University Institute of Technology (UIT)

Silver Wood Estate, H. P. University, Shimla-171005

(NAAC Accredited "A-Grade" University)

DEPARTMENT OF

INFORMATION TECHNOLOGY

Course Structure & Syllabus

for

Master of Technology Information Technology

in

Semester I-IV

Effective for the Batch 2024-2025 and onwards

SCHEME of the SYLLABUS

SEMESTER I

Subject Code	Subject	Schedule of Teaching			Schedule of Examination		
		L	P	Credits	IA	Ext. E.	Total
HSMC	Research Methodology	4	0	4	50	100	150
MT(IT)(ID)-101	Network security and cryptography	4	0	4	50	100	150
MT(IT) ID102	Advanced Concepts in Operating system	4	0	4	50	100	150
MT(IT)-103	Advanced Web Technology	4	0	4	50	100	150

XX-XXX	Elective I	4	0	4	50	100	150
MT(IT)(ID)104	MAT LAB	0	3	2	25	25	50
TOTAL		20	3	22	275	525	800

Elective-I	
ES-101	Artificial Intelligence
ES-102	Digital Image Processing
ES-103	Natural Language Processing
ES-104	Graph Theory and Optimization
ES-105	Quantum Computing

SEMESTER II

Subject Code	**Subject**	**Schedule of Teaching**			**Schedule of Examination**		
		L	**P**	**Credits**	**IA**	**Ext.E.**	**Total**
MT(IT)-201	Data Science	4	0	4	50	100	150
MT(IT)-202	Analysis of Algorithms	4	0	4	50	100	150
MT(IT)(ID)-203	Foundations of Open Source Technologies	4	0	4	50	100	150
MT(IT)-204	Cloud Computing	4	0	4	50	100	150
XX-XXX	Elective II	4	0	4	50	100	150
MT(IT)-205	Analysis of Algorithms Lab	0	3	2	25	25	50
TOTAL		20	3	22	275	525	800

Elective-II	
ES-201	Graphics and Multimedia
ES-202	Data Warehousing and Data Mining
ES-203	Human Computer Interaction
ES-204	Pattern Recognition Techniques
ES-205	Soft Computing

SEMESTER III

Subject Code	**Subject**	**Schedule of Teaching**			**Schedule of Examination**		
		L	**P**	**Credits**	**TA**	**ESE**	**Total**
XX-XXX	Self-Study/ Elective III	4	0	4	50	100	150
MT(IT)-301	Ethical Hacking	4	0	4	50	100	150
MT(IT)- 302	Research Proposal	0	0	6	150	150	300
TOTAL		8	0	14	250	350	600

Elective III

ES-301	VLSI Design
ES-302	Machine learning for Big Data
ES-303	Advanced Parallel Programming
ES-304	Distributed Database
ES-305	Advanced Computer Networks

SEMESTER IV

Subject Code	Subject	Schedule of Teaching			Schedule of Examination		
		L	P	Credits	TA	ESE	Total
MT(IT)-401	Dissertation	0	0	12	300	500	800
TOTAL		0	0		300	500	800

L – Lecture,

P – Practical

IA - Internal Assessment (Assignments, attendance, group discussion, Quiz, tutorials, seminars, etc.)

Ex. E. - External Examination to be conducted by the University

Detailed Syllabus

Semester – I

Name of the Course	**Research Methodology**		
Course Code	**HSMC**	Credits-4	L-3, T-1, P-0

Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

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

Section	Course Content
Section-A	Research Aptitude: Meaning of Research, Objectives of Research, and Motivation in Research, Types of Research, Research Approaches, and Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is done. Research Process: Reviewing the literature, Formulation of research problem, Nature and type of variables, Hypothesis - meaning, types, development of hypothesis and its testing, Meaning & Functions of Research Design.
Section-B	Data Analysis: Sources, acquisition and interpretation of data, Quantitative and qualitative data, Graphical representation and mapping of data, Sensitivity Analysis with Data Tables, Optimization with EXCEL Solver, Summarizing Data with Histograms and Descriptive Statistics, Pivot Tables, Summarizing Data with database statistical functions, using correlation, Multiple Regression, Using Sampling to Analyse Data
Section-C	Significance of Report Writing : Different Steps in writing Report, Layout of the Research Report, Types of Reports, Mechanics of Writing a Research Report, Art of scientific writing- Steps to better writing, flow method, organization of material and style, Drawing figures, graphs, tables, footnotes, references etc. in a research paper
Section-D	Use of Internet in Research Work : Use of internet networks in research

	activities in searching material, paper downloading, submission of papers, relevant websites for journals and related research work. Introduction to Patent laws etc., process of patenting a research finding, Copy right, Cyber laws.

Course Outcomes:

COs1: Identify and discuss the role and importance of research in the social sciences.

COs2: Identify and discuss the issues and concepts salient to the research process.

COs3: Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.

COs4: Identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.

Text Books:

1. Kothari, C. R., "Research Methodology Methods and Techniques", Wiley Eastern Ltd.

Reference Books:

1. Wayne L. Winston, "Microsoft Excel Data Analysis and Business Modelling", Microsoft Press.
2. Kumar, "Research Methodology: A Step-by-Step Guide for Beginners", Pearson Education.
3. Dawson, C., "Practical Research Methods", UBSPD Pvt. Ltd.
4. Sharma, N. K., "Research Methodology", KSK Publishers.

Name of the Course	**Network Security & Cryptography**		
Course Code	**MT(IT)(ID)-101**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To know the methods of conventional encryption
- To understand the concepts of public key encryption and number theory ❖ To understand authentication and Hash functions ❖ To know the network security tools and applications.
- To understand the system level security used.

Section	Course Content
Section-A	OSI Security Architecture, Classical Encryption techniques, Cipher Principles, Data Encryption Standard, Block Cipher Design Principles and Modes of Operation, Evaluation criteria for AES, AES Cipher, Triple DES, Placement of Encryption Function, Traffic Confidentiality Security trends, Attacks and services, classical cryptosystems, Different types of ciphers, LFSR sequences, Basic number theory, Congruence's, Chinese remainder theorem, Modular exponentiation, Fermat and Euler's theorem, Finite fields, continued fractions
Section-B	Simple DES, Differential Crypto analysis, DES, Modes of operation, Triple DES, AES, RC4, RSA, Attacks, Primality test factoring Authentication requirements, Authentication functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures, Authentication Protocols, Digital Signature Standard
Section-C	Authentication applications, Kerberos, X.509, PKI, Electronic Mail Security, PGP, S/MIME, IP Security, Web Security, SSL,TLS,SET. Browser general concepts, functionalities, browsers war, browsers comparison, browser security (add-ons, same-origin policy etc.) and secure browsing

Section-D	System Security, intrusion detection, Password Management, Malicious Software, Viruses and related threats, Virus Countermeasures, Distributed
	denial of service attacks. Firewalls- Firewalls design principles, Trusted systems, and Common criteria for Information Technology Security Evaluation.

Course Outcomes:

COs1: Acquire background on well-known network security protocols such as IPSec, SSL, and WEP. Understand vulnerability analysis of network security. Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.

Text Books:

1. William Stallings, "Cryptography & Network Security - Principles and Practices", Prentice Hall of India, Third Edition, 2003.
2. Wade Trappe, Lawrence C Washington, ―Introduction to Cryptography with coding theory‖, 2nd edition, Pearson, 2007.

Reference Books: 1. W. Mao, ―Modern Cryptography –Theory and Practice‖, Pearson Education, Second Edition 2007.

2. Charles P. Pflieger, Shri Lawrence Pflieger-Security in Computing 3rd editionPrentice Hall of India.

Name of the Course	**Advance Concepts in Operating System**		
Course Code	**MT(IT) ID-102**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- The aim of this module is to study, learn, and understand the main ***concepts*** of ***advanced operating systems*** (parallel processing ***systems***, distributed ***systems***, real time ***systems***, network ***operating systems***, and open source ***operating systems***); Hardware and software features that support these ***systems***.

Section	**Course Content**
Section-A	DISTRIBUTED OPERATING SYSTEMS: Introduction, Issues, Communication Primitives, Inherent Limitations, Lamport's Logical Clock; Vector Clock; Causal Ordering; Global State; Cuts; Termination Detection. Distributed Mutual Exclusion, Non-Token Based Algorithms, Lamport's Algorithm, and Token Based Algorithms. Suzuki Kasami's Broadcast Algorithm, Distributed Deadlock Detection Issues, Centralized Deadlock Detection Algorithms, Distributed Deadlock Detection Algorithms, Agreement Protocols Classification, Solutions, and Applications.
Section-B	DISTRIBUTED RESOURCE MANAGEMENT: Distributed File Systems, Design Issues, Distributed Shared Memory, Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing, Scheduling Algorithms, Synchronous and Asynchronous Check Pointing and Recovery.
Section-C	REAL TIME AND MOBILE OPERATING SYSTEMS: Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems, Real Time Task Scheduling, Handling Resource Sharing, Mobile Operating Systems, Micro Kernel Design, Client Server Resource Access, Processes and Threads, Memory Management.

Section-D	INTRODUCTION TO ANDROID: Android Application package (APK), Working with Eclipse and Android, Application Design, Controls and User Interface, Basic Graphics ad View class, Using Google Maps in applications, Applications with multiple screens, Adding Menus and popup menus in
	applications, working with images, working with text files, tables and XML, building client server applications, Publishing your application.

Course Outcomes:

COs1: Acquire sufficient knowledge on distributed operating systems and management of resources in the same. Possess real time knowledge on mobile operating systems with focus on Android.

Text Books/Reference Books:

1. Mukesh Singhal and Niranjan G. Shivaratri, ―Advanced Concepts in Operating Systems - Distributed, Database, and Multiprocessor Operating Systems‖, Tata McGraw Hill.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, ―Operating System Concepts‖, Wiley India Pvt. Ltd.
3. Rajib Mall, ―Real Time Systems: Theory and Practice‖, Pearson Education India.
4. James C.S. ―Android Application development‖, CENGAGE Learning.
5. Gargenta M., Nakamura M., ―Learning Android‖, OREILLY Publishers.

Name of the Course	**Advanced Web Technology**		
Course Code	**MT ID 103**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To know the methods of conventional encryption.
- To understand the concepts of public key encryption and number theory.
- To understand authentication and Hash functions.
- To know the network security tools and applications.
- To understand the system level security used.

Section	Course Content
Section-A	Introduction: Web Browsers, Caching, Downloading and Rendering, Persistent Connections, DNS caching and perfecting, CSS Expressions and performance, Buffering, Weblog Optimization and Security: Parallel Downloading, Controlling caches, Content compression, Control size with magnification, Optimizing images, Load balancers, Tuning MYSQL, Using query caching, Optimizing query execution and optimization, Marketing of Website: traffic generation, Newsletters; Security: SQL: query log, SQL injections.
Section-B	Search engines: Searching techniques used by search engines, keywords, advertisements, Search engine optimization for individual web pages: header entries, tags, selection of URL, alt tags, Search engine optimization for entire website: Hyperlinks and link structure, page rank of Google, click rate, residence time of website, frames, scripts, content management system, cookies, robots, Pitfalls in Optimization: optimization and testing, keyword density, doorway pages, duplicate contents, quick-change of topics, broken links, poor readability, rigid layouts, navigation styles; tools for optimization'stracking, Google analytics, checklists.

Section-C	Introduction to JavaScript: Introduction, Obtaining user inputs, memory concepts, Operators, Control Structures, Looping constructs, break, continue statements, Programmer defined functions, Scoping rules, Recursion and iteration, Array declaration and allocation, passing arrays to function, Objects: String, Date, Boolean, Window, document; using cookies, Handling Events
	Using JavaScript.
Section-D	Introduction to PHP: Installing and Configuring MySQL and PHP, Basic Security Guidelines, Variables, Data Types, Operators and Expressions, Constants, Flow Control Functions; Switching, Flow, Loops, Code Blocks and Browser Output, Objects, Strings Processing, Form processing, Connecting to database, using cookies, dynamic contents.

Course Outcomes:

- **COs1:** Understand the major areas and challenges of **web** programming.
- **COs2:** Distinguish **web**-related **technologies**.
- **COs3:** Use **advanced** topics in HTML5, CSS3, and JavaScript.
- **COs4:** Use a server-side scripting language, PHP.
- **COs5:** Use a relational DBMS, My SQL.
- **COs6:** Use PHP to access a My SQL database.

Text Books:

1. Peter Smith, ―Professional Website performance‖ Wiley India Pvt. Ltd.
2. Maro Fischer,‖ Website Boosting: Search Engine, Optimization, Usability, Website Marketing‖, Firewall Media, New Delhi.
3. Deitel H.M., Deitel P.J., ―Internet & World Wide Web: How to program‖, Pearson Education

Reference Books:

1. Kogent Learning, ―Web Technologies: HTML, JavaScript, PHP, Java, JSP, AJAX Black Book‖, Wiley India Pvt. Ltd.
2. Boronczyk, Naramore, ―Beginning PHP, Apache, MySQL Web Development‖, Wiley India Pvt. Ltd.

Name of the Course	**MAT LAB**		
Course Code	**MT(IT)(ID)-104**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters/ For Candidates: Laboratory examination will consist of two parts:
Performing a practical examination assigned by the examiner (25 marks).
Viva-voce examination (25 marks).
Viva-voce examination will be related to the practical performed/projects executed by the candidate related to the paper during the course of the semester.

Course Objectives:

- The aim of this module is to study, learn, and understand the main **concepts** of Mat-lab.
- Introduce common approaches, structures, and conventions for creating and evaluating computer programs, primarily in a procedural paradigm, but with a brief introduction to object-oriented concepts and terminology.
- Apply a variety of common numeric techniques to solve and visualize engineeringrelated computational problems.

Sr.No	**Exercises on computer**
I.	Roots of a quadratic equation.
II.	Guessing a number
III.	Units conversion
IV.	Factorial program
V.	Simulation of RC circuit
VI.	Characteristics of a MOSFET.
VII.	Finding average with dynamic array.
VIII.	Writing a binary file
IX.	Reading a binary file
X.	Plotting one dimensional and two dimensional graph using MAT LAB 2-D plot types.
XI.	Using functions in MAT LAB Environment To teacher concerned will give at least 10 exercises to solve non trivial problems using MAT LAB environment.

Course Outcomes:

By the end of this course, students should be able to

COs1: Use MATLAB effectively to analyze and visualize data.

COs2: Apply numeric techniques and computer simulations to solve engineering-related problems

COs3: Apply a top-down, modular, and systematic approach to design, write, test, and debug sequential MAT-LAB programs to achieve computational objectives.

Text Books/Reference Books:

1. Programming in MAT LAB by Marc E. Herniter Thomson ASIA Ptd. Ltd Singapore(2001)
2. MAT LAB the languages of computing. The maths work inc.

Semester - II

Name of the Course	**Data Science**		
Course Code	**MT(IT)-201**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Knowledge of Data Science
- Knowledge of Python
- To understand Panda

Section	Course Content
Section-A	Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

Section-B	User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance. NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray - Creating ndarrays - Data Types for ndarrays - Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting Unique and Other Set Logic
Section-C	Introduction to Pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking. Summarizing and Computing
	Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.
Section-D	Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Course Outcomes:

At the end of the course students will able to:

COs1: Have comprehensive knowledge of Data Science and working of Python and Panda as an advanced course.

TEXT BOOKS

1. Y. Daniel Liang, ―Introduction to Programming using Python‖, Pearson, 2012.
2. Wes McKinney, ―Python for Data Analysis: Data Wrangling with Pandas, NumPy, and I Python‖, O'Reilly, 2nd Edition, 2018.
3. Jake Vander Plas, ―Python Data Science Handbook: Essential Tools for Working with Data‖, O'Reilly, 2017.

REFERENCE BOOKS

1. Wesley J. Chun, ―Core Python Programming‖, Prentice Hall, 2006.

Name of the Course	**Analysis of Algorithms**		
Course Code	**MT(IT)-202**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- The objective of this course is to teach students various data structures and to explain them algorithms for performing various operations on these data structures.
- To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
- To understand the notations used to analyse the Performance of algorithms.
- To understand the behaviour of data structures such as stacks, queues, trees, hash tables, search trees, graphs and their representations.
- To choose the appropriate data structure for a specified application.
- To understand and analyse various searching and sorting algorithms.

Section	Course Content
Section-A	Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data abstraction, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Introduction to Linear and Non Linear data structures. Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, Circular linked lists- Operations for Circularly linked lists, Doubly Linked Lists- Operations- Insertion, Deletion. Representation of single, two dimensional arrays, sparse matrices-array and linked representations.
Section-B	Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Dequeue (Double ended queue), ADT, Array and linked implementations in C
Section-C	Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree, Representations-array and linked representations, Binary Tree traversals, Threaded binary trees, Max Priority Queue ADTimplementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap. Graphs – Introduction, Definition, Terminology, Graph ADT, Graph Representations- Adjacency matrix, Adjacency lists, Graph traversals- DFS and BFS.
Section-D	Searching- Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling. Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods. Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees- Definition and Examples, Insertion into an AVL Tree, B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatmentonly Definitions and Examples). Comparison of Search Trees. Pattern matching algorithm- The Knuth-MorrisPratt algorithm, Tries (examples only).

Course Outcomes:

At the end of the course students will be able to

COs1: Analyze the performance of various data structures.

COs2: Select a suitable data structure for a given problem statement.

COs3: Utilize the classes of Collection framework in implement various data structures.

Text Books:

1. Fundamentals of Data structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press.
2. Data structures A Programming Approach with C, D. S. Kushwaha and A. K. Misra, PHI.

Reference Books:

1. Data structures: A Pseudocode Approach with C, 2nd edition, R. F. Gilberg and B. A. Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M. A. Weiss, Pearson.
3. Data Structures using C, A. M. Tanenbaum, Y. Langsam, M. J. Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R. Kruse, C. L. Tondo and B. Leung, Pearson.
5. Data Structures using C, R. Thareja, Oxford University Press.
6. Data Structures, S. Lipscutz, Schaum's Outlines, TMH.

Name of the Course	**Foundations of Open Source Technologies**		
Course Code	**MT IT(ID)-203**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- ❖ Free and open-source software (FOSS) is computer software that can be classified as both free software and open-source software.
- ❖ That is, anyone is freely licensed to use, copy, study, and change the software in any way, and the source code is openly shared so that people are encouraged to voluntarily improve the design of the software.
- ❖ This is in contrast to proprietary software, where the software is under restrictive copyright and the source code is usually hidden from the users.
- ❖ The syllabus covers the study open source principles, strategies , how to contribute , Linux distributions, source code management tools, automation tools and reporting tools.

Section	Course Content
Section-A	Introduction to open source software : Introduction to open sources- Need of Open Sources- Advantages of Open Sources- Applications of Open Sources- commercial aspects of Open source Movement The FOSS Ecosystem Linux operating system, Roles of Operating System, Choosing the operating system, Installing different distributions of GNU/Linux, FreeBSD/Open Solaris
Section-B	Open source development Proprietary software development model vs. Open Source software development model, models for FOSS- Cathedral model and Bazaar model. Introduction to collaborative development (Developer commSectionies, mailing lists, IRC, wiki, version control, bug tracking, handling non-technical issues, localization, accessibility, documentation by doxygen). Software package management (RPM, DEB - building, and creating software repositories) Open Standards, Licensing and legal aspects in detail.
Section-C	Configuration of Network communication services and File system DHCP, DNS, WINES, NFS, NIS, Web server, Ftp Server, E-mail Server, Telnet Server, etc. Configuration through webmin or usermin, Installing & configuring
	of Cygwin, Installing and configuring of CMS – moodle, druple etc.
Section-D	Useful tool and Scripting languages Shell programming, AWK, python etc, Report writing tools. Operating System utilities, TCP/IP utilities, Network analyzer, Traffic analysis, Protocol analysis, Network Management Using SNMP

Course Outcomes:

After successful completion of the course, students will be able to:

COs1: Demonstrate the configuration of software services on servers.
COs2: Exercise the FOSS tools for the software development.
COs3: Contribute to existing FOSS in FOSS environment.

Text Books:

1. ―The complete Reference Networking‖ by Craig Zacker TMH Publication.
2. ―Distributed Systems and Networks ―by William Buchanan TMH Publication.
3. ―The complete reference Linux‖ by Richard L. Peterson Tata Mcgraw Hill Publication.

Reference Books:

1. ―Introduction to Free Software‖ - by SELF project.
2. ―Code Reading‖ - the Open Source Perspective by Diomidis Spinellis.
3. Remy Card, Eric Dumas and Frank Mevel, ―The Linux Kernel Book‖, Wiley Publications, New York, 2003.
4. Peter Wainwright, ―Professional Apache‖, Wrox Press, USA, 2002.
5. Stephen J. Mellor and Marc Balces, ―Executable UMS: A foundation for MDA‖,. Addison Wesley, USA, 2002.

Name of the Course	**Cloud Computing**		
Course Code	**MT(IT)-204**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50
Instructions			

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To understand the emerging area of "cloud computing" and how it relates to traditional models of computing.
- To impart fundamental concepts in the area of cloud computing.
- To impart knowledge in applications of cloud computing.
- Understanding the systems, protocols and mechanisms to support cloud computing.

Section	Course Content
Section-A	Overview of Computing Paradigm: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing. Cloud Computing, Evolution of cloud computing, Business driver for adopting cloud computing. Introduction to Cloud Computing: Cloud Computing (NIST Model), Introduction to Cloud Computing, History of Cloud Computing.
Section-B	Cloud service providers: Properties, Characteristics & Disadvantages Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards. Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services.
Section-C	Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree, Representations-array and linked representations, Binary Tree traversals, Threaded binary trees, Max Priority Queue ADTimplementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap. Graphs – Introduction, Definition, Terminology, Graph ADT, Graph
	Representations- Adjacency matrix, Adjacency lists, Graph traversals- DFS and BFS.

Section-D	Searching- Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling. Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods. Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees- Definition and Examples, Insertion into an AVL Tree, B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees (Elementary treatment-only Definitions and Examples). Comparison of Search Trees. Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

Course Outcomes:

At the end of the course students will be able to

COs1: Identify the applications of IoT.
COs2: Use Raspberry PI platform in designing IoT based applications.
COs3: Create real time applications that can be used in domestic and health care applications.
COs4: Convert things into smart things.

Text Book:

1. CloudComputingBible,BarrieSosinsky,Wiley-India,2010

Reference Books:

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M.Goscinski, Wile, 2011.
2. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
3. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

Name of the Course	**Analysis of Algorithms Lab**

Course Code	**MT(IT)-205**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters/ For Candidates:

Laboratory examination will consist of two parts:

Performing a practical examination assigned by the examiner. (25 marks)

Viva-voce examination. (25 marks)

Viva-voce examination will be related to the practical performed/projects executed by the candidate related to the paper during the course of the semester.

Course Objectives:

- To write and execute programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables and search trees.
- To write and execute write programs in C/C++ to implement various sorting and searching methods.

Week1: Write a C/C++ program that uses functions to perform the following:

a) Create a singly linked list of integers.
b) Delete a given integer from the above linked list.
c) Display the contents of the above list after deletion.

Week2: Write a C/C++ program that uses functions to perform the following:

a) Create a doubly linked list of integers.
b) Delete a given integer from the above doubly linked list.
c) Display the contents of the above list after deletion.

Week3: Write a C/C++ program that uses stack operations to convert a given infix expression into its postfix equivalent, Implement the stack using an array.

Week 4: Write C/C++ programs to implement a double ended queue ADT using

a) Array and
b) Doubly linked list respectively.

Week 5: Write a C/C++ program that uses functions to perform the following:

a) Create a binary search tree of characters.
b) Traverse the above Binary search tree recursively in post order.

Week 6: Write a C/C++ program that uses functions to perform the following:

a) Create a binary search tree of integers.
b) Traverse the above Binary search tree non recursively in in order.

Week 7: Write C/C++ programs for implementing the following sorting

	methods to arrange a list of integers in ascending order: a) Insertion sort b) Merge sort **Week 8:** Write C/C++ programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Quick sort b) Selection sort

Course Outcomes:

COs1: Analyze the asymptotic performance of algorithms. Write rigorous correctness proofs for algorithms. Demonstrate a familiarity with major algorithms and data structures.

COs2: Apply important algorithmic design paradigms and methods of analysis.

Text Books/ Reference Books:

1. C and Data Structures, Third Edition, P. Padmanabham, BS Publications.
2. C and Data Structures, Prof. P.S. Deshpande and Prof. O.G. Kakde, Dreamtech Press.
3. Data structures using C, A. K. Sharma, 2nd edition, Pearson.
4. Data Structures using C, R. Thareja, Oxford University Press.
5. C and Data Structures, N. B. Venkateswarlu and E. V. Prasad, S. Chand.

Semester –III

Name of the Course	**Ethical Hacking**		
Course Code	**MT (IT)-301**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		

Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Introduces the ethical hacking methodologies.
- Covers applying cyber security concepts to discover and report vulnerabilities in a network.
- Explores legal and ethical issues associated with ethical hacking.

Section	Course Content
Section-A	Introduction: Hacking Impacts, The Hacker Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking
Section-B	The Business Perspective: Business Objectives, Security Policy, Previous Test Results, Business Challenges Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, Timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement Preparing for a Hack: Technical Preparation, Managing the Engagement Reconnaissance: Social Engineering, Physical Security, Internet Reconnaissance
Section-C	Enumeration: Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase Exploitation: Intutive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, Root Kits, applications, Wardialing, Network, Services and Areas of Concern

Section-D	Deliverable: The Deliverable, The Document, Overall Structure, Aligning Findings, Presentation Integration: Integrating the Results, Integration Summary, Mitigation, Defence Planning, Incident Management, Security Policy, Conclusion.

Course Outcomes:

Upon completion of the course students should be able to:

COs1: Plan a vulnerability assessment and penetration test for a network.

COs2: Execute a penetration test using standard hacking tools in an ethical manner.

COs3: Report on the strengths and vulnerabilities of the tested network.

COs4: Identify legal and ethical issues related to vulnerability and penetration testing.

Textbook And Reference Books

1. James S. Tiller, ―The Ethical Hack: A Framework for Business Value Penetration Testing‖, Auerbach Publications, CRC Press
2. EC-Council, ―Ethical Hacking and Countermeasures Attack Phases‖, Cengage Learning
3. Michael Simpson, Kent Backman, James Corley, ―Hands-On Ethical Hacking and Network Defense‖, Cengage Learning

LIST OF ELECTIVES

Semester-I

Name of the Course	**Artificial Intelligence and expert system**		
Course Code	**ES-101**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To explain the basic concepts of knowledge, knowledge representation, problem solving, and searching technique of Artificial Intelligence.
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving particular engineering problems.

Section	**Course Content**
Section-A	Introduction and Overview of Artificial intelligence, Intelligent Computer. Problems, Problem Spaces & Search: Problems &state Space Search Chess Problem, Water Jug Problem, Problem characteristics, Production system characteristics. Knowledge: Knowledge Representation: General concepts of knowledge representation Approaches &issues in knowledge representation Knowledge Based Systems, Knowledge Organization, Knowledge Manipulation, Acquisition of Knowledge.
Section-B	Formalized Symbolic logics – Syntax and Semantics for Propositional Logic, Properties of Wffs, Conversion to Clausal Form, Inference Rules, resolution, Dealing with Inconsistencies - Truth Maintenance Systems, Symbolic Reasoning under uncertainty, Statistical Reasoning. Structural Knowledge – Graph, frames and Related Structures.
Section-C	Natural Language Processing: Overview of Linguistics, Grammar and Languages, Syntactic Processing, Semantic Analysis, Morphological, Discourse and Pragmatic Processing, Natural Language Generation, Natural Language Systems, Parsing and its types.

Section-D	Expert Systems: Definition, applications, Rule Based System Architecture, Non Production System Architecture, Basic Components of E.S. Types of expert system. Overview of PROSPECTOR, MYCIN and DENDRAL. Basic function of PROSPECTOR, MYCIN AND DENDRAL Expert System.

Course Outcomes:

COs1: Optimization of systems, Design optimization, Synthesis optimization, Artificial intelligence, Process Synthesis, Inverse Design, Expert Systems, Intelligent Health Control.

Text Books:

1. Dan W. Patterson, ―Introduction to Artificial Intelligence and Expert systems.‖ Prentice-Hall. 2. A. Rich and K. Knight, ―Artificial Intelligence‖, Tata McGraw Hill.

Reference Book:

1. E. Charnaik and D. McDermott, ―Introduction to Artificial Intelligence‖.

Name of the Course	**Digital Image Processing**		
Course Code	**ES-102**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Understand the need for **image** transforms different types of **image** transforms and their properties.
- Develop any **image processing** application.
- Understand the need for **image** compression and to learn the spatial and frequency domain techniques of **image** compression.

Section	Course Content
Section-A	**Introduction to Computer Vision:** Imaging basics, image Representation, Binary Image Analysis **Image Vision:** 2-D visual geometry, 3-D visual geometry, Applications of computer vision.
Section-B	**Image Perception and Physical Modeling:** Human visual system, Light, brightness, contrast, Colour modeling and representation. **Image Acquisition and Display:** Image Sensing using Single sensor, Image Sensing using Sensor strip, Image Sensing using sensor array, Image formation model. **Image Enhancement:** Functions used frequently for image enhancement, Histogram based approaches, Piece-wise linear transformation Functions.

Section-C	**Image Filters and restoration:** Spatial Filtering: Smoothing Spatial Filters, Sharpening Spatial Filters,Noise models of Image restoration:-Spatial and Frequency Properties of Noise**,** Some Important Noise Probability Density Functions**,** Periodic Noise **Color Image Processing:** Color Fundamentals, Color Models, Color Transformation, Smoothing and Sharpening, Color Image Compression
Section-D	**Image Compression coding:** Huffman Coding, Run-Length Coding, LZW Coding, Bit-Plane Coding, Predictive Coding
	Image Analysis: Feature detection and extraction, Image segmentation, Detection of Isolated Points, Line detection, Edge Detection, **Object Recognition:** Structural Methods, Matching Shape Numbers, String Matching

Course Outcomes:

At the end of the course students will able to:

COs1: Understand the need for **image** transforms different types of **image** transforms and their properties.

COs2: Develop any **image processing** application. Understand the need for **image** compression and to learn the spatial and frequency domain techniques of **image** compression.

Text Books:

1. Pankaj Jalote, ―An Integrated Approach to Software Engineering‖, 3rd Edition, Narosa Publishing House.
2. K. K. Aggrawal and Yogesh Singh, ―Software Engineering‖, 3rd Edition, New Age International (P) Ltd.

Reference Books:

1. Pressman, R.S., ―Software Engineering – A Practitioner's Approach‖, Third Edition, McGraw Hills.
2. Mall Rajib, ―Fundamentals of Software Engineering‖, PHI, New Delhi.

Name of the Course	**Natural Language processing**		
Course Code	**ES-103**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To introduce students about the techniques in natural language processing.
- To understand how system answers the goals of its designers, or meets the needs of its users.

Section	**Course Content**
Section-A	Introduction: Regular Expressions and Automata. , Morphology and FiniteState Transducers. Computational Phonology and Text-to-Speech, Probabilistic Models of Pronunciation and Spelling, N-grams, HMMs and Speech Recognition.
Section-B	Syntax: Word Classes and Part-of-Speech Tagging, Context-Free Grammars for English, Parsing with Context-Free Grammars, Features and Unification, Lexicalized and Probabilistic Parsing, Language and Complexity.
Section-C	Semantics-Representing Meaning, Semantic Analysis. Lexical Semantics, Word Sense Disambiguation and Information Retrieval

Section-D	Pragmatics-Discourse, Dialogue and Conversational Agents, Generation, Machine Translation Regular Expression Operators, The Porter Stemming Algorithm, C5 and C7 tag sets, Training HMMs: The Forward-Backward Algorithm.

Course Outcomes:

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

COs1: Understand approaches to syntax and semantics in NLP.

COs2: Understand approaches to discourse, generation, dialogue and summarization within NLP.

COs3: Understand current methods for statistical approaches to machine translation.

COs4: Understand machine learning techniques used in NLP, including hidden

Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP

Text Books:

1. Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal. NLP: A Paninian Perspective, Prentice Hall, New Delhi.

References:

1. Winograd, Language as a Cognitive Process, PEARSON Education.

Name of the Course	**Graph Theory and Optimization**		
Course Code	**ES-104**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To develop analytical capability and to impart knowledge in graphs, linear programming problem and statistical methods and their applications in Engineering & Technology.

Section	**Course Content**
Section-A	Basics of Graph Theory: Graphs - Data structures for graphs, Subgraphs, Operations on Graphs, Connectivity – Networks and the maximum flow - Minimum cut theorem - Trees - Spanning trees - Rooted trees – Matrix representation of graphs.
Section-B	Classes of Graphs: Eulerian graphs and Hamiltonian graphs - Standard theorems - Planar graphs -Euler's formula - Five colour theorem - Coloring of graphs - Chromatic number (vertex and edge) properties and examples - Directed graphs.
Section-C	Graph Algorithms: Computer Representation of graphs - Basic graph algorithms - Minimal spanning tree algorithm - Kruskal and Prim's algorithm - Shortest path algorithms - Dijsktra's algorithm - DFS and BFS algorithms.

Section-D	Optimization Techniques: Linear programming – Graphical methods – Simplex method (Artificial variables not included) – Transportation and assignment problems. Statistics: Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations.

Course Outcomes:

Students are able to:

COs1: Understand the various types of graph Algorithms and graph theory properties.

COs2: Analyse the NP – complete problems.

COs3: Distinguish the features of the various tree and matching algorithms.

COs4: Appreciate the applications of digraphs and graph flow.

COs5: Understand the linear programming principles and its conversion.

Text Books:

1. Narsingh Deo, ―*Graph Theory with Applications to Engineering and Computer Science*‖, PHI 1974.
2. Rao S.S., ―*Engineering Optimization: Theory and Practice*‖, New Age International Pvt. Ltd., 3rd Edition 1998.

Name of the Course	**Quantum Computing**		
Course Code	**ES-105**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- The objective of this course is to provide the students an introduction to quantum computation. Much of the background material related to the algebra of complex vector spaces and quantum mechanics is covered within the course.

Section	**Course Content**
Section-A	**Introduction to Quantum Computation:** Quantum bits, Bloch sphere representation of a qubit, multiple qubits. **Background Mathematics and Physics:** Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of Quantum mechanics, Measurements in bases other than computational basis.
Section-B	**Quantum Circuits:** single qubit gates, multiple qubit gates, design of quantum circuits. **Quantum Information and Cryptography:** Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

Section-C	**Quantum Algorithms:** Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.
Section-D	**Noise and error correction:** Graph states and codes, Quantum error correction, Fault-tolerant computation.

Course Outcomes:

At the end of the course, the student should be able to:

COs1: The course represents a comprehensive survey on the concept of quantum computing with an exposition of qubits, quantum logic gates, quantum algorithms and implementation.

COs2: Starting with the main definitions of the theory of computation, the course mostly deals with the application of the laws of quantum mechanics to quantum computing and quantum algorithms.

Textbook And Reference Books

S.No. Author(s)/Name of Books/Publishers

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms.

LIST OF ELECTIVES

Semester-II

Name of the Course	**Graphics and Multimedia**		
Course Code	**ES-201**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To develop an understanding and awareness how issues such as content, information architecture, motion, sound, design, and technology merge to form effective and compelling Interactive experiences for a wide range of audiences and end users.
- To understand the graphics and their transformations.
- To understand two-dimensional and three-dimensional graphics and their transformations.
- To become familiar with understand clipping techniques and Blender Graphics

Section	**Course Content**
Section-A	Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-toviewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.Three dimensional concepts;

Section-B	Three dimensional object representations – Polygon surfaces- Polygon tables-Plane equations – Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces B-Spline curves and surfaces. TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.
Section-C	Multimedia basics − Multimedia applications − Multimedia system architecture − Evolving technologies for multimedia − Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases. Compression and decompression − Data and file format standards − Multimedia
	I/O technologies − Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.
Section-D	Multimedia authoring and user interface – Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems. CASE STUDY: BLENDER GRAPHICS Blender Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures

Course Outcomes:

Students are able to

COs1: To become familiar with various software programs used in the creation and implementation of multi- media.

COs2: To appreciate the importance of technical ability and creativity within design practice.

COs3: To gain knowledge about graphics hardware devices and software used.

TEXT BOOKS:

1. Donald Hearn and Pauline Baker M, ―Computer Graphics", Prentice Hall, New Delhi, 2007 [SECTION I – III]
2. Andleigh, P. K and Kiran Thakrar, ―Multimedia Systems and Design‖, PHI, 2003. [SECTION-IV,V]

REFERENCES:

1. Judith Jeffcoate, ―Multimedia in practice: Technology and Applications‖, PHI, 1998.
2. Foley, Vandam, Feiner and Hughes, ―Computer Graphics: Principles and Practices, 2nd Edition, Pearson Education, 2003.
3. Jeffrey McConnell, ―Computer Graphics: Theory into Practice‖, Jones and BartlettPublishers, 2006.
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan, 1990.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard,
4. Kelvin Sung, and AK Peters, ―Fundamentals of Computer Graphics, CRC Press, 2010.

Name of the Course	**Data Warehousing and Data Mining**		
Course Code	**ES-202**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- ❖ Conceptual understanding of Data cleaning, analysis and visualization ❖ Data mining techniques.
- ❖ Web mining and Spatial mining

Section	Course Content
Section-A	Introduction: DSS, Data warehouse Architecture, Data Staging & ETL, Multidimensional Model, Meta data, Accessing data warehouse, ROLAP, MOLAP, HOLAP System Lifecycle: Risk factors, Top-down, Bottom-up, Data mart design phases, Methodological framework, Testing data marts, Data Sources: Inspecting and normalizing schemata, Integration problems, Integration phases, Mapping, User Requirements & Conceptual Modelling: Glossary based requirements analysis, Goaloriented requirements analysis, Dimensional Fact Model, Advanced modelling, Events and Aggregation, Time, Formalizing the dimensional fact model
Section-B	Logical Modelling & Design: MOLAP, HOLAP & ROLAP systems, Views, Temporal scenarios, Fact schemata to star schemata, View materialization, View Fragmentation, Populating - reconciled databases, dimension tables, fact tables & materialized views, Cleansing data Data Warehouse Components: Overall architecture, database, Sourcing, acquisition, clean-up and transformation tools, Metadata, Access tools, Administration and management, Info delivery System Building a Data Warehouse: Considerations - business, design, technical & implementation, integrated solutions, Benefits
Section-C	Introduction: Data mining, Measuring effectiveness, Discovery Vs prediction, Overfitting, Comparing the technologies, Decision trees, where to use them, General idea, how do they work, Strengths and weaknesses.
	Techniques and Algorithms: Neural networks - uses, making predictions, different kinds, Kohonen feature map, their working, Nearest Neighbour& Clustering – uses, predictions and differences, their working, Genetic Algorithms – uses, cost minimization, cooperative strategies, their working, Rule Induction – uses, evaluation of rules, rules Vs decision trees, their working, Using the right technique, Data mining & business process
Section-D	*Cluster Analysis*- Outlier, Cluster Vs Classification, Clustering Issues, impact ofOutliers on clustering, clustering problems, Clustering Approaches. *Association Rules:* Introduction, Basic concepts, Association Rule AlgorithmsApriori AND Mining frequent item sets with and without candidate generation. *Web Mining*: Introduction, Web data, Web Knowledge Mining Taxonomy, Web Content mining, Web Usage Mining Research, Ontology based web mining Research, Web mining Applications.

Course Outcomes:

After undergoing the course, Students will be able to understand:

COs1: Design a data mart or data warehouse for any organization.

COs2: Develop skills to write queries using DMQL **COs3:** Extract knowledge using data mining techniques **COs4:** Adapt to new data mining tools.

Text Book:

1. DataMining Concepts and Techniques -Jaiwei Han Micheline Kamber,2/e, Morgan Kaufmann, 2006.

References:

2. Introduction to Data Mining, Adriaan, Addison Wesley Publication.
3. Data Mining Techniques, A.K.Pujari, University Press.

Name of the Course	**Human Computer Interaction**		
Course Code	**ES-203**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50
Instructions			

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Understanding how to develop high-quality user interfaces for interactive systems
- Study of Development process
- Understand different interaction styles.
- Address various Design issues.

Section	Course Content
Section-A	**Managing Design Processes:** Introduction, Organizational Design to support Usability, The four pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Social Impact statement for Early Design Review, Legal Issues. **Evaluating Interface Designs:** Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance Tests, Evaluation during Active use, Controlled Psychological Oriented Experiments.
Section-B	Introduction, Organizational Design to support Usability, The four pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Social Impact statement for Early Design Review, Legal Issues. **Evaluating Interface Designs:** Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance Tests, Evaluation during Active use, Controlled Psychological Oriented Experiments.
Section-C	**Direct Manipulation and Virtual Environments:** Introduction, Examples of Direct Manipulation, Discussion of Direct Manipulation, 3D Interfaces, Teleoperation, Virtual and Augmented Reality **Menu Selection, Form fillin, and Dialog Boxes:** Introduction, Task-related Menu Organization, Single Menu, Combination of

	Multiple Menus, Content Organization, Fast movement through Menus, Data entry with Menus: Form filling, Dialog boxes and Alternatives, Audio Menus and Menus for small Display **Command and Natural Languages** Introduction, Command-Organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing **Interaction Devices** Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and Large
Section-D	**Quality of Service** Introduction, Models of Response Time Impacts, Expectations and Attitudes, User Productivity, Variability in Response Time, Frustrating Experiences **Balancing Function and Fashion** Introduction, Error Messages, Non-anthropomorphic Design, Display Design, Webpage Design, Window Design, colour. **User Documentation and Online Help** Introduction, Online versus Paper Documentation, Reading from Paper versus from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online Tutorials and Animated Demonstrations, Online CommSectionies for User Assistance, The Development Process **Information Search** Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced filtering and Search Interface.

Course Outcomes:

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

COs1: Explain and compare a variety of **pattern classification**, structural **pattern recognition**, and **pattern** classifier combination **techniques**.

COs2: Summarize, analyze, and relate research in the **pattern recognition** area verbally and in writing.

Text Books:

1. Robert Schalkoff, ―*Pattern Recognition: Statistical Structural and Neural Approaches*‖, John wiley&sons , Inc,1992.
2. Duda R.O., P.E.Hart& D.G Stork, ― *Pattern Classification*‖, 2nd Edition, J.Wiley Inc 2001.

Reference Books:

1. Earl Gose, Richard johnsonbaugh, Steve Jost, ―*Pattern Recognition and Image Analysis*‖, Prentice Hall of India,.Pvt Ltd, New Delhi, 1996.
2. Bishop C.M., ―*Neural Networks for Pattern Recognition*‖, Oxford University Press, 1995.

Name of the Course	**Pattern Recognition Techniques**		
Course Code	**ES-204**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To learn pattern recognition fundamentals, techniques, trends and applications.
- Pattern features and Statistical techniques
- Feature extraction techniques and advances in the field
- Syntactic Pattern Recognition

Section	Course Content
Section-A	Pattern recognition introduction, pattern recognition systems, decision cycle, learning and adaptation: Supervised learning, unsupervised learning, reinforcement learning. Pattern recognition, Classification and Description—Patterns and feature Extraction with Examples—Training and Learning in PR systems—Pattern recognition Approaches
Section-B	Statistical pattern recognition: Introduction to statistical Pattern Recognition—supervised Learning using Parametric and Non Parametric Approaches. Introduction—Discrete and binary Classification problems—Techniques to directly Obtain linear Classifiers Formulation of Unsupervised Learning Problems—Clustering for unsupervised learning and classification.
Section-C	Syntactic pattern recognition: Overview of Syntactic Pattern Recognition—Syntactic recognition via parsing and other grammars–Graphical Approaches to syntactic pattern recognition—Learning via grammatical inference.
Section-D	Neural pattern recognition: Introduction to Neural networks—Feedforward Networks and training by BackPropagation—Content Addressable Memory Approaches and Unsupervised Learning in Neural PR.

Course Outcomes:

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

COs1: Explain and compare a variety of **pattern classification**, structural **pattern recognition**, and **pattern** classifier combination **techniques**.

COs2: Summarize, analyze, and relate research in the **pattern recognition** area verbally and in writing.

Text Books:

1. Robert Schalkoff, ―*Pattern Recognition: Statistical Structural and Neural Approaches*‖, John wiley & sons , Inc,1992.
2. Duda R.O., P.E.Hart& D.G Stork, ― *Pattern Classification*‖, 2nd Edition, J.Wiley Inc 2001.

Reference Books:

1. Earl Gose, Richard Johnsonbaugh, Steve Jost, ―*Pattern Recognition and Image Analysis*‖, Prentice Hall of India, Pvt Ltd, New Delhi, 1996.
2. Bishop C.M., ―*Neural Networks for Pattern Recognition*‖, Oxford University Press, 1995.

Name of the Course	**Soft Computing**		
Course Code	**ES-205**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- The course aims at providing knowledge of soft computing concepts and introducing the idea of neural networks, fuzzy logic and use of genetic algorithms.
- At the end of this course, students should be able to analyze the implementation of neural networks, implementation of genetic algorithms in various Optimization problems and use of Fuzzy Logic.

Section	**Course Content**
Section-A	Intelligent Agents: Agents Behaviour and Environments, Structure of Agents, Planning Problem, Planning with state Space Search, Partial order Planning, GRAPHPLAN, Planning in logic, planning in non-deterministic domains, hierarchical task planning, Multi agent planning, execution.
Section-B	Probabilistic Reasoning Fuzzy Logic: Knowledge representation under uncertainty, Bayesian theorem, Bayesian Networks, Dumpster Shafer theory, Representing vagueness, Fuzzy sets, operation on fuzzy sets, reasoning with fuzzy logic, Fuzzy Automata, Fuzzy Control methods, Fuzzy decision making, inference in temporal models, Hidden Markov Models, Kalman Filters.

Section-C	Neural Networks: Basic concepts, Single layer perception, Multilayer Perception, Supervised and Unsupervised learning – Backpropagation networks - Kohnen's self organizing networks - Hopfield network. Introduction to Artificial Neural Systems - Perceptron - Representation - Linear separability - Learning – Training algorithm -Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing
Section-D	Generic Algorithms: Evolutionary computation. Survival of the Fittest - Fitness Computations - Cross over – Mutation, Reproduction - Rank method - Rank space method.

Course Outcomes:

COs1: Understand **soft computing** techniques and their role in problem solving. Conceptualize and parameterize various problems to be solved through basic **soft computing** techniques. Analyze and integrate various **soft computing** techniques in order to solve problems effectively and efficiently.

Text Book:

1. Stuart J.Russel, Norvig: AI: A Modern Approach, Pearson Education, and Latest Edition.
2. Michael Negnevitsky: Artificial Intelligence: A Guide to Intelligent Systems, 2/E, Addison-Wesley.

References:

1. James Freeman A. and David Skapura M: Neural Networks - Algorithms, Applications & Programming Techniques Addison Wesley.
2. Yegnanarayana B.: Artificial Neural Networks, Prentice Hall of India Private Ltd., New Delhi.
3. Hagan, M.T., Demuth, Mark Beale: Neural Network Design By Cengage Learning.
4. Goldberg, David E.: Genetic algorithms in search, optimization and machine learning, Latest Edition, Addison Wesley.

LIST OF ELECTIVES Semester-III

Name of the Course	**VLSI Design**		
Course Code	**ES-301**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Introduction of architecture and design concepts underlying modern complex VLSIs and system-on-chips.
- Study of core VLSI architecture concepts.
- Analyzing design for testability.

Section	Course Content

Section-A	**Introduction**: Overview of VLSI design Methodologies, VLSI Design flow, Design Hierarchy, Concept of Regularity, Modularity, and Locality, VLSI design styles. **Fabrication of MOSFETs**: Fabrication Process flow: basic steps, Fabrication of NMOS Transistor, the CMOS n-Well Process, Layout Design Rules, Full- Custom mask Layout design, CMOS Inverter Layout Design. **MOS Transistor**: The MOS Structure, Structure and operation of MOSFET, The MOS System under External Bias, The Threshold Voltage, MOSFET Current–Voltage Characteristics, Channel Length Modulation, Substrate Bias Effect, MOSFET Scaling and Small Geometry Effects, Short Channel Effects, Narrow Channel Effects, Limitation Imposed by Small Device Geometries, MOSFET Capacitances.
Section-B	**MOS Inverters**: Static Characteristics: CMOS Inverters, Circuit operation, Voltage transfer characteristics of CMOS Inverter, Calculation of VIL, Calculation of VIH, Calculation of inverter threshold voltage, Noise Margin. **MOS Inverters**: Switching Characteristics: Delay Time Definitions, Calculation of Delay Times, Inverter Design with delay constraints, Estimation of Interconnect Parasitic, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.
Section-C	**Combinational MOS Logic Circuits**: CMOS Logic Circuits, Layout of simple logic gates, Complex Logic Circuits, Layout of Complex Logic Gates, AOI and OAI Gates, CMOS Transmission Gates (pass gates), Complementary Pass Transistor Logic. **Sequential MOS Logic Circuits**: Behaviour of Bistable
	element, SR Latch Circuits, Clocked Latch and Flip flop Circuits, CMOS DLatch and Edge Triggered Flip flop, Clocked JK Latch, Master slave Flip flop.
Section-D	**Semiconductor Memories**: Dynamic Random Access Memory, DRAM Configuration, Historical Evaluation of DRAM Cell, DRAM Cell Types, operation of one transistor DRAM Cell, DRAM Operation Modes, Static Random Access Memory, Full custom SRAM Cell, CMOS SRAM Design Strategy, Operation of SRAM, Flash Memory NOR Flash Memory Cell, NAND Flash Memory Cell, Flash Memory Circuit. **Design for Testability**: Fault Types and Models, Ad Hoc Testable Design Techniques, Scan –based Techniques, Built-In Self Test Techniques.

Course Outcomes:

COs1: Identify the various IC fabrication methods.

COs2: Express the Layout of simple MOS circuit using Lambda based **design** rules. **COs3:** Apply the Lambda based **design** rules for subsystem **design COs4:** Differentiate various FPGA architectures.

COs5: **Design** an application using Verilog HDL.

TextBook:

1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, MH, 2002

Reference Book:

1. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design :ASystems Perspective, Fourth Edition.

Name of the Course	**Machine Learning for Big Data**		
Course Code	**ES-302**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50
Instructions			
For Paper Setters: The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.			

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To offer understanding of big data and a look at the dominant software systems and algorithms for coping with Big Data.
- To introduce machine learning and the analysis of large data sets using distributed computation and storage infrastructure.

Section	Course Content
Section-A	Understanding big data landscape, Getting Started with Big Data Analytics, Analyzing Big Data in Context, Getting Value from Predictive Analytics and Big Data
Section-B	Humanizing Big Data Analytics, Publishing Data and Analytics to Cloud Service, evaluating tools and techniques
Section-C	Introduction: Definition, Probability Theory, Basic Algorithm Density Estimation: Limit Theorems, Parzen Window, Estimation, Sampling
Section-D	Optimization: Preliminaries, Unconstrained Smooth Convex Minimization, constraint, stochastic, nonconvex optimizations, online learning and boosting. Conditional densities: regression, multiclass classification, CRF, Hidden Markov Models

Course Outcomes:

COs1: The students **learning outcomes** are designed to specify what the students will be able to perform after completion of the **course**:

COs2: Ability to identify the characteristics of datasets and compare the trivial **data** and **big data** for various applications.

Text Books:

1. Introduction to Machine Learning by Alex Smola and S.V.N. Vishwanathan, Cambridge university press, 2008
2. Big Data analytics for DUMMIES: Michael Wessler, OCP & CISSP, John Wiley & Sons.

Reference Books:

1. Machine Learning: A Probabilistic Perspective By Kevin P. Murphy, MIT Press.
2. Foundation of machine learning by By Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar,
3. MIT Press
4. Introduction To Machine Learning by Nils J. Nilsson, Robotics Laboratory
5. Big Data Now by by O'Reilly Media, Inc. 2013.

Name of the Course	**Advanced Parallel Programming**		
Course Code	**ES-303**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50
Instructions			

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To present the main concept behind parallel programming models and their implementation.
- To analyzes productive programming environments and their efficient implementation.
- To describe the tools required to understand the behaviour of parallel applications when executed on current supercomputing architectures.

Section	Course Content
Section-A	Introduction: Why Parallel Architecture, Convergence of Parallel Architectures, Fundamental Design Issues Parallel Programs**:** introduction, The Parallelization Process, Parallelization of an Example Program
Section-B	Programming for Performance: Partitioning for Performance, Data Access and Communication in a Multi-Memory System, Performance Factors, The Parallel Application Case Studies, Implications for Programming Models Workload-Driven Evaluation: Scaling Workloads and Machines, Evaluating a Real Machine, Evaluating an Architectural Idea or Trade off
Section-C	Shared Memory Multiprocessors: Introduction, Cache Coherence, Memory Consistency, Realizing Programming Models, Physical DMA, Comparison of Communication Performance, Synchronization Directory-based Cache Coherence: Scalable Cache Coherence, Overview of Directory-Based Approaches, Assessing Directory Protocols and Tradeoffs, Design Challenges for Directory Protocols, Memory-based Directory Protocols, Cache-based Directory Protocols, Synchronization, Advanced Topics
Section-D	Hardware-Software Tradeoffs: Introduction, Relaxed Memory Consistency Models, Overcoming Capacity Limitations, Reducing Hardware Cost Advanced Topics
	Interconnection Network Design: Introduction, Organizational Structure, Interconnection Topologies, Evaluating Design Trade-offs in Network Topology, Routing, Switch Design, Flow Control, Case Studies

Course Outcomes:

COs1: After completion of course students :-will be familiar with the concepts of parallel processing and understand the particular problems arising in programming of parallel machines; will be familiar with the parallel computing models and the ―parallel-way of thinking‖ required in the design of parallel algorithms; will be able to apply the basic algorithmic techniques and design algorithms in a shared memory as well as a distributed memory environment;

COs2: will understand and be able to apply basic parallel programming principles in a shared/ distributed memory environment

Text Books:

1. Parallel Computer Architecture: A Hardware / Software Approach by David Culler, Jaswinder Pal Singh and with Anoop Gupta, Morgan Kaufmann Publishers

Reference Books:

1. Introduction to Parallel Computing by Ted G. Lewis and H. El-Rewini, Prentice-Hall, 1992.
2. Designing and Building Parallel Programs byIan Foster , Addison Wesley, 1995
3. Highly Parallel Computing by G.S. Almasi and A. Gottlieb, Benjamin Cummings, 1994.
4. Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare, PHI Learning Pvt. Ltd

6. Big Data Now by by O'Reilly Media, Inc. 2013.

Name of the Course	**Distributed Database Management System**		
Course Code	**ES 304**	Credits-4	L-3, T-1, P-0

Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To offer a good understanding of database systems concepts.
- To prepare the student to be in a position to use and design databases for different applications.
- To make students familiar with the design and implementation issues of distributed database management system

Section	Course Content
Section-A	Introduction: Distributed data processing, Fundamentals of distributed database system(transparent management of distributed and replicated data, reliability, improved performance, system expansion), Disadvantages of distribute DBMS (complexity, cost, directory management, concurrency control, deadlock management, reliability, OS support, heterogeneous databases, relationship)Relational Data Base Management System: Basic concepts, Data Modeling for a database, Records and files, Abstraction and Data Integration, Three tier architecture proposal for DBMS, Components of a DBMS, Advantages and disadvantages of DBMS, Data Models, Data associations model. Normalization: Dependency structures, Normal forms.
Section-B	Distributed DBMS Architecture: Architectural models for distributed DBMS (Autonomy, distribution, heterogeneity, architectural alternatives), Client/ server systems, Peer- to peer distributed systems. Allocation: problem, information requirement, allocation model, solution methods. Distributed database design: design strategies (top- down design and bottom up design process), design issues(reasons for fragmentation, alternatives, degree and correctness rules of fragmentation, allocation alternatives, information requirement) Fragmentation: horizontal, vertical, hybrid fragmentation.
Section-C	Controlling Concurrency: terminology, Multi-transaction processing systems, centralized DBE concurrency control, concurrency control in distributed

	database systems Deadlock handling: definition, deadlocks in centralized systems, deadlocks in distributed in distributed system, distributed deadlock detection Replication control: replication control scenarios, replication control algorithms
Section-D	Failure and commit protocols: terminology, Undo/redo and database recovery, Transaction states revised, database recovery, other types of database recovery, recovery-based Redo/ Undo processes, complete recovery algorithm, distributed commit protocols DDBE security: cryptography, securing communications, securing data architectural issues.

Course Outcomes:

COs1: Acquire background on distributed data processing. Also work out the intricacies of concurrency and other protocols in a distributed system of databases.

Text Book/Reference Books:

1. Mukesh Singhal and Niranjan G. Shivaratri, ―Advanced Concepts in Operating Systems - Distributed, Database, and Multiprocessor Operating Systems‖, Tata McGraw Hill.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, ―Operating System Concepts‖, Wiley India Pvt. Ltd.
3. Rajib Mall, ―Real Time Systems: Theory and Practice‖, Pearson Education India.
4. James C.S. ―Android Application development‖, CENGAGE Learning.
5. Gargenta M., Nakamura M., ―Learning Android‖, OREILLY Publishers.

Name of the Course	**Advanced Computer Architecture**		
Course Code	**ES-305**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective Sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To offers a good understanding of the various functional Sections of a computer system.
- To prepare the student to be in a position to design a basic computer system.

Section	Course Content
Section-A	Parallel Computer Models: The State of Computing, Multiprocessors and Multicomputer, Multi-vector and SIMD Computers, Random Access Machines, VLSI Complexity Model Program and Networks Properties: Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures
Section-B	Principles of Scalable Performance: Performance Metrics and Measures, Speedup, Performance Laws, Scalability Analysis and Approaches Processors and Memory Hierarchy: Advance Processor Technology, Superscalar and Vector Processors, memory hierarchy technology, virtual memory technology
Section-C	Multiprocessors and Multicomputer: Multiprocessor System Interconnects, Cache Coherence and Synchronization Multivector and SIMD Computers**:** Vector Processing Principles, Multivector multiprocessors, compound vector processing, SIMD computer organizations, the connection machines

Section-D	Parallel Models, languages and compilers: parallel programming models, parallel languages and compilers, dependence analysis of data arrays, code optimization and scheduling. Parallel program development and environment: parallel programming environments, synchronization and multiprocessing modes, shared variable program structures, message passing program development

Course Outcomes:

COs1: At the end of this **course** students should: know the classes of **computers**, and new trends and developments in **computer architecture**.

COs2: Understand pipelining, instruction set **architectures**, memory addressing. Understand the performance metrics of microprocessors, memory, networks, and disks.

Text Books

1. Kai Hwang: Advanced Computer Architecture: Parallelism, Scalability, Programmability, Tata McGraw-Hill.

References

1. Parallel Computing – Theory and Practice by Michael J. Quinn, 2nd Edition, McGraw Hill.
2. Design and Analysis of Parallel Algorithms by S.G. Akl, Prentice Hall.
3. Analysis and Design of Parallel Algorithms - Arithmetic and Matrix Problems, by S. Lakshmivarahan and S.K. Dhall, McGraw Hill International Edition.
4. A Practical Approach to Parallel Computing by S.K. Ghosal, Universities Press Limited
5. Computer Architecture and parallel processing by Hwang Briggs, McGraw Hill, 1984.

Admission & Eligibility Criteria for M. Tech Admissions

1. The admission process and eligibility criteria for the Master of Technology (M. Tech.) in Information Technology program shall be in accordance with the norms prescribed by the All India Council for Technical Education (AICTE), which are as follows:

- B.Tech./B.E./ AMIE Computer Science Engineering/ IT with minimum 55% marks (50% marks for SC/ST/PC Category) in qualifying examination.

2. The admission to the M.Tech. program shall be based on the merit of valid GATE score and left out seats will be filled on the basis of the merit of qualifying exam.

OR

University may conduct entrance examination for deciding the merit, in case the number of applications received are more than 100.

3. The total number of student intake shall be 18, plus supernumerary seats as per HPU norms.
4. The entrance test will be based on Multiple Choice Questions (MCQ) with a total of 100 marks, each question carrying one mark. There will be no negative marking.

Course Duration

The M. Tech. programmes in UIT shall be of two (02) year duration, spread over four (04) semesters and shall be run-on Full-Time basis. It may be extended to a maximum duration of 5 years with approval from the appropriate authority.

The details of semester wise course outlines and syllabi are available on UIT website.

Departmental Master Program Committee (DMPC) under Faculty of Engineering and Technology

Each academic Department shall have a Departmental Master Programme Committee (DMPC) for dealing with academic matters (admission process: counseling, presentation/thesis evaluation, etc.) pertaining to Master's Degree Programme.

Constitution of DMPC

Any faculty member holding an Engineering degree may be appointed as a member of the DMPC. The DMPC shall have the following constitution:

1.	Chairperson, DMPC	HoD
2.	Convener, DMPC	To be nominated by the Head of the Department (HoD)
3.	***Additional Members**	
	1. One Professor, if available (otherwise Associate/Assistant Professor with PhD)	Member
	2. One Associate Professor, if available (otherwise Assistant Professor with PhD)	Member
	3. One Assistant Professor	Member
	4. One Professor/ Associate Professor/Assistant Professor from another r Department (To be nominated by the HoD, in consultation with the Departmental)	Member

**In case there is not a sufficient faculty member in a particular Department/Centre, Director may nominate faculty holding an Engineering degree from other Departments/Centres of the university.*

5. The student may choose to have a co-supervisor, subject to the approval of the DMPC.

6. The final evaluation of the M.Tech. Thesis shall be conducted through a public defense, open to all, wherein the candidate shall present and defend their research work before a panel of examiners. In the event that the candidate's performance is deemed unsatisfactory, He/She shall be required to reappear for a subsequent defense, subsequent to incorporating the necessary revisions and improvements, until the evaluation process is successfully completed.