MASTER OF COMPUTER APPLICATIONS

Course Title: Graph Theory and Combinatorics

Course Objectives: The objective of the course is to Explain basic concepts in combinatorial graph theory Define how graphs serve as models for many standard problems discuss the concept of graph, tree, Euler graph, cut set and Combinatorics. See the applications of graphs in science, business and industry.

Pre-requisites:
Fundamentals of IT and C Language

Course Contents/Syllabus:

	Weightage (%)
Module I : Introduction to Graph Theory Basic Terminology, Walks, paths, circuits, connectedness, Handshaking Lemma, Isomorphism, Sub graphs, Reach ability, Union and Interaction of Graphs	15
Module II : Graph Theory Euler Graph, Shortest path problem, Hamiltonian graph, Traveling Salesman Problem, Bipartite graphs.	15
Module III : Trees Introduction to trees, Rooted trees, path length in rooted trees, spanning trees, Fundamental circuits, spanning trees of a weighted graph, cut sets and cut vertices, Fundamental cut set, Minimum spanning tree.	25
Module IV : Directed Graph Directed graphs and connected ness, directed trees, Network Flows, Max Flow-MinCut Theorem, Matrix representation of a graph, Planar graphs: Combinational and Geometric Duals, Kuratowski"s graphs, Detection of planarity, thickness and crossing.	25
Module IV : Combinatorics Partitions, counting functions, number of partitions into odd or unequal parts. Necklaces, Euler's function, set of symmetries, enumeration in the odd and even cases.	20

Course Learning Outcomes:
After completion of the course, the student will be able to:
- Understand and explain the basic concepts of graph theory.
- Apply the basic concepts of mathematical logic.
- Analyze the basic concepts of mathematical logic.
- Evaluate some real time problems using concepts of graph theory.

- *Text:*
- C.L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill, 2nd Edition, 2000.
- N. Deo**,** Graph Theory with Applications to Engineering and Computer Science, PHI publication, 3rd edition, 2009

- *References:*
- Harikishan, Shivraj Pundir and Sandeep Kumar, Discrete Mathematics, Pragati Publication, 7th Edition, 2010.
- Colmun, Busby and Ross, Discrete Mathematical Structure, PHI Publication, 6th Edition, 2009

Course Title: Core Java

Course Objectives:
The objective is to impart programming skills used in this object oriented language java.
The students are expected to learn it enough so that they can developed program in Java and the web solutions like creating applets etc.

Pre-requisites: OOP Programming Concept

Course Contents/Syllabus:

	Weightage (%)

Module I – Introduction to Java	**15**
Descriptors/Topics	
Introduction of Java, History of Java, JDK Tools, Class File, Java Bytecode, JVM, identifiers, Data types, Operators. Control Statements, loop, arrays, Inheritance in Java, Multilevel hierarchy, method overriding, Abstract classes, Final classes, Command line arguments	
Module II – Java with Object Orientated Features	**20**
Descriptors/Topics	
Introduction to oops, Classes and Objects, Encapsulation, Abstraction, Polymorphism, Inheritance, A Closer look at Methods and Classes, constructors, types of constructors, method overloading; Inheritance, Single Inheritance, Multilevel hierarchy; Method overriding; Constructors, Various Types of Constructor, Role of Constructors in inheritance, Abstract classes; final; static; super; Garbage Collection	
Module III – Exception Handling Interface and Thread in Java	**20**
Descriptors/Topics	
Exception handling in Java, try, catch, throw, throws and finally, Uncaught Exceptions, creating and using user defined exception Multiple catch, Java's Built-in Exception Interface: Defining Interfaces, Abstract Methods in Interfaces, Implementing Interfaces, Extending Interfaces, Interface References, Default Methods in Interfaces, Static Methods in Interfaces, Constants in Interfaces Thread: Thread life cycle, Creating and implementing thread, multi-threaded programming, thread priorities, synchronization of thread, resuming and stopping Threads	
Module IV - Java Packages and GUI	**20**
Descriptors/Topics	
Defining, Implementing and applying Packages, Importing Packages, Types of packages, User define package, Introduction to lang Package classes; Introduction to IO package – input streams, output streams, Sample programs on I/O files; string handling Applet Class, Life cycle of applet, creating an executable applet, adding applet to HTML file, The Graphics class, Draw lines, rectangles, circles, ellipse, arcs, polygon etc. Using control loops in Applet	
Module V - Event Driven Programming and Database Programming using JDBC	**25**
Descriptors/Topics	
AWT- Introduction to AWT, Event handling Mechanism, Event Model, Event Classes, Sources of Events, Event Listener Interfaces, working with Windows, AWT Controls; Layout Manager; Introduction to swing classes and controls; Advantages of swings over AWT; Basics, networking classes and interfaces, using java.net package, doing TCP/IP and Datagram Programming; JDBC Architecture, Connection interface, Java database connectivity, introduction to package java.sql.*, working with SQL statements	

Course Learning Outcomes:

- Evaluate how to use the concepts of data structures and its execution in actual environment.
- Apply advance C programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for particular problems.
- Create and Design abstract data types such as linked list, stack, queue and tree by using 'for static and dynamic implementations.
- Analyze, and evaluate appropriate abstract data types and algorithms to solve problems.

Lab/ Practical details, if applicable:

- Java programs using classes & objects and various control constructs such as loops etc, and exception handling program in java
- Programs related to Interfaces & Packages.
- Java programming using thread and multithreaded programming
- Java programs for creating Applets for display of images and texts.

Text Reading:
JAVA The Complete Reference by PATRICK NAUGHTON & HERBERT SCHILD, TMH
Introduction to JAVA Programming a primar, Balaguruswamy.

References:
"Introduction to JAVA Programming" Daniel/Young PHI
Jeff Frentzen and Sobotka, "Java Script", Tata McGraw Hill

Course Title: ADVANCED DATABASE MANAGEMENT SYSTEMS

Course Objectives:

- To provide a strong foundation in advanced database concepts from an industry perspective.
- To covers advanced data modeling concepts like OOD Modeling and ORD Modeling
- To learn query processing and transaction management concepts for object-relational database, Parallel databases and distributed database

Pre-requisites:
> Concepts of Database Management System and OOPs Concepts

Course Contents/Syllabus:

	Weightage (%)
Module I Query Processing • Basic concepts of query processing; • converting SQL queries into Relational Algebra; • Basic Algorithms for executing query operations; • Query tree and query graph; • Heuristic optimization of query tree, functional dependencies, normal forms	**20**
Module II Object Oriented and Extended Relational Database Technologies • Overview of Object oriented database; • OO Concepts; • architecture of ORDBMS and OODBMS; • OOD Modeling, • ORD modeling, • Specialization, Generalization, • Aggregation and Associations, Object Query Language; • Object Relational Concepts.	**20**

Module III Parallel and Distributed Database	**20**
- Introduction; - Design of Parallel databases, Parallel Query Evaluation; - Distributed databases principles; - Architectures; design; implementation; - Fragmentation; - Transparencies in Distributed Databases; - Transaction control in Distributed Database; - Query Processing in Distributed Database	
Module IV Databases on the Web and Semi Structured Data	**20**
- Web interfaces to the Web, - Overview of XML; Structure of XML data, - Document schema, - Querying XML data; - Storage of XML data, XML applications; - The semi structured data model, - Implementation issues, - Indexes for text data.	
Module V Advance Transactions and Emerging trends	**20**
- Multilevel Transactions, - Long-lived transactions(Saga); - Data warehousing and Data Mining; - Active database; - Spatial Database; - Deductive database; - Multimedia database.	

Student Learning Outcomes:

- Identify advance database concepts and database models.
- Apply and analyze various terms related to transaction management in centralized, parallel and distributed database.
- Produce data modeling and database development process for object –oriented DBMS.
- Analyze and Implement the concept of object- relational database in development of various real time software.
- Explain the issues related to multimedia and mobile database performance.

Lab/Practicals details, if applicable:

1) Develop a database application to demonstrate the representation of multivalued attributes and the use of nested tables to represent complex objects. Write suitable queries to demonstrate their use.

2) Develop a database application to demonstrate storing and retrieving of BLOB and CLOB objects

3) Design and develop a suitable Student Database application. One of the attributes to be maintained is the attendance of a student in each subject for which he/she has enrolled. Using TRIGGERS, write active rules to do the following:Whenever the attendance is updated, check if the attendance is less than 85%; if so, notify the Head of the Department concerned.Whenever, the marks in an Internal Assessment Test are entered, check if the marks are less than 40%; if so, notify the Head of the Department concerned.

4) A Private Nursing Home has hired you as a database expert to maintain information about Patients, Doctors, Treatments and other related details i.e. Medicine prescribed, lab tests recommended and Doctor's Remark given to the patient by the doctor. Justify your role as a responsible database designer by developing suitable ER Diagram and Data Flow Diagram. Also mention all possible assumptions which is helpful in producing correct database design. Draw a suitable layout for designing the Database.

5) A Librarian has hired a database designer to maintain information about its members of library, books, library rules and other related details i.e. about issue of books, returns of books etc. You have to draw a suitable ER Diagram and Data Flow Diagram and also suggest a suitable database design to maintain above mentioned data keeping in mind redundancy and consistency of data. Make all suitable assumption for running the business process

6) Examination department of the university wants to computerized the examination process and by maintaining data about students, course, date sheet of exams, Final Grade obtained by student's semester wise. Draw a suitable E R Diagram and Data Flow Diagram to explain the examination process. Also draw a suitable layout for designing the database which is capable of maintaining above mentioned data.

7) Implement the following based on above mention business process:
   a) Apply all possible integrity constraints into the database to maintain the integrity and consistency of data.
   b) Perform various types of SQL queries to retrieve data from multiple tables (Two or Three)
   c) Suggest and create some suitable views based on the database from one or more Tables.
   d) Use various oracle function including group functions through multiple table.
   e) Perform some select command on view created from one or more Tables

Text Reading:

- Fundamental of Database Systems, Elmasri&Navathe, Pearson Education, 2010
- Database System Concepts; Korth&Sudarshan, TMH.2011
- Database Illuminated, Catherine Ricarso, Second Edition, Jones &Bartleft Learning.2013
- Database Management System , S K Sinha, Second Edition, Pearson Publication 2011

References:
- Data Base Management System, Leon & Leon, Vikas Publications ,2010
- Introduction to Database Systems, Bipin C Desai, Galgotia, 2012

Course Title: ADVANCED SOFTWARE ENGINEERING PRINCIPLES

Course Objectives:

To provide an advanced understanding and knowledge of the software engineering techniques, techniques to collect software requirements from client and CASE tools and to understand the importance of these case tools in software development.

Pre-requisites:

1. Student should have knowledge of development languages of software
2. Student should know what is software in actual means

Course Contents/Syllabus:

	Weightage (%)
Module I Life Cycle Models	**20**
• Waterfall Model • Prototying Models • Incremental Development • Spiral Model • Rapid Application Development • Componant Model • Agile Software Development • Selection of appropriate development process	

Module II Formal Methods	20
• Basic concepts • Mathematical Preliminaries • Mathematical notations for Formal Specification • Formal Specification Languages • Z-Notations • Ten commandments of formal methods • Formal Methods- The Road Ahead	
Module III Component-Based Software Engineering	25
Component-Based Software Engineering • Engineering of Component-based Systems • CBSE Process • Domain Engineering • Component-based Development • Classifying and Retrieving Components • Economics of CBSE **Cleanroom Software Engineering** • The Cleanroom Approach • Functional Specification • Cleanroom Design Cleanroom Testing	
Module IV Client/Server Software Engineering	20
Client/Server Software Engineering • The Structure of Client/Server Systems • Software Engineering for Client Server Systems • Analysis Modeling Issues • Design for Client Server Systems • Testing Issues. **Web Engineering** • The Attributes of Web-based Applications • WebE Process • Framework for WebE • Formulating/Analyzing Web-based Systems • Design for Web-based Applications • Testing Web-based Applications • Management Issues. **Service Oriented Software Engineering** • Services as Reusable Components • Service Engineering • Software Development with Services	

Module V Reengineering and CASE	15
Reengineering • Business Process Reengineering • Software Reengineering • Reverse Reengineering • Restructuring, Forward Reengineering • Economics of Reengineering.	
Computer-Aided Software Engineering • Introduction • Building Blocks for CASE • Taxonomy of CASE Tools • Integrated CASE Environments • Integration Architecture • CASE Repository • Case Study of Tools like TCS Robot.	

Student Learning Outcomes:

1. Analyze the software life cycle models;
2. Identify the importance of the software development process;
3. Analyze the importance of CASE tools;
4. Design and develop correct and robust software products using advanced software engineering techniques;
5. Able to understand business requirements pertaining to software development.

Pedagogy for Course Delivery:

The course would be covered under theory lectures. In addition to assigning project–based learning, early exposure to hands-on design to enhance the motivation among the students. It incorporates designing of problems, analysis of solutions submitted by the students groups and how learning objectives were achieved. Continuous evaluation of the students would be covered under quiz, viva etc.

Text Reading:

• Roger S. Pressman, Software Engineering a Practitioners Approach, McGraw-Hill (2008).
• J. Bowan, Formal Specification and Documentation using Z - A Case Study Approach, International Thomson Computer Press (2003).
• Antoni Diller, Z., An Introduction to Formal Methods (second edition), Wiley, 2nd edition (1994).

References:

- M. Dyer, The Cleanroon Approach to Quality Software Development, Wiley (1992).
- Prowell, S., Trammell, C.J. and Poore, J.H, Cleanroom Software Engineering: Technology and Process, Addison-Wesley, Massachusetts (1999).
- Allen, Frost, Yourdon, Component-Based Development for Enterprise Systems: Applying the Select Perspectives, Cambridge University Press (1998).
- Zantinge and Adriaans, Managing Client/Server, Addison-Wesley (1996).

Course Title: Professional Communication

Course Objectives:

This course aims to equip students with effective oral and written communication. Students will earn the difference between oral and written communication, and speaking in multicultural context, conducting and participating in meetings, the correct format of business documents.

Course contents/Syllabus:

Module I: Verbal and Non-verbal communication

Oral Communication: forms, advantages and disadvantages. Written Communication: forms, advantages and disadvantages. Principles and Significance of Non-verbal communication. KOPPACT: Kinesics, Oculesics, Proxemics, Paralinguistics, Artifactics, Chronemics, Tactilics

Module II: Social Communication Essentials

Small Talk. Building rapport. Informal Communication: Grapevine-water cooler- Communication

Module III: Cross cultural Communication

Public speaking in multi-cultural context. Culture and context. Ethnocentrism, Stereotyping, cultural relativism.

Module IV: Meetings

Meetings: Meaning and importance. Purpose of meeting. Steps in conducting meeting. Written documents related to meeting: Notice, agenda,minutes.

Module V: Report writing

Types of reports. Significance of Report. Report planning. Process of Report writing. Visual Aids in Report

Module VI: Employment communication

Cover letter. Resume. Participating in a group discussion. Preparation for Interview. Appearing in Interview

Text and References:

- Krizan, Merrier, Logan and Williams. Effective Business Communication, New Delhi: Cengage, 2011
- Keyton. Joann. Communication and Organizational Culture. Sage Communications

Course Title: Research Methodologies

Course Objectives:

The objectives of the course are:

- The students are able to recognize the steps involved in doing research work.
- The students will be able to collect data using various media and using the best possible sample available.
- The students would learn to propose their Hypothesis and build models for the problem.
- The students would be able to correctly document their findings in the form of a report.

Pre-requisites: None

Course Contents/Syllabus:

	Weightage (%)
Module I : Introduction	15
Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration and testing, Heuristic and simulation modeling.	
Module II: Sampling	20
Sampling and data collection- Techniques of sampling, Random, Stratified, Systematic, Multistage-sampling, Primary and secondary sources of data. Design of questionnaire.	
Module III : Data Collection and Experiments	20
Design of Experiments- Objectives, strategies, Factorial experimental design, designing engineering experiments, basic principles-replication, randomization, blocking, guidelines for design of experiments.	
Module IV : Models and Hypothesis	25

Single factor experiment- Hypothesis testing, analysis of Variance component (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effect model, estimation of variance components, Model adequacy checking.	
Module V: Report Writing	20
Structure and components of Scientific Reports, Types of Report, Technical Reports and Thesis; Different steps in the preparation – Layout, structure and Language of typical reports; Illustrations and tables, Bibliography, Referencing and foot notes. Oral presentation- Planning, Preparation and practice, Making presentation, Use of visual aids, Importance of Effective Communication. Conventions and strategies of Authentication, Citation Preparing Research papers for journals, Seminars and Conferences, Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index, ISBN & ISSN. Preparation of Project Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology, Time frame and work plan, Budget and Justification, References	

Student Learning Outcomes:

After completion of this course, the student will be able to:

Recognize the various steps involved in research.

Collect data from samples, Examine and Analyze the data.

Develop models for problems.

Explain the entire process in the form of a report.

Text & References:

Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition, 2012.

Research Methodolody – Methods and Techniques – C.R. Kothari, New Age International, New Delhi, 2004.

Practical Research:Planning Design – Paul D. Leddy, London, 1980.

Course Title: Data Structures Using C Language

Course Objectives: The aim of this course is to

- Provide in-depth knowledge of usage, design, and analysis of data structures in computer programs.
- Make students understand the concepts of linear and nonlinear data structure.
- Impart knowledge about asymptotic notations and their usage.

Pre-requisites: - Computer programming using 'C' language

Course Learning Outcomes:

- Evaluate how to use the concepts of data structures and its execution in actual environment.
- Apply advance C programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for particular problems.
- Create and Design abstract data types such as linked list, stack, queue and tree by using 'for static and dynamic implementations.
- Analyze, and evaluate appropriate abstract data types and algorithms to solve problems.

	Weightage (%)
Module I: Introduction to Data Structures	**15**
Data Types in C Language, Abstract data type, Pointers in C, Arrays in C Language, Implementation of Single Dimensional & Multi-Dimensional Arrays, Address Calculation in Single and Multi-Dimensional Arrays. Row	

major order and column major order, Sparse matrix, Asymtotic notations, Time Complexity.	
Module II: Stacks and Queues	15
Definition & Examples, Representing Stack using an Array, Implementing Push and Pop Operation in a Stack, Infix Postfix & Prefix Expressions, Evaluating a Postfix Expression, Conversion from one form of an expression to another form , Towers of Hanoi, Queues and its Sequential Representation, Insert –Delete- Print Operations, Dequeue and its implementation ,Circular Queues and their Implementation, Priority Queues with basic operations.	
Module III : Programming with Linked Lists	20
Introduction, Insertion and deletion of a node to single linked list, Doubly, Circular & Header linked lists with basic operations, List allocating and freeing dynamic variables, Addition of two polynomials list, Joseph Problem.	
Module IV : Programming with Trees	20
Binary Trees, Operations on Binary Trees, node representation, internal and external nodes, tree traversal, constructing a tree, Binary Search Tree(BST)- definition, representation, Implementation of BST. Constructing a binary search tree based on its given infix and pre/post fix order, deletion and insertion of a node in binary search tree, Threaded binary trees, Height Balanced Tree, Constructing an AVL Tree, Insertion and Deletion of a node, searching a node ,Paged binary tree, Multiway search tree-B tree, B+ tree, B* tree.	
Module V: Searching and Sorting Techniques	15
Insertion Sort, Selection Sort, Merge Sort, Heap Sort, Bubble Sort, Radix Sort, Quick Sort, Count Sort, , Linear Search, Binary Search ,Complexities of Sorting and Searching Algorithms, Hashing, Hash Functions, Collision Resolution Techniques.	
Module VI: Graph and Their Applications	15

Introduction, Graph Theory Terminology, Sequential Representation of Graph (Adjacency and Path Matrix), Warshall Algorithms, Linked Representation of Graph, Different Operations on Graphs, Traversing A Graph (DFS, BFS),Shortest path algorithm, Spanning Trees-Introduction, Representation of Spanning tree, Constructing A Spanning Tree(Prim's Algorithm, Kruskal's Algorithm).	

List of Experiments:

1. Write a program to search an element in a given array using linear search.
2. Write a program to search an element in a given array using binary search.
3. Write a program to sort the elements of an array using the following techniques: Bubble Sort, Selection Sort, and Insertion Sort. Compare the time taken by each sorting technique.
4. Write a program using the concept of iteration and recursion to sort the elements of an array using Quick Sort.
5. Write a program to implement Heap sort.
6. Write a program to implement Merge sort.
7. Write a program to delete an element from the kth element of an array.
8. Write a program to insert an element at the kth element in an array.
9. Write a program to remove duplicates in an array.
10. Write a program to merge two sorted arrays.
11. Write a program to perform the following operations on two given matrices: Addition and Multiplication.
12. Write a program to implement a Stack, show overflow and underflow while performing push and pop operations respectively.
13. Write a program to evaluate a postfix expression.
14. Write a program of Towers of Hanoi Problem.
15. Write a program to implement a queue and show the following: insertion and deletion.
16. Write a program to implement a circular queue and show the following: insertion and deletion.
17. Write a program to implement Linear Linked List and show the following operations: creation, display, insertion, deletion and searching.
18. Write a program to increment the data part of every node in a linked list by 10.
19. Write a program to implement a stack using linked list and show the following operations: Push, Pop, and Display.
20. Write a program to implement a stack using linked list and show the following operations: Insertion, Deletion, and Display.
21. Write a program to count the number of repetitions of a number in a linked list.
22. Write a program to implement Doubly Linked List and show the following operations: creation, display, insertion, deletion and searching.
23. Write a program to implement Joseph Problem.

24. Write a program to implement Binary tree and display the contents using preorder, postorder and inorder traversal techniques.
25. Write a program to construct a Binary Search tree and perform the following operations: Insertion and Deletion of a node.
26. Write a program to construct an AVL tree and perform the following operations: insertion, deletion and searching.
27. Write a program to insert and delete nodes in a graph using adjacency matrix.
28. Write a program that demonstrates Warshall's algorithm.
29. Write a program to implement Depth First Search using linked representation of graph.
30. Write a program to implement Breadth First Search using linked representation of graph.
31. Write a program to implement Prim 's Algorithm
32. Write a program to implement Kruskal Algorithm
.

Text

- Yashwant Kanetkar," Data Structure using C", BPB Publication, 5th Edition ,2011
- A.Tannenbaum,Y. Lanhgsam and A.j. Augenstein ," Data Structures Using C And C++ ",Prentice Hall of India,2nd Edition,2009.
- R.S Salaria "Data Structures & Algorithms using C",Khanna Publication,4th edition,2009
- E.Horowitz and S.Sahni,Fundamentals of Data Structures in C ",2nd Edition,Universities Press,2008.
- Jean-Paul Tremblay, P.G Sorenson, "An Introduction to Data Structures with applications" , Mcgraw-Hill ,2nd Edition ,1984.

References:

- Shaum's outline Series,"Data Structure",TMH,Special Indian Edition,Seventeenth Reprint,2009
- Robert L Kruse "Data Structure and Program Design in C", Prentice Hall ,1991.
- Noel Kalicharan,"Data Structure in C" ,Ist edition Create space publisher, 2008.
- Mark Allen Weiss,"Data Structure and algorithm Analysis in C",2nd Edition AddisonWesley,1996
- Jean-Paul Tremblay "An Introduction to Data Structures with applications" , Mcgraw-Hill College, 2nd edition ,1984.
- E. Balagurusamy, "Problem Solving through C language", TMH publication, Fourth Edition, 2008.

Course Title: Network Security and Cryptography

Course Objectives:

The objectives of this course can be illustrated as:

- ➢ To provide conceptual understanding of network security issues, challenges and mechanisms.
- ➢ To develop basic skills of secure network architecture and explain the theory behind the security of different cryptographic algorithms.
- ➢ To describe common network vulnerabilities and attacks, defense mechanisms against network attacks, and cryptographic protection mechanisms.
- ➢ To explore the requirements of real-time communication security and issues related to the security of web services.

Pre-requisites: Basic Networking Concept

Course Contents/Syllabus:

Module I: Introduction to Network Security	% Weightage
Introduction to Security Attacks, Services and Mechanism, Classical encryption techniques, Substitution Ciphers and Transposition ciphers, Cryptanalysis, Steganography, Stream and Block ciphers, A Brief Overview of Hardware Security	20
Module II: Secret Key Cryptography	10
Modern Block Ciphers: Block Ciphers Principles, Shannon's Theory of Confusion and Diffusion, Fiestal Structure, Data Encryption Standard (DES), Strength of DES, Idea of Differential Cryptanalysis, Block Cipher Modes of Operations, Triple DES	
Module III: Public Key Cryptography	15
Advanced Encryption Standard (AES) encryption and decryption, Fermat's and Euler's theorem, Chinese Remainder theorem, Principals of Public Key Crypto Systems, RSA algorithm, Security of RSA algorithm.	
Module IV: Authentication Standards & Key Management	15

Message Authentication Codes: Authentication requirements, authentication functions, message authentication code, Hash Functions, Secure Hash Algorithm (SHA), Message Digest, Digital Signatures: Digital Signatures, Digital Signature Standards (DSS), proof of Digital Signature Algorithm	
Module V: Web Security	**15**
Authentication Applications: Kerberos, Overview of Access Control List (ACL), Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME. IP Security: Architecture, Authentication Header, Encapsulating Security Payloads, Key Management, Introduction to Secure Socket Layer, Secure electronic, transaction (SET)	
Module VI: System Security	**15**
System Security: Introductory Idea of Intrusion, Intrusion Detection Techniques, Viruses and Worms, Firewalls, Design Principles of Firewalls, IT Acts and Cyber Laws (Global Standards), Virtual Private Network, Recent attacks on networks (Packet Analyzer, Buffer Overflow and Port Scanning), Blockchain Technology, Preventing Privacy and Piracy on Internet	
Module VII: Cyber Forensic and Its Applications	**10**
Brief Overview of Cyber Forensic, Cyber Forensic Processes, Cyber Forensic Applications and Cyber Forensic Tools, Digital Evidence, Investigating Windows and Unix Systems, E-mail Tracing	

Course Learning Outcomes:

The Network Security program gives students the chance to develop the technical skills necessary to fully manage sophisticated and vulnerable computer network environments. Students will have the skill sets needed to handle the day-to-day troubleshooting problems for securing the networks of all sizes.

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

- Analyze multiple operating systems, systems software, network services and security. Evaluate and compare systems software and emerging technologies.
- Evaluate solutions for networking and security problems, balancing business concerns, technical issues, and security.
- Creating concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance, and implementing new technologies.

References Books:

- SENSS 300-206: Implementing Cisco Edge Network Security Solutions, Cisco Certified Network Professional Security (CCNP Security) Certification Book, Cisco Press, 2016
- CompTIA Security+ Study Guide: Sy0-401 (Paperback) by Emmett Dulaney, Chuck Easttom, Sixth Edition, May 2014
- W. Stallings, "Networks Security Essentials: Application & Standards", 5th Edition, Prentice Hall Publication, 2013
- W. Stallings, "Cryptography and Network Security: Principles and Practice", International Edition, Pearson Education, 2013.
- Behrouz A. Frouzan, "Cryptography and Network Security", Tata McGraw Hill Education, 2007
- *Guide to Computer Forensics and Investigations*, by Nelson, Phillips, Enfinger, Steuart, 2nd ed, ISBN 0-619-21706-5, 2005
- Bruce Schiener, "Applied Cryptography", Second Edition, John Wiley & Sons Publication, 1996
- Bernard Menezes," Network Security and Cryptography", Cengage Learning Publication, 2010
- Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill Education, 2003

Any Other Study Material:
- http://www.cnss.gov/Assets/pdf/cnssi_4009.pdf
- http://en.wikipedia.org/wiki/Network_security

Course Title: Research Methodologies

Course Objectives:
The objectives of the course are:

The students are able to recognize the steps involved in doing research work.
The students will be able to collect data using various media and using the best possible sample available.
The students would learn to propose their Hypothesis and build models for the problem.
The students would be able to correctly document their findings in the form of a report.

Pre-requisites: None

Course Contents/Syllabus:

	Weightage (%)

Module I : Introduction Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration and testing, Heuristic and simulation modeling.	15
Module II: Sampling Sampling and data collection- Techniques of sampling, Random, Stratified, Systematic, Multistage-sampling, Primary and secondary sources of data. Design of questionnaire.	20
Module III : Data Collection and Experiments Design of Experiments- Objectives, strategies, Factorial experimental design, designing engineering experiments, basic principles-replication, randomization, blocking, guidelines for design of experiments.	20
Module IV : Models and Hypothesis	25

Single factor experiment- Hypothesis testing, analysis of Variance component (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effect model, estimation of variance components, Model adequacy checking.

Module V: Report Writing

Structure and components of Scientific Reports, Types of Report, Technical Reports and thesis; Different steps in the preparation – Layout, structure and Language of typical reports; Illustrations and tables, Bibliography, Referencing and foot notes.

Oral presentation- Planning, Preparation and practice, Making presentation, Use of visual aids, Importance of Effective Communication. Conventions and strategies of Authentication, Citation

Preparing Research papers for journals, Seminars and Conferences, Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index, ISBN & ISSN.

Preparation of Project Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology, Time frame and work plan, Budget and Justification, References

Student Learning Outcomes:

After completion of this course, the student will be able to:

Recognize the various steps involved in research.

Collect data from samples, Examine and Analyze the data.

Develop models for problems.

Explain the entire process in the form of a report.

Text & References:

Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition, 2012.

Research Methodolody – Methods and Techniques – C.R. Kothari, New Age International, New Delhi, 2004.

Practical Research:Planning Design – Paul D. Leddy, London, 1980.

Course Title: Artificial Intelligence and Robotics

Course Objectives: The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of Artificial Intelligence.The emphasis of the course is on teaching the fundamentals and not on providing a mastery of specific commercially available software tools or programming environments.

Upon successful completion of the course, students will have an understanding of the basic areas of artificial intelligence search, knowledge representation, learning and their applications in design and implementation of intelligent agents for a variety of tasks in analysis, design, and problem- solving. Aim of this course is to know about Lisp and Prolog and use of these languages in AI. Graduate students are expected to develop some familiarity with current research problems and research methods in AI by working on a research or design project

Pre-requisites: Nil

Course Contents/Syllabus:

	Weightage (%
Module I Introduction to AI and Problem Representation:	20%
Descriptors/Topics : Introduction: Artificial Intelligence (AI) and its importance, AI Problems (tic tac toe problem, water jug problems), Application area of AI. Problem Representations: State space representation, problem-reduction representation, production system, characteristics and types of production system	
Module II Heuristic Search Techniques and Game Playing	20%
Descriptors/Topics Heuristic Search Techniques :AI and search process, brute force search, depth-first search, breadth-first search, time and space complexities, heuristics search, hill climbing, best first search, A* algorithm and beam search, AO search, constraint satisfaction. Game Playing: AI and game playing, plausible move generator, static evaluation move generator, game playing strategies,problems in game playing.	
Module III Logic and Knowledge Representation	15%
Descriptors/Topics Knowledge Representation and Structured Knowledge: Associative networks, frame structures, conceptual dependencies and scripts Logic: Prepositional logic: syntax and semantics, First Order Predicate Logic (FOPL): Syntax and semantics,	

conversion to clausal form, inference rules, unification, and the resolution principles .	
Module IV Knowledge Acquisition and Expert System **Descriptors/Topics** Knowledge Acquisitions: Type of learning, Knowledge Acquisition, Early work in machine learning, learning by induction. Expert System: Introduction to expert system, Phases of expert system, characteristics of expert system and a case study;Introduction of Executive Support System and Decision Support System	**15%**
Module V. Robotics and its application **Descriptors/Topics** Robotics and Its applications, DDD concept, Intelligent robots, Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system	**15%**
Module VI Core OF AI **Descriptors/Topics** Introduction to Neural Network; Fuzzy Logic; LISP and Prolog; Research orientation of soft computing techniques; Knowledge management, Ontology, Overview of Natural Language Processing .	**15%**

Course Learning Outcomes:

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

Describe human intelligence and AI
Explain how intelligent system works.
Apply Knowledge representation and semantic in   Knowledge representation.
Develop some familiarity with current research problems and research methods in AI.
Demonstrate and Illustrate about functionalities of Robots and Robotics.
Apply basics of Fuzzy logic and neural network

Text Reading:
        i.   Elaine Rich, Kevin Knight, Artificial Intelligence TMH (Any Edition).
        ii.   Max Barber,Logic Programming with Prolog,Springer,2013

References:

      iii.   Dan W. Patterson, Introduction to AI and Expert System, PHI

      iv.   V S Janakiraman, K Sarukesi, P Gopalakrishan, Foundations of Artificial Intelligence and Expert Systems, Macmillan India Ltd

      v.

Additional Reading:

    i.   Introduction to Artificial Intelligence by Wolfgang Ertel and Nathanael T. Black ,springer ,2017

    ii.   V S Janakiraman, K Sarukesi, P Gopalakrishan, Foundations of Artificial Intelligence and Expert Systems, Macmillan India Ltd.

Any other Study Material:

    iii.   https://www.tutorialspoint.com/artificial_intelligence

    iv.   **www.nptel.ac.in**

    v.   https://swayam.gov.in/nd1_noc20_cs42/preview

Course Title: ERP

Course Objectives:

1. With the basic concepts of ERP systems for manufacturing or service companies, and the differences among (Material Requirement Planning) MRP, MRP II, and ERP systems;
2. Apply the principles of ERP systems, their major components, and the relationships among these components;
3. with the knowledge of typical ERP systems, and the advantages and limitations of implementing ERP systems.
4. To comprehend the technical aspects of ERP systems
5. To be able to map business processes using ERP concepts and techniques

Pre-requisites: Nil

Course Contents/Syllabus:

	Weightage (%)
Module I Introduction to Enterprise Resource Planning	

Descriptors/Topics Introduction of the term Business Process Reengineering(BPR) ,BPR Methodology, Current BPR Tools ,Introduction to material requirement planning (MRP), Definition of Enterprise Resource Planning (ERP); Evolution of ERP; Characteristics, Features, Components and needs of ERP; ERP Vendors; Benefits & Limitations of ERP Packages	
Module II Enterprise Modeling and Integration of ERP	
Descriptors/Topics Need to focus on Enterprise Integration/ERP; Information mapping; Role of common shared Enterprise database; System Integration, Logical vs. Physical System Integration, Benefits & limitations of System Integration, ERP's Role in Logical and Physical Integration	
Module III ERP Architecture and Implementation Methodology of ERP	
Descriptors/Topics Generic Model of ERP system; Core Modules functionality; Types of ERP architecture, Client Server Architecture, Web-based Architecture, Service Oriented Architecture (SOA) ; Difficulty in selecting ERP, Approach to ERP selection, Request for Proposal approach, Proof-of-Concept approach; General Implementation Methodology of ERP, Vanilla Implementation; Evaluation Criteria of ERP packages; Project Implementation Team Structure	
Module IV Introduction to SAP , Oracle APPS	
Descriptors/Topics SAP, Integrated SAP Model, SAP Architecture, SAP R/3 System & mySAP, SAP Modules; Oracle Apps, Oracle AIM Methodology, Oracle Fusion Modules; A Comparative assessment of ERP Packages	
Module V ERP for Supply Chain Management and Customer Relationship Management	

Descriptors/Topics
      Supply Chain Management and ERP
      Definition of Supply Chain Management (SCM); Supply Chain Council's SCOR Model; Stevens Model of Supply Chain
      Management; Aims of SCM; SCM Key Drivers; Collaborative Design & Product Development; Benefits of SCM; ERP Vs
      SCM; Key SCM Vendors
      Customer Relationship Management and ERP
Definition of Customer Relationship Management (CRM); CRM Evolution; CRM Delivery Processes, CRM support Processes; CRM Analysis Processes; CRM Components; Key CRM Vendors	

Course Learning Outcomes:

1. Classify different processes of the organization and relationship among all processes .
2. Examine systematically the planning mechanisms in an enterprise, and identify all components in an ERP system and the relationships among the components;
3. Describe the Generic Model of ERP and General ERP Implementation Methodology.
4. Apply the concepts of BPR, SCM and CRM.

5. To demonstrate knowledge of SAP and Oracle Apps

Text Reading:
1. Enterprise Systems For Management, Luvai F. Motiwalla, Jeff Thompson, Pearson Education., 2nd Ed., 2011.
2. Enterprise Resource Planning, Ravi Shankar, S.Jaiswal, Galgotia Publication Pvt. Ltd., 1st Ed., 1999.
3. Enterprise Resource Planning – Concepts and Practices by Vinod Kumar Garg & N K Venkatakrishna, PHI
4. Textbook of Enterprise Resource Planning by Mahadeo Jaiswal & Ganesh Vanapalli, Macmillan, 1/e 20
5. Enterprise Resource Planning, Mary Sumner, Pearson Education, Fourth Impression 2009
6. Enterprise Resource Planning, Ellen F. Monk, Bret J. Wagner, Cengage Learning, First Indian Reprint 2009

References:
1. CRM at the speed of Light : Social CRM strategies, tools and techniques for engaging your customers : 4th edition by Paul Greenberg , McGraw Hill ,2009

2. Supply Chain Management Casebook : The Comprehensive Coverage and Best Practices in SCM , by Chuck Munson , Pearson FT Press 2013

3. Definitive Guide to Supply Chain Best Practices, The Comprehensive Lessons and Cases in Effective SCM , by Robert Frankel , Pearson FT Press , 2014

4. Enterprise Resource Planning by Mary Sumner , Prentice Hall , 2005

Course Title: Introduction to Data Analytics

Course Objectives:
The aim of the course is to

- Introduce students to rapidly growing field and equip them with some of its basic principles and tools as well as its general mindset.
- To learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration, exploratory data analysis, predictive modeling, descriptive modeling, data product creation, evaluation, and effective communication.
- Application to solving problems.

Pre-requisites:
- Basic knowledge of algorithms and reasonable programming experience
- Basic linear algebra (solution of linear systems and eigenvalue/vector computation)

- Basic probability and statistics

Course Contents/Syllabus:

	Weightage (%
Module I : Introduction to Data Analytics	20%
Introduction to Data Science, Big Data and Data Science, Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting, Modern Data Analytic Tools	
Module II: Data Representation and pre-processing	20%
Multi-Dimensional data, Basic tools (plots, graphs and summary statistics) of EDA, Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation. Data summarization, Data Normalization.	
Module III : Machine Learning Concepts	20%
Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model, Feature Generation (role of domain expertise) and Feature Selection algorithms: Filters; Wrappers	
Module IV Supervised and Unsupervised Learning	20%
Decision Trees; Random Forests, Machine Learning Algorithms - Linear Regression, - k-Nearest Neighbors (k-NN), k-means, Naive Bayes, SVM, Clustering, Expectation Maximization, Dimensionality Reduction, Feature Selection, PCA, factor analysis	
Module V Reinforcement Learning	20%
Reinforcement Learning: Value iteration; policy iteration; TD learning; Q learning; actor-critic	

Course Learning Outcomes:

After completion of the course, the student will be able to:

- Describe what Data Science is and the skill sets needed to be a data scientist.
- Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.
- Explain the significance of exploratory data analysis (EDA) in data science.
- Describe the Data Science Process and how its components interact.
- Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes) for predictive modeling.
- Identify common approaches used for Feature Generation.
- Identify and explain fundamental mathematical and algorithmic ingredients that constitute a Recommendation Engine

- Create effective visualization of given data (to communicate or persuade).
- Work effectively in teams on data science projects.
- Reason around ethical and privacy issues in data science conduct and apply ethical practices.

Text/References Books:

- Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
- James, G., Witten, D., Hastie, T., Tibshirani, R. An introduction to statistical learning with applications in R. Springer, 2013.
- Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann, 2011.
- Hastie, T., Tibshirani, R., Friedman, J. The Elements of Statistical Learning, 2nd edition. — Springer, 2009.
- Murphy, K. Machine Learning: A Probabilistic Perspective. - MIT Press, 2012.
- "Practical Data Science with R". Nina Zumel, John Mount. Manning, 2014
- "Data Science for business", F. Provost, T Fawcett, 2013

Course Title: Machine Learning using Python

Course Objectives:

Machine learning is the science of getting computers to act without being explicitly programmed. This course provides a broad introduction to machine
learning, datamining, and statistical pattern recognition. It will introduce you a wide range of machine learning tools in Python. The main focus
is   on   the
concepts, methods, and applications of the general predictive modeling and unsupervised learning and how they are implemented in the Python language
environment. The goal is to understand how to use these tools to solve real world problems. After this course you will be able to carry out your experiments
with the public available algorithms or develop your own algorithm.

Pre-requisites:

Learners those who wish

1. To learn how to execute on predictive analytics by way of the Python language.
2. To turn ideas into software, quickly and faithfully."

3. those who already have a firm understanding of Python and are looking to extend those Python skills to machine learning and advanced statistical method

Course Contents/Syllabus:

	Weightage (%)
Module I: Basics	**10**
Introduction to machine learning, different forms of learning; Basics of probability theory, linear algebra and optimization, Overview of target function representations, Types of ML techniques, hypothesis selection through cross	
Module II : Regression Analysis	**25**
Linear regression, ridge regression, Lasso, Bayesian regression, regression with basic functions, Correlation, covariance, Mahalanobis distance, Minkowski distance, distance metric, Jaccard coefficient, missing values, feature transformations, Geometrical interpretation of Euclidean, dealing with uncertainty	
Module III: Statistical Estimation	**25**
Maximum likeliHood estimation (MLE) theory and example using binomial distribution, Maximum likeliHood estimation (MLE) of univariate Gaussian, generative vs discriminative models, Maximum likelihood estimation of bivariate Gaussian distribution, sufficient statistics, Bayesian Learning	
Module IV: Computational Learning Theory: PAC Learning, VC Dimension, Bias/Variance Tradeoff.	**30**
Classification Methods: Linear Discriminant Analysis, Logistic regression, Perceptrons, Large margin classification, Kernel methods, Support Vector Machines. Classification and Regression Trees, Multi-layer Perceptrons and Back propagation **Clustering:** Partitional Clustering - k-means, k-medoids; Hierarchical Clustering - Agglomerative, Divisive, Distance measures: Density based clustering – DB Scan; Spectral clustering. **Frequent Pattern Mining:** Apriori Algorithm; FP-Growth	

Lab Assignments:
• To create Line chart, Bar chart and Histogram.
• Create a n * k matrix to represent a linear function that maps k-dimensional vectors to n-dimensional vectors.
• Solving problem generated due to Simpson's Paradox.
• Pandas
• Scrapy
• Manipulating and Rescaling data.
• Finding k-nearest neighbor
• Spam Filter
• Entropy of Partition

Course Learning Outcomes:

- Explain the objectives and functions of machine learning
- Describe the type of machine learning and data modelling, and data engineering
- Analyze the different machine leaning algorithm, such as Linear regression, ridge regression, Lasso, Bayesian regression, regression with basic functions
- Demonstrate theoretical of machine learning mechanisms for predictive analysis
- Categorize different ways of machine learning approach such as supervised learning, unsupervised learning, reinforcement learning and deep learning
- Be fluent with popular machine learning techniques
- Be aware of other available machine learning modules
- Explain and adopt the machine learning algorithm

Text & References:

The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies by Erik Brynjolfsson and Andrew McAfee. ISBN-10: 0393239357
- Getting started with Internet of Things, by Cuno Pfister, Shroff; First edition (17 May 2011), ISBN-10: 9350234130
- Big Data and The Internet of Things, by Robert Stackowiak, Art licht, Springer Nature; 1st ed. edition (12 May 2015), ISBN-10: 1484209877

Course Title: **Routing and Switching Essentials**

Course Objectives:
- Introduces the concept of interconnection of switches in Local Area Network (LAN) and its configuration
- Explains the procedure to provide network access to LAN users.
- Explains the role of Virtual Local Area Network (VLANs) & inter- VLAN in a network.
- Imparts Knowledge how to manage and troubleshoot various types of routes.
- Aims at developing an understanding of how a router learns about remote networks and determines the best path to those networks.
- Gives insights of static routing as well as different Routing Protocols like RIP & OSPF.

Prerequisites: Fundamental knowledge of Computer Networks including layered architecture & concept of LAN & WAN

Course Title	Weightage
Module I : Introduction to Switched Networks, Basic Switching Concepts and Configuration	**15% Weightage**
LAN Design, Converged Network, Switched Network, Frames Forwarding, Switching Domains, Basic switch configuration, Switch security, Secure remote access, Security concerns in LAN, Switch port security	
Module II VLANs	**15% Weightage**
Overview of VLAN, VLAN Assignment, VLAN Trunks, DTP, VLAN Security and Design	
Module III : Routing Concepts	**10% Weightage**
Initial configuration of a router, Functions of a router, Routing Decision, Path determination, Router operation	
Module IV : Inter-VLAN Routing	**15% Weightage**

Inter-VLAN Routing configuration, Troubleshoot Inter-VLAN Routing, Layer 3 Switching	
Module V : Static Routing	**15% Weightage**
Static Routing, Types of Static Route, Configure Static Route and Default Route, Review of CIDR and VLSM, Configure Summary and Floating Static Route	
Module VI : Routing Dynamically	**30% Weightage**
Dynamic Routing Protocol, Dynamic Routing Protocol Operation, Dynamic V/S Static Routing, Types of Routing Protocol, Distance Vector Dynamic Routing, RIP and RIPng, OSPF, OSPF Message, OSPF Operation, Access Control Lists, DHCP, Network Address Translation for IPv4	

Course Learning Outcomes:
- Plan and effectively manage any LAN network using Switching.
- Deploy and effectively manage the LAN.
- Analyze how a router learns about remote networks and determines the best path to those networks.
- Describe the relationship between router interfaces, directly connected networks and the routing table.
- Categorize various dynamic routing protocols.
- Analyze DHCP protocols and Network Address Translation

Text & References:
Text Books:

- Rick Graziani , Allan Johnson, Routing Protocols & Concepts: CCNA Exploration Companion Guide, Pearson Education, Edition 1,2012
- Cisco Networking Academy Program :Routing & Switching Essentials Companion Guide, Pearson Education, Edition 1, 2014

References Books:

- BehrouzForouzan , Data Communications and Networking , Tata McGraw-Hill , Edition 5, 2012,
- Andrews S. Tanenbaum, David J Wetherall , Computer Networks , Pearson Education , Edition 5, 2012,

Web Reference:

- Cisco.netacad.com
- https://learningnetwork.cisco.com
- https://learningspace.cisco.com

Course Title: SCALING NETWORKS

Course Objectives:
This course describes the architecture, components, and operations of routers and switches in larger and more complex networks. Participants learn how to configure routers and switches for advanced functionality. By the end of this course, participants will be able to configure and troubleshoot routers and switches and resolve common issues with OSPF, EIGRP, and STP in both IPv4 and IPv6 networks. Participants will also develop the knowledge and skills needed to implement a WLAN in a small-to-medium network.

Pre-requisites: Computer Networks

Course Contents/Syllabus:

	Weightage (%
Module I: Introduction to Scaling Networks:	
Introduction, Implementing a Network Design, Switch Hardware, Router Hardware, Managing Devices	**15**
Module II: LAN Redundancy & Link Aggregation	
Introduction, Spanning Tree Concepts, Purpose of Spanning Tree, STP Operation, Varieties of STP, Spanning Tree Configuration, First Hop Redundancy Protocols, Link Aggregation Concepts, Link Aggregation Configuration, Troubleshooting Link Aggregation.	**20**
Module III: Wireless LANs	
Wireless LAN Concepts ,Wireless LAN Standards, Wireless LAN Security, Wireless LAN Configuration	**15**
Module IV: Adjust and Troubleshoot Single-Area OSPF & Multi area OSPF	**20**

Characteristics of OSPF, Configuring Single-Area OSPFv2,Configuring Single-Area OSPFv3, Advanced Single-Area OSPF Configurations, Troubleshooting Single-Area OSPF, Multi-Area OSPF Operation, Configuring Multi-Area OSPF	
Module V: EIGRP & EIGRP Advanced Configurations and Troubleshooting Characteristics of EIGRP, Configuring EIGRP for IPv4, Operation of EIGRP, Configuring EIGRP for IPv6, Advanced EIGRP Configurations, Troubleshoot EIGRP Implementation	**20**
Module VI: IOS Images and Licensing Managing IOS System Files, Naming Conventions, Managing Cisco IOS Images, Software Licensing, IOS Licensing, License Verification and Management	**10**

Course Learning Outcomes:

Participants who complete the Scaling Networks course will be able to perform the following functions:

- Understand, configure and troubleshoot enhanced switching technologies such as VLANs, Rapid Spanning Tree Protocol (RSTP), Per VLAN Spanning Tree Plus Protocol (PVST+), and Ether Channel
- Understand, configure, and troubleshoot first hop redundancy protocols (HSRP) in a switched network
- Understand, configure, and troubleshoot wireless routers and wireless clients
- Configure and troubleshoot routers in a complex routed IPv4 or IPv6 network using single-area OSPF, multi area OSPF, and Enhanced Interior Gateway Routing Protocol (EIGRP)
- Manage Cisco IOS Software licensing and configuration files

Text & References:

Text:

- CCNA-Routing & Switching, Scaling Networks, Cisco Certified Networking Academy

References:

- Behrouz Forouzan ,Data Communications and Networking ; Tata McGraw-Hill ;Edition 5; 2012
- Andrews S. Tanenbaum, David J Wetherall; Computer Networks; Pearson Education; Edition 5, 2012
- William Stallings, Data & Computer Communications, PHI, Edition 6, 2012
- Jerry Fitzgerald and Alan Dennis, Business Data Communications & Networking, John Wiley & Sons Inc, 2010.

Web Reference: cisco.netacad.com

Course Title: SOFTWARE TESTING AND RELIABILITY

Course Objectives:

The course aims at

1. Training the students with hand-on experience of different approaches to Testing,
2. To give insight of Management of test and Software Reliability,
3. Describe various models and its verification.

Pre-requisites: Software Engineering-I

Course Contents/Syllabus:

	Weightage (%
Module I : Fundamentals of Testing	10
Human and errors, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction and Containment, Testing and Debugging, Software Quality, Requirement Behaviour and Correctness, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, Test Metrics, Agile Methodology and Its Impact on testing, Test Levels: Unit, Component, Module, Integration, System, Acceptance, Generic	
Module II: Approaches to Testing	15
Static Testing, Structured Group Examinations, Static Analysis, Control flow & Data flow, Determining Metrics, Dynamic Testing, Black Box Testing: Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing and Decision Table Technique and Used Case Testing and Advanced black box techniques, White Box Testing: Statement Coverage, Branch Coverage, Path Coverage, System integration, Deployment testing, Beta testing, Scalability testing, Reliability testing, Stress testing, Acceptance testing: Acceptance criteria, test cases selection and execution	
Module III : Test Management	15
Test Organization, Test teams, tasks and Qualifications, Test Planning, Quality Assurance Plan, Test Plan, Prioritization Plan, Test Exit Criteria, Cost and economy Aspects, Test Strategies, Preventive versus Reactive Approach, Analytical versus heuristic Approach, Test Activity Management, Incident Management, Configuration Management, Test Progress Monitoring and Control,	

Specialized Testing: Performance, Load, Stress & Security Testing	
Module IV : Software Reliability	**15**
Defining Software Reliability, Software Reliability Attributes and Specification, Concept of Introduction to Measurement and Inspection Process, Documents and Metrics, Basics of Reliability Theory, Software Reliability Problem, Modeling Process, Software Reliability Models (SRGM), preliminary Concepts of Reliability Engineering, Parameter Estimation, Model Validation	
Module V: Software Reliability Growth Models	**15**
Execution Time Models, Calendar Time Models, Erlang Model, Modeling Fault Dependency and Debugging Time Lag, Testing Effort Dependent Modeling, Distributed Environment, Imperfect Debugging, Testing-Domain Models, Change-Point, Unified Approach Concepts, Artificial Neural Networks based SRGM, Introduction to Discrete SRGM.	
Module VI : Software Reliability Allocation Models	**15**
Software Reliability Allocation Models, Criteria for Model Evaluation, Optimal Reliability Allocation, Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software.	
Module VII : Software Verification, Validation & Testing	**15**
Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools	

Course Learning Outcomes:

The student will be able:

 To apply methods and techniques to analyze requirements, and design and code software artifacts to assess and model software reliability.

 To apply the principles and methods of software testing.

 To select and apply in autonomy appropriate technologies and techniques for different types of testing all over the software process development in different domains and contexts.

Text Books:

1. Andreas Spillner, Tilo Linz and Hans Schaefer; "Software Testing Foundations", Shroff Publishers and Distributors
2. D Srinivasan and R Gopalswamy; "Software Testing: Principles and Practices", Pearson Education, 2006

References Books:

3. Aditya P. Mathur; "Foundations of Software Testing", Pearson Education Custom Edition, 2000
4. Robert V Binder; "Testing Object Oriented Systems: Models, Patterns and Tools", Addison Wesley, 1996

5. P K Kapur, H Pham, A Gupta and PC Jha; "Software Reliability Assessment with OR Applications", Springer-Verlag London Limited, 2011
6. P K Kapur, R B Garg & S Kumar; "Contributions to Hardware and Software Reliability" World Scientific, London, 1999
7. John Musa; "Software Reliability Engineering", McGraw-Hill
8. Roger S. Pressman; "Software Engineering – A practitioner's approach", 5th Edition, McGraw Hill
9. Deepak Kumar: "Software Reliability Engineering, A Brief Description LAMBERT – Academic Publishing

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Course Title: Software Project Planning and Management

Course Type: PG

Course Objectives:

(i)   To understand the importance of project management in today's world.

(ii)   To establish the importance of projects in implementing organization strategy

(iii) To understand the rules for creating a Work Breakdown Structure for a project

(iv)   To demonstrate the importance of WBS to the management of projects and how it serves as a database for planning and control

Pre-requisites:
NIL

Course Contents/Syllabus:

	Weightage (%)
Module 1: **Introduction - Project Management Fundamentals**	**20**
Project Definition; Triple Constraints; Projects & Operation; What is Project Management; Project ManagementFramework; Project Life Cycle and Organization; Typical Characteristics of Project Life Cycle; Project Stakeholders;Project Management Process Groups; Project Management Process Interactions; Project Management KnowledgeAreas;	
Module II: Project Integration Management	**20**
Develop Project Charter: Inputs-Project Statement of Work, Business Case, Contract, Enterprise EnvironmentalFactors, Organizational Process Assets. Tools and Techniques-Expert Judgment, Outputs-Project Charter. DevelopProject Management Plan: Inputs-Project Charter, Outputs from Planning Processes, Enterprise EnvironmentalFactors, Organizational Process Assets, Problems with software projects, Management control, Requirementspecification, Information and control in organization, Introduction of Step Wise project planning, Step: 0-4, Step: 5-Project Execution : Inputs-Project Management Plan, Approved Change Requests, Enterprise Environmental Factors,Organizational Process Assets. Tools and Techniques-Expert Judgment, Project Management Information System,Outputs-Deliverables, Work Performance Information, Change Requests, Project Management Plan Updates, ProjectDocument Updates	
Module III : Monitor and Control Project Work	**20**
Inputs-Project Management Plan, Performance Reports, Enterprise Environmental Factors, Organizational Process Assets, Tools and Techniques-Expert Judgment, Outputs-Change Requests, Project Management Plan Updates, Project Document Updates, Integrated Change Control: Inputs-Project Management Plan, Work Performance Information, Change Requests, Enterprise Environmental Factors, Organizational Process Assets, Tools and Techniques-Expert Judgment, Change Control Meetings, Outputs-Change Request Status Updates, Project Management Plan Updates, Project Document Updates,	
Module IV: Close Project or Phase	20
Inputs-Project Management Plan, Accepted Deliverables, Organizational Process Assets, Tools and Techniques-Expert Judgment,Outputs-Final Product, Service, or Result Transition, Organizational Process Asset Updates.	
Module5: Case Study and Exercises	**20**
Project Scope Management ; Collect Requirements, Define Scope, Create WBS, Verify Scope, Control Scope, Case Study and Exercises, Project Quality Management : Plan Quality, Perform Quality Assurance, Perform Quality Control 10 of project planning. Tools and Techniques-Expert Judgment, Outputs-Project Management Plan.Direct and Manage	

Course Learning Outcomes:

1   To identify key characteristics of a high-performance project team

2   To understand the critical success factors in project management

3   To understand project closure process

4   To enable a student prepare for CAPM®

Text Book:

1.   A Guide to the Project Management Body of Knowledge (PMBOK® Guide) 4th or 5th Edition

2.   Project Management : Core Textbook by Samuel &Goplan (Wiley India) with 3 CD ROMs

Reference Book:

1   A Management Guide to PERT/CPM by Weist& Levy (PHI)

2   Project Management by Harold Kerzner

Course Title: UNIX /LINUX PROGRAMMING

Course Objectives :

- This course provides the students with the skills to use the UNIX and LINUX operating system.
- This course aims to introduce basic commands for editing and manipulating files, managing processes and interacting with the Bourne/Bourne Again Shell..
- The course also teaches the participant how to use the programming constructs of the shell language to write scripts that may be used to simplify or automate tasks.
- This course creates understanding of various editors and file creations, data manipulation and reports using vi, sed and awk

- This course will prepare the students to work on UNIX/LINUX ENVIRONMENT as a technical user or system administrator of a powerful, fast growing, multitasking, open operating

system which is currently used on all types of computers from micros to mainframes.

Pre-requisites: Concepts of Operating System, Programming in C

Course Contents/Syllabus:

	Weightage (%)
Module I : INTRODUCTION	10
Introduction to Operating System , History of GNU , Unix and LINUX ,UNIX Family, Unix System Layered and Detailed Architecture, Features of UNIX/LINUX , Concept of Files in UNIX, Absolute Path and Relative Path , UNIX /LINUX file system structure, Types of shells (Bourne, BASH, KORN,C), Process and Process States , Inode, Two User Interfaces –Character User Interface(CUI) and Graphic User Interface (GUI) , LINUX booting Process , X Window System, LINUX Graphical environment, LINUX Desktop environment –GNOME and KDE	
Module II: PROCESSES	

Process state and transitions , the context of a process , Process System processes; running jobs in background, Job control; foreground and background jobs; suspend and interrupt a process; Back grounding and killing jobs; stopping and restarting jobs; scheduling jobs using batch and at command	5
Module III : UNIX/LINUX COMMANDS	30
Telnet connect through Login Account , password, logout ,Internal and External Commands, shell , current working directory, referring to home directories, Commands to move around by path concept, creating new directories, creating files –touch , cat ; copying files; moving files, Deleting files and directories;Filters and Pipes , looking at files : cat, more, pg, less , head , tail; Cal, banner, file, wc, sort, cut, grep ,cmp, comm., diff, uniq ;Calculator: expr , bc ;Getting online help; manual pages ; listing commands , meta characters ,Wildcards; hidden files; Standard input and output; redirecting input and output; filter; pipes; file permissions; user and group; Interpreting file permissions; Permission Dependencies; Changing permissions, Setting Permissions. Managing file links; hard links; symbolic links; jobs and process: process ID; foreground and background jobs; suspend and interrupt a process; killing jobs; changing password, exit.	
Module IV : VI EDITOR and SHELL PROGRAMMING	30
Command mode, insert mode and last line mode; command to delete character, insert line; deleting text, command for moving the cursor; including other files; running shell commands; getting vi help; search and replace commands; changing and deleting text, Change word, Change line, Delete current line, Delete n lines, Delete remainder of Lines; copying and moving; Saving and Exiting ; Shell as an interpreter; pattern matching; ; redirection; pipes; command substitution; shell variables, environment variables , Keywords, Assignment Statements, read , echo ,Shell scripts and execution methods, Setting positional parameters (set command), Shift , metacharacters , arithmetic operators, logical and relational operators, Test Command: Numerical Test, File Test and String Test; Control Flow through if, case ; Loops ; while, until , for	
Module V : sed AND awk	15
Syntax for sed , regular expressions, Addressing: sed commands , Modify a File with sed , metacharacters, Inserting / Deleting/Printing Text/Lines , Substitution , Multiple edits, reading from file and writing to file, quit command Introduction to sed scripting ; Syntax for awk , working of awk, Input from files, Input from commands, Formatting output-print and printf function , concept of record and field in awk .	
Module VI : SYSTEM ADMINISTRATION	10
Adding and Removing Users, Starting up and Shutting down the System, Disk Management, File System Mounting and Unmounting, Monitoring System Usage, Ensuring System Security	

Course Learning Outcomes:

Upon completion of this course, the students should be able to do the following:

The student will be able:

- To customize a UNIX login account using environment variables, configuration files and startup scripts.
- To maintain UNIX directories and files, manage UNIX jobs and processes, use of UNIX pipes and file redirection
- To manipulate data with proper use of Unix filters, role of an operating system and UNIX philosophy.
- To operate in both graphical and text-based environments; automate a sequence of operations by writing a shell script.
- To examine UNIX security tools to ensure UNIX directories and files are protected from unauthorized users.
- To relate the use of on-line documentation, research and experimentation in order to discover how new UNIX commands function.
- To Construct some scripts to automate some regular Industry tasks and prepare reports using editors and awk

Professional Skill Development Assignment(PSDA) :

1. Study and present UNIX & LINUX Operating System evolution, architecture, features
2. Compare different UNIX family Operating systems and their extended features.
3. For each Sh command learn Bash Command and make a table of sh vs bash commands
4. Presentation of all topics with practical examples of commands and scripts. Questions will be asked with a twist in scripts.
5. Search for companies which are still working on UNIX /Linux and find out the reasons.
6. Install LINUX on your Computer systems and make shell scripts using sh and bash .
7. Each student has to find 50 Interview questions related to UNIX/LINUX which MNCs ask in technical rounds . Practice those questions and make pdf of screenshots to submit.
8. Once a week one group will ask interview questions from other group and rate the interview.
9. Create 5 Users on your Linux systems using adduser and /etc/passwd.
10. Mount your printer to the Linux system and print the work done

Lab/Practicals details, if applicable:

Sr. No.	Shell Program
1	Write the commands to : a. Find all logged in users with usernames of at least four characters b. Find all users on your system whose user ids are greater than 99 c. Find the number of users on your system whose user ids are greater than 99
2	Write a shell script to : a. list all the files in your directory in decreasing order of file size. b. Display long list of a directory c. Display all files starting from letter "a" and ending with letter "t"
3.	Write a shell script that accepts two file names from the command line : a. copies the first to second file and display the second file. b. append file1 to file2 and display file2.
4.	Write a shell script that accepts one file and directory name and move that file to the directory and show recursive listing and long listing.
5	Write a shell script that asks your name and invite you on current date for a party and append any message to a file name party.
6	Write a shell script a) that reads a file name from command line and changes name to filename.logname. b) Display the number of links and size of the file given as the command line argument.
7	Write a shell script which displays the date in desired formats :

	1. Thursday, 02 July 2020. 2. July 25,2020 3. 02-07-2020, Thursday 4. dd-mm-yy 5. dd/mm/yyyy
8	Write a shell script and declare two variables A and B. i) Take static value of A=5 and B=3. Perform all arithmetic operations on it. ii) Assign integer values to variables and perform relational operations on the values assigned and display the messages accordingly iii) Accept values from command-line and perform logical operations on the values accepted , and display the messages accordingly.
9	Write a shell script which accepts a number and finds whether the number is an odd or even number.
10	Write a shell script to give the result of student. Take marks of the five subjects, student name, roll no and percentage and show a message whether a student gets division as per the following rules: 70% <-> distinction 60%->1st division 50%->2nd division <40%->Fail
11	Write a shell script which checks the age of the student for swimming. The condition are as follows: <10- not allowed 10-18- junior pool only >18- swimming is allowed in depth also
12	Write a shell script that takes an unspecified number of command line arguments (up to 9) of ints and finds their sum. Modify the code to add a number to the sum only if the number is greater than 10
13	Write a shell script that will take an input file and remove identical lines (or duplicate lines from the file)

14	Write a shell script to find out the gross salary of an employee when the given information is as under:-
	a) If basic salary is less than Rs.1500/-
	    HRA = 10% of basic
	    DA = 90% of basic
	b) If basic is greater than or equal to
	    Rs.1500/- HRA = 500/-
	    DA = 98% of basic

15	Write a shell script to enter a year and show a message whether the year is a leap year or not.
16	Write a shell script using concept of position parameters which copies one file and display destination file and it should also contain an error message if the source file does not exist.

17	Write a shell script to find area and perimeter of rectangle.
	.
18	Write a shell script where distance between two cities is input through the keyboard in km. Convert and print this distance in meters, feet, inches and cm.
19	Write a shell script that accepts a. employee name in small case and converts it to Uppercase and sort the employee names in ascending order b. employee ID and remove all digits from the string
20	Write a shell script to find sum of digits of a number and check whether the number is palindrome or not.
21	Pass a filename as command line argument to script which finds (i) Whether file exists or not. (ii) Display the message what type of file it is. (a) If the file is an ordinary file check its read permission. If available display the file else display message read permission denied. (b) Check its write permission and if available append that file by your name and course, else display error message. (c) Check execute permission & if available shows the output of that file. (iii) (a) If it's a directory check its read permission, if available list the directory. (b) Check its write permission; if available make a sub-directory in that directory. Create two file in that sub-directory that you created.
22	Write a menu driven program:- a) Place the pwd of user. b) List the directory of user. c) Long listing the directory of the user and at the same time this long listing is to be stored in a file. d) Create a file in your directory and copy this file in your directory. e) Move the specified file to your parent directory. f) Rename the specified file in the current directory. g) Make a sub directory in the current directory and change its permission by taking away all the permission of group and others.
23	Write a Menu driven program a) Check the contents of /etc/passwd file. b) List of users who have currently logged in. c) Pwd d) Exit
24	Write a shell script where you accept a character and you have to echo message whether the entered character is a small case, capital case or a digit or a special symbol. Display error message if more than one character is entered.
25	Write a shell script where you accept a word and echo the message a) Whether the word begins with vowel, consonant or a digit. b) Check whether the word begins with small case vowel or capital case vowel. c) Checks whether the word ends with a digit.
26	Write a shell script where you check whether a) The word begins with "a" and ends with "t" b) The word begins with "s" and ends with "p" c) Any word with fixed length of 4 characters. d) Display the word starting with "z" and ending with "l"

27	Write a shell script that accepts only three arguments from command line. The first is the pattern string, the second is the filename in which the pattern is to be searched and the third is the filename in which result is to be stored.
28	Write a shell script that computes the factorial of a given number.
29	Write a shell script that works like a calendar reminding the scheduled meetings depending on the day of the week.
30	Write a shell script that accepts even number of Integers from command line : a. Add the integers appearing at odd positions b. Multiply the integers appearing at even poistions
31	Write a shell script that surf the given directory and changes the extension of files from text to doc
32	Write a shell script for renaming each file in the directory such that it will have the current shell PID as an extension. The shell script should ensure that the directories do not get renamed.
33	**Write A Command To Print The Squares Of Numbers From 1 To 10 Using Awk Command.**
34	**Write A Command To Find The Sum Of Bytes (size Of File) Of All Files In A Directory**
35	**In The Text File, Some Lines Are Delimited By Colon And Some Are Delimited By Space. Write A Command To Print The Third Field Of Each Line.**
36	**Write A Command To Replace The Second Occurrence Of The Word "unix" With "UNIX" In A File?**
37	**Write A Command To Remove All The Occurrences Of The Word "AIIT" except the First One in a line with in the entire file?**
38	**Write A Command To Duplicate Each Line In A File?**
39	**Write a shell script using awk command where it displays employee name and salary from a n employee file which has data:**

Empname	empcode	designation	department	salary

40	Write a shell script to print the square of first five numbers (1-5)

Text Books :

1. UNIX AND SHELL PROGRAMMING , Yashwant P.Kanetkar , BPB Publication , 2002
2. The Complete Reference Linux, Richard.L Peterson ,Tata Mc Graw Hill, 2003 ,Fifth Edition

Reference Books :

3. "Unix: Concepts and Application", Sumitabha Das, TMH, Second Edition, 1998
4. "Linux Programming by Examples: The Fundamentals", Arnold Robbins, Pearson Education, First Edition, 2004
5. "Design of the Unix operating System" , Maurice J. Bach ,PHI, First Edition, 1986

6. Unix Shell Programming, by Stephen G. Kochan and Patrick Wood , Pearson Education ,3rd edition , 2007

7. **Introduction to UNIX , David I. Schwartz , Pearson Education , Second Edition , 2009**
8. UNIX SHELLS by Example, Ellie Quigley , Prentice Hall, Fourth Edition, 2008
9. "Linux Administration- A beginners Guide" , Steve Shah and Wale Soyinka , Tata Mc Graw Hill, Fourth Edition ,2005

Course Title: Quantitative Aptitude I
Course Code:

Course Objectives: Increase Employability skills

Pre-requisites: Class XII Mathematics

Student Learning Outcomes:
- Apply knowledge on Ratio, Proportion and Fraction, Work Time and Speed Time
- Appling real time problems on Equations and Inequalities
- Enhance knowledge on Numbers, Sequence and Series

Course Contents/Syllabus:

	Weightage (%)
Module I : Ratio, Proportion and Fraction, Work Time and Speed Time	35
Ratio and proportion, Fraction, Numerator and Denominator, Time and Speed, Time and Work, Profit and Loss, Indices, Percentage	
Module II Equations and Inequalities	40
Logarithms Equations - Linear - simultaneous linear equations up to three variables, quadratic and cubic equations in one variable, equations of a straight line, intersection of straight lines, graphical solution to linear equations. Inequalities - Graphs of inequalities in two variables - common region.	
Module III Numbers, Sequence and Series	25
Sequence and Series – Arithmetic and geometric progressions Sets, Functions and Relations Limits and Continuity	

Text & Reference Book:

- **Quantitative Aptitude for Competitive Examinations Paperback – 21 Feb 2017 by <u>R S Aggarwal</u>**
- **Quantitative Aptitude for the CAT Paperback – 30 May 2016, by <u>Nishit K. Sinha</u>**
- **FMS Admission Test 10 Mock Tests For Admission into Faculty Of Management Studies, Delhi University Paperback – 2012, by Dr. Suchi Rustogi and Dr. Ajay Vikram Singh.**

Semester III

Course Title: SOFTWARE TESTING AND RELIABILITY

Course Level: PG

Course Objectives:

The course aims at

1. Training the students with hand-on experience of different approaches to Testing,

2. To give insight of Management of test and Software Reliability,

3. Describe various models and its verification.

Pre-requisites: Software Engineering-I

Course Contents/Syllabus:

	Weightage (%)
Module I : Fundamentals of Testing	10
Human and errors, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction and Containment, Testing and Debugging, Software Quality, Requirement Behaviour and Correctness, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, Test Metrics, Agile Methodology and Its Impact on testing, Test Levels: Unit, Component, Module, Integration, System, Acceptance, Generic	
Module II: Approaches to Testing	15
Static Testing, Structured Group Examinations, Static Analysis, Control flow & Data flow, Determining Metrics, Dynamic Testing, Black Box Testing: Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing and Decision Table Technique and Used Case Testing and Advanced black box techniques, White Box Testing: Statement Coverage, Branch Coverage, Path Coverage, System integration, Deployment testing, Beta testing, Scalability testing, Reliability testing, Stress testing, Acceptance testing: Acceptance criteria, test cases selection and execution	
Module III : Test Management	15

Test Organization, Test teams, tasks and Qualifications, Test Planning, Quality Assurance Plan, Test Plan, Prioritization Plan, Test Exit Criteria, Cost and economy Aspects, Test Strategies, Preventive versus Reactive Approach, Analytical versus heuristic Approach, Test Activity Management, Incident Management, Configuration Management, Test Progress Monitoring and Control, Specialized Testing: Performance, Load, Stress & Security Testing	
Module IV : Software Reliability	**15**
Defining Software Reliability, Software Reliability Attributes and Specification, Concept of Introduction to Measurement and Inspection Process, Documents and Metrics, Basics of Reliability Theory, Software Reliability Problem, Modeling Process, Software Reliability Models (SRGM), preliminary Concepts of Reliability Engineering, Parameter Estimation, Model Validation	
Module V: Software Reliability Growth Models	**15**
Execution Time Models, Calendar Time Models, Erlang Model, Modeling Fault Dependency and Debugging Time Lag, Testing Effort Dependent Modeling, Distributed Environment, Imperfect Debugging, Testing-Domain Models, Change-Point, Unified Approach Concepts, Artificial Neural Networks based SRGM, Introduction to Discrete SRGM.	
Module VI : Software Reliability Allocation Models	**15**
Software Reliability Allocation Models, Criteria for Model Evaluation, Optimal Reliability Allocation, Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software.	
Module VII : Software Verification, Validation & Testing	**15**
Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools	

Self-Work/ Professional Skill Development activities

Activity 1	Self-Work/ Professional Skill Development activities can be conducted by dividing the class into group of 7-8 students and same will be evaluated by board of faculty members along with the group report. Some of the suggested activities are:
	1 Case study on Software Testing

	2 Case study on impact on testing 3 Case study on test Plan 4. Case study on prioritization Plan
Activity 2	. Describe Software Reliability Attributes and Specification - Software reliability estimation - Execution Time Models estimation - Calendar Time Models estimation - Erlang Model estimation
Activity 3	Discussion and report on the following topics: 1. Understanding the concept of Verification and Validation 2. Modeling Fault Dependency and Debugging Time Lag 3. Testing Effort Dependent Modeling 4. Distributed Environment
Activity 4	Q1. Explain imperfect Debugging condition in software. Discuss optimal reliability allocation problem in software. Discuss quality improvement process in software. Discuss major SQA activities.

Course Learning Outcomes:

The student will be able:

To apply methods and techniques to analyze requirements, and design and code software artifacts to assess and model software reliability.

To apply the principles and methods of software testing.

To select and apply in autonomy appropriate technologies and techniques for different types of testing all over the software process development in different domains and contexts.

Text Books:

1. Andreas Spillner, Tilo Linz and Hans Schaefer; "Software Testing Foundations", Shroff Publishers and Distributors
2. D Srinivasan and R Gopalswamy; "Software Testing: Principles and Practices", Pearson Education, 2006

References Books:

3. Aditya P. Mathur; "Foundations of Software Testing", Pearson Education Custom Edition, 2000
4. Robert V Binder; "Testing Object Oriented Systems: Models, Patterns and Tools", Addison Wesley, 1996
5. P K Kapur, H Pham, A Gupta and PC Jha; "Software Reliability Assessment with OR Applications", Springer-Verlag London Limited, 2011
6. P K Kapur, R B Garg & S Kumar; "Contributions to Hardware and Software Reliability" World Scientific, London, 1999
7. John Musa; "Software Reliability Engineering", McGraw-Hill
8. Roger S. Pressman; "Software Engineering – A practitioner's approach", 5th Edition, McGraw Hill
9. Deepak Kumar: "Software Reliability Engineering, A Brief Description LAMBERT – Academic Publishing

Course Title: Advanced Web Technologies

Level: PG

#	Existing
1	**Course Objectives:** • This course is aimed to provide a fundamental understanding of dynamic web site creation. • To develop basic skills of creating web pages and explain the coding behind the designing of websites. • To explore the requirements of designing and developing a website.
2	**Prerequisites:** Fundamentals of IT

3	**Course Learning Outcomes:**
	After completion of this course, students will be able to:
	- Identify the principles of coherent web coding and good visual design. - Analyze examples of coding practice and web site design. - Design web pages using HTML tags and features. - To recognize the proper way of structuring a fully functional website. - Create web pages using PHP and database connectivity using MySQL. - Modify, add, and delete data in a database through a web page. - Utilize their design skills to create a professional website
4	**Module I: HTML**

	A brief overview; HTML Tags : HTML Document Type Overview , the Outer Structure of an HTML Document: Part , The Outer Structure of an HTML Document: Part ,Creating and Using Templates , HTML and Text; Paragraphs ; Block and Inline Tags ; Controlling Line Breaks and Spaces ; Phrase Elements ; Font-Markup Elements ; Quotations and Quote Marks ; Pre-Formatted Text using the PRE Tag ; Aligning Paragraphs ; HTML Lists ; Selecting a Typeface using the FONT Tag ; Selecting a Type Size using the FONT Tag ; Introduction to Hyperlinks; Absolute and Relative URLs ; Specifying a Different Base for Relative URLs ; Adding Titles to Your Links ; Fragments: Linking to a Segment of a Page ; Inline Images and the IMG Tag ; Breaking Lines Around an Image ; Image Borders ; Tables: Introduction to HTML Tables ; Formatting Tables with CSS ; Aligning Images with Tables ; Frames: Frames Overview ;Hiding Frame Borders :Forms: HTML Forms.
5	**Module II: CSS And Java Script**
	Introduction to CSS; What's Needed; what is CSS? Selecting a Type Face Using the FONT Tag ; Basics ;Web Sites that use CSS ;Breakdown of a CSS Rule ; CSS in HTML Documents; The Document Tree ; Writing your First Rule .Introduction to Java Script; data types, Variable, dialog boxes; Event handling Front level validations using JavaScript.

6	**Module III : XHTML Structure**
	Introduction and Overview; what is XML? ; Conversion ; Structure of an XHTML Document ; Outer Document Containers ; Creating and Using Templates; XHTML and Text; Paragraphs; Block and Inline Tags; Controlling Line Breaks and Spaces; Phrase Elements; Font Mark –Up Elements; Headings; Quotations and Quote Marks; Pre-formatted Text Using the PRE Tag ;Selecting a Type Size Using the FONT Tag ; XHTML Lists ; Introduction to Hyperlinks ; Relative URLs ; Specifying a Base for Relative URLs ; Fragments ; Inline Images ; Flowing Text Around an Image ;Tables: Introduction to XHTML Tables ; Aligning Images with Tables; Frames: Frames Overview ; Forms : Forms Overview.
7	**Module IV : PHP**
	Introducing Apache, PHP, My SQL : Installing Apache, Php, Mysql ; Configuring Apache for PHP ;PHP Basics: Syntax rules ; Escaping characters ; Reserved words ; Variable ; Data types; Functions ; Function arguments ; Multiple Arguments; Variable scope; Performing Operations: Arithmetic operators; Logical operators; Assignment operators; Comparison operators ; Conditional operators; Making Statements: Conditional if statement; If else statement; Switch statement ; For

	loop; While loop ; Do-while loop ; Interrupting loops ; Return statements; Using arrays: Creating an array, changing array elements; Listing array elements; Manipulating Arrays; Creating Dynamic Content: Identifying browser platform; Server date and time; Time specific content; Getting form values; Displaying submitted values; String manipulation; Browser redirection;
8	**Module V: File Handling Using PHP**
	Displaying directory files; Copying and renaming files; Opening and closing files; Reading files; Writing files ; Creating and Uploading forms and Script, Uploading a file; Data persistence: Setting up cookies and Sessions. Introducing databases; Creating tables, SQL Data types; Insertion; Updating and Deletion data, tables databases; SQL Queries; Creating Mysql user and password ; Connecting a user to Mysql ; Listing databases; Listing table names ; Inserting database and Altering tables ; Retrieving data from a table Web Hosting ;Registering Domains. ; Parking Web sites; Publishing with FTP.

Self work questions

Q1 Create a web page that will have separate links to show map of India and World. When user will open a map of India, create links to display the information of each state i.e. highlighted in the map in a separate window/document. (The information should be brief i.e. not more than 3-4 sentences.) When user will open a world map, show the list of countries on clicking the image in a new window.

Q2 Write an HTML page to display information of three products. The name of three products should be displayed at the top. The hyperlink should be provided to move to the details of the product like its features, size, price etc. along with its image. The link should be internal link.

Q3 Design and develop any suitable web application using HTML, CSS and XML

Q4 Develop web based application using suitable client side and server side web technologies.

List of Experiments:

1. Write a program:

A) To add a button on a form.

B) To add ordered list in page.

C) To add menu in page.

2. Write a program to create frames using percentage.

3. Write a code that will display text CRICKET TEAMS spreads over two rows with the names of the teams on the right.

4. Write a program for student mark sheet in html document.

5. Write html code to develop a webpage having two frames that divide the webpage into two equal rows and then divide the row into equal columns fill each frame with a different background color.

6. Write HTML code for the registration form like you see while creating an account in Gmail.

7. Create a web page using frame. Divide the page into two parts with Navigation links on left hand side of page (width=20%) and content page on right hand side of page (width = 80%). On clicking the navigation Links corresponding content must be shown on the right hand side.

CSS/XML

8. Create a catalog for an online shopping company that sells music records using style sheets.

9. Create a catalog for an online banking system that opening account in customer using style sheets.

10. Create a catalog for shop which sell computer peripherals using html tables.

11. Create a XML document of 10 student of SEM VI IT. Add their Enrollment No., marks obtained in 5 subject, total marks and percentage save this XML document at the server. Write a program that accepts students enrollment No. As an input and returns the student marks, total and percentage by taking the students information for the XML document.

12. Design a web page of your home town with an attractive background color, text color, an image, font face etc. (Use **inline CSS** for formatting)

13. Create a HTML form with the use of Cascading Style Sheets.

14. Create a DHTML form for the dynamic use of records in a web form.

PHP with Database Programming

15. Write PHP programs to

a) Print whether current year is leap year or not.

b) Print whether given number is odd or even.

c) Print first 10 Fibonacci numbers.

16. Develop a site on creating a poll.

17. Write a Php script to implement numeric, associative and multidimensional array.

18. Write a Php script for Login form.

19. Write a Php script to send E-mails.

20. Create a HTML form to add new records to EMPLOYEE table

Text:

- Ivan Bayross , "HTML, DHTML, JavaScript, Perl, CGI" , BPB Publication, Third Edition, 2013.
- Thomas Powell, "The Complete Reference HTML & XML" , BPB Publication, Fourth Edition, 2002.
- Alexis Leon and Mathew Leon, Leon Tech world, "Internet for everyone", Vikas Publishing House,2012.
- Sarah Horton & Whitney Quesenbery, "A Web for Everyone", Anticipated publication, 2012.
- Michael K. Glass, Yann Le Scouarnec, Elizabeth Naramore, Gary Mailer, Jeremy Stolz, Jason Gerne "Beginning PHP, Apache, MySQL Web Development" , ISBN: 978-0-7645-5744-6

References:
PHP Manual

Any other Study Material:

http://www.allbookez.com/ivan-bayross-html-dhtml-javascript-perl/
www.gobookee.org/**internet-for-everyone**-**alexis**-**leon**-**tech**-**world**

Course Title: Internet of Everything

Course Objectives:

The **Introduction to the Internet of Everything (IoE)** course provides an overview of the concepts and challenges of the IoE economy. The course discusses the Internet and its evolution to the interconnection of people, processes, data, and things that forms the Internet of Everything.

- Learn how the IoE turns information into action, creating unprecedented economic opportunity.

- Understand how the IoE brings together operational technology and information technology systems.

- Discover how business processes for evaluating and solving problems are being transformed.

- Learn the security concerns that must be considered when implementing IoE solutions.

- Practice what you learn using [Cisco Packet Tracer,](#) a network configuration simulation tool.

- Connect to the global Cisco Networking Academy community.

Pre-requisites: Fundamental of Computer Science

Course Contents/Syllabus:

	Weightage(%)
Module I: What Is the IoE Internet and its evolution, Internet of Everything, IoE benefits to individuals and organizations, Concept of a network Foundation to connect different devices,decision-making processes and interactions.	15%
Module II: Pillars of the IoE Interconnection of people, process, data, and things, Standard and protocol in IoE.	15%
Module III: Connecting the Unconnected IoT application in the home and industry ,Protocol suite and its necessity for communication across a network,IoE and its affects to the evolution of data storage and access , Example of a Home IoE implementation environment.	20%
Module IV: Transitioning to the IoE Internet of Everything (IoE) drivers for the convergence between an organization's operational technology (OT) and information technology (IT) systems , M2M, M2P, and P2P interactions in an IoE , Business processes for evaluating a problem that can be solved with IoE, Necessary architectural structure to implement an IoE solution,Security concerns that must be considered when implementing IoE solutions.	25%
Module V: Bringing It All Together Benefits and impediments to implementing an IoE solution,Physical	25%

topology and logical topology of an IoE Healthcare solution model , M2M, M2P and P2P interactions of an IoE Healthcare solution model ,Concept of prototyping in IoE,Recent trend and applications of IoE.

TextBook:

-
    Adrian McEwen and Hakim Cassimally, "Internet of Things", Wiley, 2013

- ArshdeepBhaga" Internet of Things, A hands on approach" VPT, first edition, 2014

Course Title: CLOUD INFRASTRUCTURE AND SERVICES
Level: PG

Course Objectives:

The primary objective of this course is

- To give students the skills and knowledge to understand how Cloud Computing Architecture can enable transformation, business development and agility in an organization.
- To understand Concepts and infrastructure of cloud computing and its business applications.
- To understand the role and responsibilities of professional field, how to deal with ethical, legal, security and social issues and responsibilities related to cloud computing.

Prerequisites:

NIL

Course Contents / Syllabus:		
1	**Module I: Cloud Computing Fundamental**	**Weightage**
	Cloud Computing Fundamental: Cloud computing definition, Characteristics of Cloud computing as per NSIT, private, public and hybrid cloud. Cloud types; Iaas, Paas, Paas. Benefits and challenges of cloud computing; public vs private clouds, role of virtualization in enabling the cloud, Steps involved in transitioning from Classic data center to Cloud computing environment; Business Agility: Benefits and challenges to cloud architecture. Application, availability, performance, security and disaster recovery; next generation Cloud Application.	**20%**
2	**Module II: Cloud Application**	
	Cloud Application: Technologies and the processes required when deploying web services. Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.	**20%**
3	**Module III: Cloud Services Management**	
	Cloud Services Management: Reliability, availability and security of services deployed from cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g. Amazon, Microsoft and Google, Salesforces.com, Ubuntu and Redhat)	**25%**

4	**Module IV: Case Study: Application Development**	
	Application Development: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App	**15%**
5	**Module V: Cloud Security and Migration to Cloud**	
	Security concerns and counter measures in Cloud environment, Governance, Risk, and Compliance aspects in Cloud, Cloud security best practices, Cloud models suitable for different categories of users, Considerations for choosing applications suitable for Cloud, Different phases to adopt the Cloud. Best Practice Cloud IT Model: Analyze of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO).	**20%**

Profession Skill Development Activities (Self Work): 5-6 students will be assigned a task, each group will present their work in front of all

Activity No.	Activity
1	Find existing cloud computing service providers and prepare a brief note on each with type of services provided by them and how it is helping businesses and common man.
2	Study research papers to measure the advantages and disadvantages for cloud computing.
3	Study research papers for identification of latest trends and prepare the note on each trend.
4	Prepare case study report on any organization using cloud platform and produce write up on how they got benefited after implementation.
5	Create any applications of your choice and deploy the same on cloud.

Course Learning Outcomes:
   The student will be able to:

- Analyze the components of cloud computing showing how business agility in an organization can be created.
- Analyze the local and global impact of Information Technology on individuals, organizations and society.
- Evaluate the development of web services from cloud architecture
- Critique the consistency of services deployed from a cloud architecture
- Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.
- Critically analyze case studies to derive the best practice model to apply when developing and deploying cloud based applications

Text & References:

Text Books:

- Kumar Saurabh, Cloud Computing: Insights Into New-Era Infrastructure, Wiley India Pvt Ltd, (2011), ISBN: 8126528834
- Anthony T. Velte, Cloud Computing: A Practical Approach, Tata McGraw Hill Education Private Limited, (2009), ISBN: 0070683514
- Halper Fern, Kaufman Marcia, Bloor Robin, Hurwit Judith, Cloud Computing For Dummies , Wiley India Pvt Ltd, (2009) ISBN: 8126524871

References Books:

- Gautam Shroff: Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]
- Toby velte, Anthony Velte, Robert Elsenpeter; Cloud computing, A practical Approach [ISBN: 0071626948]
- Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]

Web References:
- http://www.vmware.com/files/pdf/techpaper/cloud-infrastructure-achitecture-case-study.pdf
- http://www.priv.gc.ca/resource/fs-fi/02_05_d_51_cc_e.pdf
- http://www.dialogic.com/~/media/products/docs/whitepapers/12023-cloud-computing-wp.pdf
- http://130.226.142.177/wp-content/uploads/2012/05/Guidelines-to-BuildingPrivateCloud-Infrastructure-Technical-Report.pdf
- http://cloudscaling.com/pdf/IaaS_Building_Guide_v1.pdf

Course Title: CONNECTING NETWORKS

Course Objectives: The objective of the course is:

- To introduce the networking concepts and technologies for connecting geographically distant network
- To judiciously use packet-switching or circuit switched networks for IPv6
- To understand the congestion and its control using frame- relay
- To connect the various segments of teleworkers using VPN
- To secure an organization and its router by applying ACLs using IPv6
- Troubleshoot the IPv6 network
- Developing the skills necessary to plan and implement small networks across a range of applications

Pre-requisites: Data Communication & Computer Networks

Course Contents/Syllabus:

	Weightage (%)
Module I: **Hierarchical Network Design ad WAN Technologies**	15%
Enterprise Network Design: Network Requirements, Structured Engineering principles; Design of the Networks: Network Hierarchy, The Access Layer, Distribution Layer; Two-Tier Collapsed Core Design; Case Study: Cisco Enterprise Architecture; WAN Technologies: Purpose of WANs and WAN Operations; **SW: Study any Emerging Network Architectures and Select a WAN Technology that is suitable for the Enterprise**	
Module II: Point to Point Connections and Frame Relay	25%
Point To Point Protocols: Serial Point to Point Overview, Configure PPP; Basic Frame Relay Concepts, Configuring Frame Relay, Advanced Frame Relay Concept, Configuring Advanced Frame Relay Concept **SW: Troubleshooting PPP and Frame Relay Networks**	
Module III: Network Address Translation	20%
NAT Characteristics: Benefits and Drawbacks; Static NAT and Dynamic NAT; Configure PAT Using CLI; Configuration of Port Forwarding using CLI; Configuration of NAT in IPv6 **SW: Trouble shooting NAT**	
Module IV: Broadband Solutions and Securing Site-to Site Connectivity	20%
Business Requirement for Teleworker Services, Broadband Services; Configuring xDSL Connectivity: PPPoE Overview, Configuring PPPoE; Virtual Private Networks: Benefits and Drawbacks; Site to Site GRE Tunnels; introducing IPSec; Remote Access	
Module V: Network Monitoring	20%
Network Monitoring using Syslog, SNMP, Netflow; Troubleshooting with Systems Approach, Network Documentation; Troubleshooting Process; Troubleshooting Tools; Symptoms and Causes of Network **SW: Troubleshooting IP Connectivity**	

Course Learning Outcomes: The student will be able to:

- ☐ Plan and effectively manage any WAN network using PPP , Frame Relay or VPN
- ☐ Deploy and effectively manage the security for the given network and Frame security policy
- ☐ Explain the major techniques involved, and networks & systems issues for the design and implementation of networking of inter and intra WAN networks.
- ☐ Describe the key components and technologies such as NAT, DHCP involved and to gain hands-on experiences in building the network.
- ☐ Analyze the cause of congestion and related factors for Quality of Service
- ☐ Enhance the perform by troubleshooting
- ☐ Assist in Transition from IPV4 to IPV6

Self-Work/ Professional Skill Development activities

Activity 1	Self-Work/ Professional Skill Development activities can be conducted by dividing the class into group of 7-8 students and same will be evaluated by board of faculty members along with the group report. Some of the suggested activities are: **Study any Emerging Network Architectures and Select a WAN Technology that is suitable for the Enterprise**
Activity 2	**Troubleshooting PPP and Frame Relay Networks**
Activity 3	**Trouble shooting NAT and PAT with given scenario**
Activity 4	Investigate the PPoE and VPN network
Activity 5	**Troubleshooting IP Connectivity with given scenario and Investigate SNMP protocol**

List of Practical – Accessing the WAN

1. **Basic PPP Configuration in packet tracer and checking of connectivity and troubleshooting.**
2. **Challenge of PPP with OSPF configuration**
3. Basic Frame Relay configuration and troubleshooting with EIGRP protocols.
4. Basic DHCP configuration and troubleshooting
5. Basic NAT configuration and troubleshooting
6. Basic PAT configuration and troubleshooting
7. Configuration of Enterprise Network and troubleshooting

Text & References:

Text

- ▯   Cisco Networking Academy Programme CCNA 3 & 4 Companion Guide, 3rd edition by Pearson Education
- ▯   Cisco Networking Academy Programme CCNA 3 & 4 Lab Companion, 3rd edition by Pearson Education

References:

- ▯   Cisco Networking Academy Programme CCNA 3 & 4 Engineering General, 3rd Edn by Pearson Education
- ▯   Data Communications and Networking by Behrouz Forouzan, 3e, Tata McGraw-Hill
- ▯   Computer Networks by Andrews S. Tanenbaum, 4e, Pearson Education

Web Portal:

- ▯   https://cisco.netacad.com
- ▯   https://learningspace.cisco.com/

Course Title: Statistics using R-Programming
Course Objectives:
- The primary objective of this course is to provide the basic principles, techniques, and applications of R language
- Make students able to do statistics using R-programing
- Provide the mathematical basic of inferential statistics and regression

- Aim of this course is to develop some familiarity with current research problems and research methods in R programming by working on a research or design project

Pre-requisites: Basic Knowledge of mathematics and programming

Course Contents/Syllabus:

	Weightage (%)
Module I: Introduction and preliminaries	**10%**
The R environment, Related software and documentation, R and statistics, window system, R interactively, An introductory session, Getting help with functions and features, R commands, case sensitivity, etc, Recall and correction of previous commands, Executing commands from or diverting output to a file, Data permanency and removing objects, Data Description: Vectors, Vector operations, Lists and List operation, Data Frames. High-level plotting commands, The plot() function	
Module II: Data Description and Probability	**20%**
Types of Data, Features of Data Distributions, Descriptive Statistics, Exploratory data Analysis, Multivariate Data and Data Frames, Comparing Populations, Sample Spaces, Events, Model Assignment, Properties of probability, Counting Methods, Conditional Probability, Independent Events, Byes Rule and Random Variables.	
Module III: Discrete and Continuous Distributions	**20%**
Discrete Random Variables, Discrete Uniform Distribution, Binomial Distribution, Expectation and Moment Generating Functions, Empirical Distribution, Functions of Discrete Random Variables, Continuous Random variables, Continuous Uniform Distribution, Normal Distribution, Functions of Continuous Random Variables. Joint and Marginal Probability Distributions, Joint and Marginal Expectation, Conditional Distribution, Independent Random Variables, Bivariate Transformations of Random Variables, Multinomial Distribution.	
Module IV: Sample Distributions, Estimations, Hypothesis Testing	**25%**
Simple Random Samples, Sampling from a Normal Distribution, Center Limit Theorem, Sampling Distributions of two samples statistics, simulated sampling distributions, Point Estimation, Confidence Interval for Means, Confidence Intervals for differences of Means, Confidence Intervals for Proportions, Confidence Intervals for Variances, Fitting Distributions, Sample size and margin of errors. Test for Proportions, One sample tests for means and variances, two-sample tests for means and variances, Analysis of variance (ANOVA).	
Module V: Simple Linear Regression and Multiple Linear Regression	**25%**
Simple Linear Regression: Estimation Model Utility and Inference, Residual Analysis. Multiple Linear Regression Model, Estimation and Prediction, Polynomial Regression, F-Statistic, Residual Analysis and diagnostic Tools.	

Course Learning Outcomes:
After the completion of this course students able to

- Learned or remember all the tools, packages, and functions of R which are used to solve the statistics
- Understand the method of solving statistical problems using R tools and packages
- Apply the tools and functions of R to solve real world problems
- Can evaluate various tools which they study in R for statistics

- Create new statistical model for solving real world problem using data sets

Text & References:

Text:

1. Kerns, G. Jay. "Introduction to Probability and Statistics Using R" (2011). (Online available)
2. W. N. Venables, D. M. Smith and the R Core Team," An Introduction to R". (Online available)

Course Title: PATTERN RECOGNITION TECHNIQUES

Course Objectives: This course will introduce the fundamentals of statistical pattern recognition. First, focus will be on generative methods such as those based on Bayes decision theory and related techniques of parameter estimation and density estimation. Next, discuss discriminative methods such as nearest-neighbor classification and support vector machines. Methods of pattern recognition are useful in many applications such as information retrieval, data mining, document image analysis and recognition, computational linguistics, forensics, biometrics and bioinformatics.

Pre-requisites: Concepts of Computer Graphics

Course Contents/Syllabus:

	Weightage (%)
Module I Introduction Introduction: Introduction to Pattern Recognition, Feature Detection, Classification, Review of Probability Theory, Conditional Probability and Bayes Rule, Random Vectors, Expectation, Correlation, Covariance, Review of Linear Algebra, Linear Transformations	20
Module II Decision Theory, ROC Curves, Likelihood Ratio Test, Linear and Quadratic Discriminants, Fisher Discriminant, Sufficient Statistics, Coping with Missing or Noisy Features, Template-based Recognition, Feature Extraction, Eigenvector and Multilinear Analysis	20

Module III	20
Training Methods, Maximum Likelihood and Bayesian Parameter Estimation, Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent, Support Vector Machines, K-Nearest-Neighbor Classification.	
Module IV	**20**
Non-parametric Classification, Density Estimation, Parzen Estimation, Unsupervised Learning, Clustering, Vector 25% Quantization, K-means, Mixture Modeling, Expectation-Maximization, Hidden Markov Models, Viterbi Algorithm, Baum-Welch Algorithm, Linear Dynamical Systems, Kalman Filtering	
Module V	**20**
Bayesian Networks, Decision Trees, Multi-layer Perceptrons, Reinforcement Learning with Human Interaction	

Course Learning Outcomes:

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

• Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.

• Summarize, analyze, and relate research in the pattern recognition area verbally and in writing.

• Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.

• Apply pattern recognition techniques to real-world problems such as document analysis and recognition.

• Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

Pedagogy for Course Delivery:

- **Lectures in blended/flipped mode**
- **Assignments,**
- **Presentations,**
- **Online LMS**
- **Class Test**
- **Case study**

Text & References:

Text:
- Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", 2nd Edition, John Wiley, 2006.
- C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2009.

References:
- S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Edition, Academic Press, 2009.