications Theory: Euclidean algorithm, Euler Theorem, Fermat Theorem, Totent functions, multiplicative and additive inverse, RSA, Selection of public and private keys

MODULE III

Authentication: Security Handshake pitfalls, Online vs. offline password guessing, Reflection attacks, Per-session keys and authentication tickets, Key distribution centers and certificate authorities, Trusted Intermediaries, Public Key infrastructures, Certification authorities and key distribution centers, Kerberos

MODULE IV

Introduction to TCP/IP protocol stack, Implementation layers for security protocols and implications, IPsec: AH and ESP, IKE, SSL/TLS , Electronic Mail Security, Establishing keys Privacy, source authentication, message integrity, non-repudiation, proof of submission, proof of delivery, message flow confidentiality, anonymity, Pretty Good Privacy (PGP)

MODULE V

Firewalls and Web Security, Packet filters, Application level gateways, Encrypted tunnels, Cookies, Data base privacy, buffer overflow attacks, SQL injection attacks.

Reference books:

- Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

MCS 401

Image processing

Course Objectives:

This course is an introduction to the fundamental concepts and techniques in basic digital image processing and their applications to solve real life problems. The topics covered include Digital Image Fundamentals, Image Transforms, Image Enhancement, Restoration and Compression, Morphological Image Processing, Nonlinear Image Processing, and Image Analysis. Application examples are also included.

Course Outcomes:

Upon completion of this course, students will be familiar with basic image processing techniques for solving real problems. Student will also have sufficient expertise in both the theory of two- dimensional signal processing and its wide range of applications, for example, image restoration, image compression, and image analysis.

MODULEI - INTRODUCTION

Fundamental Steps in Image Processing: Element of visual perception, Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels.

Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation.

MODULEII

Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods

Image restoration: A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function.

MODULEIII -MORPHOLOGICAL ALGORITHMS

Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms, Image Segmentation : Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation, region-oriented segmentation, representation schemes like chain codes, polygonal approximations, boundary segments, skeleton of a region,

MODULEIV - IMAGE COMPRESSION

Introduction – Principle of compression – Types of compression – Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards, Runlength Encoding – Huffman Coding – Modified Huffman Coding JPEG – Other State-of-the-Art Image Compression – Image Compression Standard Fie Formats.

MODULEV - PATTERN RECOGNITION

Introduction, System Component, Complexity of Pattern Recognition, Object Representation, Feature Detection, Recognition Strategies – Classification, Matching, Feature Indexing, Recognition based on decision–theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching

REFERENCES BOOKS

1. Rafael C. Gonzalez, Richard.E, “Digital Image Processing (3rd Edition”) Woods Prentice Hall, 2007.
2. Anji Reddy.M, Hari Shankar.Y, “Textbook of Digital Image Processing”, BS Publications, 2006.
3. Robert Shcowebgerdt , “Remote sensing models & methods for image processing”, III edition, 2004.

4. William K. Pratt, Digital Image Processing: PIKS Inside (3rd ed.), John Wiley & Sons, Inc., 2001
5. M.A. Joshi, Digital Image Processing: An Algorithmic Approach, Prentice-Hall of India, 2006
6. B. Chandra and D.D. Majumder, Digital Image Processing and Analysis, Prentice-Hall of India, 2007

MCS 402

Natural language processing

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

Course Outcomes:

Upon end of this course, the students would gain:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline.
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- An ability to function effectively on teams to accomplish a common goal.
- An understanding of professional, ethical, legal, security, and social issues and responsibilities.
- An ability to use current techniques, skills, and tools necessary for computing practice.
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

Module I

Introduction to Natural Language Understanding: The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

Module II

Introduction to semantics and knowledge representation, Some applications like machine translation, database interface.

Module III

Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

Module IV

Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

Module V

Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Books:

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, NLP: A Paninian Perspective, Prentice Hall, New Delhi
2. James Allen, Natural Language Understanding, 2/e, Pearson Education, 2003
3. D. Jurafsky, J. H. Martin, Speech and Language Processing, Pearson Education, 2002
4. L.M. Ivansca, S. C. Shapiro, Natural Language Processing and Language Representation
5. T. Winograd, Language as a Cognitive Process, Addison-Wesley

MCS 403

Artificial Intelligence

Course Objectives:

The course is designed to introduce both − (I) The traditional approach to machine learning using symbolic representations and manipulations, i.e., knowledge representations and problem solving techniques. (2) Techniques and application of machine learning techniques to data mining.

Course Outcomes:

Upon completion of this course,

- students will be familiar with several powerful search techniques for automatically solving complex problems.
- Student will also have sufficient expertise in both the theory of machine learning and its application to data mining, so as to use these powerful techniques in a wide range of industrial contexts, for example, bioinformatics, electronic commerce, and finance.

Module I

Introduction and Overview: Meaning Of AI, The AI Problems, Task Domains, AI Technique, Criteria for Success, Problems, Problem Spaces & Search: Defining The Problem As a State Space Search,

Module II

Production Systems – BFS, DFS, Heuristic Search, Common AI Problems, Heuristic Search Techniques: Generate & Test, Hill Climbing, Best First Search, Constraint Satisfaction, Means-End Analysis

Module III

Knowledge Representation: General Concepts Of Knowledge, Approaches of Knowledge Representation, Predicate Logic To Represent Knowledge, Resolution, Unification algorithm, Knowledge Representation using Rules: Procedural Vs Declarative Knowledge, Logic Programming, Forward Vs Backward Reasoning, Matching & Control Knowledge

Module IV

Statistical Reasoning - Probability & Bayes Theorem, Certainty Factors and Rule Based Systems, Bayesian N/W, Fuzzy Logic and applications, Natural Language Processing – Introduction, Steps, Syntactic Processing, Semantic Analysis, Discourse & Pragmatic Processing, Spell Checking

Module V

Learning: Meaning, Rote Learning, Learning by taking Advice, Learning from examples, Explanation-Based learning, Expert Systems & Its Architecture, Speech Recognition, Overview of Prolog: Introduction, Converting English to Prolog Facts and Rules, Goals, Prolog Terminology.

MCS 404
System Development project (System Design and Implementation)

MCS 405
Elective IV

- **Distributed and Parallel Computing**
- **Cloud Computing**

Distributed data and parallel computing

Course Objectives:

A selection of topics from the following: the challenges faced in constructing parallel and distributed applications, including testing, debugging and performance evaluation.Understanding the major tools and techniques that allow programmers to effectively program the parts of the code that require substantial communication and synchronization;

- Studying the core ideas behind modern coordination and communication paradigms and distributed data structures;
- Introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs;
- Realizing not only the basic principles but also the best practice engineering techniques of concurrent and distributed computing;
- Presenting techniques to formally study the safety and progress properties of concurrent and distributed algorithms;
- Analyzing the performance of current multi-core and future many-core systems.

Course Outcomes:

On successful completion of this course students will be able to:
1. To develop and apply knowledge of parallel and distributed computing techniques and methodologies.
2. To gain experience in the design, development, and performance analysis of parallel and distributed applications.
3. To gain experience in the application of fundamental Computer Science methods and algorithms in the development of parallel applications.
4. To gain experience in the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.

MODULE I

Introduction to Distributed Data system, Distributed Database Architecture, Distributed Data base Design, Transaction processing Concurrency Control techniques, Security. Types of Data Fragmentations, Fragmentation and allocation of fragments, Distribution transparency, access primitives, integrity constraints.

MODULE II

Parallel Computing: Introduction to parallel computing. Parallel computing platforms. Communication cost in parallel machine: message passing costs in parallel computers and communication costs in shared-address-space machines. Parallel algorithm models: the data parallel model, the task graph model, the work pool model, the master-slave model, the pipelining or producer consumer model and hybrid model. Performance metric of parallel systems: execution time, total parallel overheads, speed up, efficiency and cost. Scalability of parallel systems, application of parallel computing

MODULE III

Grouping and aggregate function, Query processing, Equivalence transformation of queries. Management of Distributed transaction and concurrency control: Distributed Data base Administration, Catalouge Management Authorisation, Security and protection. Examples of distributed database systems. Cost Analysis

MODULE IV

Task Partitioning and Load Balancing: Introduction to task partitioning strategies, Static task partitioning and scheduling strategy, ,Master Initiated Sub-task (MIS) size scheduling strategy, Worker-Initiated Sub-task(WIS) size scheduling strategy, runtime task scheduling strategy, MIMD(Multiple Instruction Multiple Data) classification, SIMD(Single Instruction Multiple Data) classification.

MODULE V

The load balancing problem: static versus dynamic load balancing, classification of load balancing algorithms. Deterministic: the diffusion method, the dimension exchange method and the gradient method. Stochastic algorithms: randomized allocation and physical optimization. Models of load balancing algorithm. Termination detection of load balancing. Performance metrics.

References:

1. Ceri & Palgathi, "Distributed Database System", McGraw Hill.
2. Raghu Rama Krishnan and Johannes Gechrib, "Database Management Systems", Mc Graw Hill.
3. Date C. J, "An Introduction to Database System, Vol1 & II", Addition Wesley.
4. Korth, Silbertz, Sudarshan , "Database Concepts", McGraw Hill.
5. Elmasari , Navathe, "Fundamentals of Data Base Systems", Addition Wesley.
6. Data C. J , "An Introduction to Database System" , Addition Wesley
7. RamaKrishnan , Gehke, "Database Management System", McGraw Hill

Elective IV

Cloud Computing

Course Objectives:

The student will learn about the cloud environment, building software systems and components that scale to millions of users in modern internet, cloud concepts capabilities across the various cloud service models including Iaas,Paas,Saas, and developing cloud based software applications on top of cloud platforms.

Course Outcomes:

On completion of this course, the students would have:

1. Understanding the key dimensions of the challenge of Cloud Computing
2. Assessment of the economics , financial, and technological implications for selecting cloud computing for own organization
3. Assessing the financial, technological, and organizational capacity of employers for actively initiating and installing cloud-based applications.
4. Assessment of own organization's needs for capacity building and training in cloud computing-related IT areas

Module I

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

Module II

Cloud Applications: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

Module III

Cloud Services Management: Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization.

Module IV

Virtualized Data Center Architecture : Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and design, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures, Application Development: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Module V

Security Concepts: Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud;

References

1. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach [ISBN: 0071626948]
3. Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]