Detailed Syllabus for Master of Computer Application_2022-2023

DEPARTMENT OF COMPUTER APPLICATION

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

PREAMBLE

Education plays an enormously significant role in the building of a nation. There are quite a large number of educational institutions, engaged in imparting education in our country. Majority of them have entered recently into semester system to match with international educational pattern. However, our present education system is churning out youth who have to compete locally, regionally, nationally as well as globally. The present alarming situation necessitates transformation and/or redesigning of system, not only by introducing innovations but developing "learner-centric approach.

Majority of Indian higher education institutions have been following the system, which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions. There is need to allow the flexibility in education system, so that students depending upon their interests can choose inter-disciplinary, intra-disciplinary and skill-based courses. This can only be possible when choice based credit system (CBCS), an internationally acknowledged system, is adopted. The choice based credit system not only offers opportunities and avenues to learn core subjects but also explore additional avenues of learning beyond the core subjects for holistic development of an individual. The CBCS will undoubtedly facilitate benchmarking of our courses with best international academic practices.

Advantages of the choice based credit system:

•Shift in focus from the teacher-centric to student-centric education.

•Student may undertake as many credits as they can cope with (without repeating all courses in a given semester if they fail in one/more courses).

•CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

•CBCS makes education broad-based and at par with global standards. One can take credits by combining unique combinations.

•CBCS offers flexibility for students to study at different times and at different institutions to complete one course (ease mobility of students). Credits earned at one institution can be transferred to another institution.

CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the Choice Based Credit System. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The Choice Based Credit System provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses to acquire more than the required credits and adopt an interdisciplinary approach to learning.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

It has been a necessity to align higher education with the emerging needs of the economy so as to ensure that the graduates of higher education system have adequate knowledge and skills for employment and entrepreneurship since last few years. The higher education system has to incorporate the requirements of various industries in its curriculum, in an innovative and flexible manner while developing a well-groomed graduate. CSE department aims to encourage research and innovation in the field of Machine Learning, Cyber security, Artificial Intelligence and other allied areas such as Computational Theory, Cloud Computing, Block chain Technology, Data Science, Big Data Analytics and many more. The objective of the MCA program in Master of Computer Application is to prepare students to undertake careers involving innovative technologies, develop a problem solving capability, or to opt for advanced studies for research oriented careers.

In order to give due importance to practical applications as well as theoretical aspects of MCA, the curriculum for the Master of Computer Application program is exclusively designed to meet the IT requirements for various organizations. The core objective of this programme is to prepare the students for productive career in software industry and academia by providing an outstanding environment of teaching and research in the core and emerging areas of the discipline. The programme equips students with the skill and relevant competence to handle all practical problems faced by industry.

JOB OPORTUNITIES

Booming IT sector in India has plenty of jobs for post graduate computer application. Candidates with a high percentage of mark and good communication skills as well as sound computer knowledge do not face problem in getting a job. Computer engineers can get jobs in non-IT companies like universities, research, private and public industries, government departments, business organizations, commercial organizations and the manufacturing sector, etc. Besides the Computer Engineers have plenty of options to work in IT companies in departments such as design, development, assembly, manufacture, and maintenance, etc. Software Developers: Software developers are professionals who are concerned with facets of the software development process which involves activities such as design and coding, computer programming, project management, etc.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 01: Teach the appropriate computer application methods: Post Graduates of the program will engage in the effective practice of computer application to identify and solve important problems in a diverse range of application areas such as functional programming and object-oriented programming paradigms to enable participants to analyze, design, implement and evaluate computerized solutions (such as developing computer program) to real-life problems.

PEO 02: Real Life Problem Solving: Demonstrate the critical thinking and communication skills required in a technical environment and synthesize data and technical concepts to create novel products and solutions for the real life problems.

PEO 03: Leadership: Post Graduates of the program will engage in successful careers in industry, academia and attain positions of importance where they have impact on their business, profession and community.

PEO 04: Lifelong Learning: Help participants acquire the knowledge, skills, experience and values to become lifelong learners and be able to obtain employment in a computer-related field or go on to graduate study.

PROGRAM OUTCOMES (PO)

PO	Summary	Description
PO1	Application knowledge	Apply the knowledge of mathematics, science, application fundamentals, and Impart proficiency in the basic mathematics and programming methods as employed in computer science.
PO2	Problem analysis	Identify, formulate, research literature, and analyze complex problems reaching substantiated conclusions using first principles of mathematics, natural sciences and computer application.
PO3	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO4	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO5	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO6	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in

PO7	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO8	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO9	Life-Long Learning	Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change

TYPES OF COURSES

1. Courses are the subjects that comprise the Master of Computer Application Programme.

2. A course may be designed to comprise lectures, tutorials, laboratory work, fieldwork, outreach activities, project work, vocational training, viva, seminars, term papers, assignments, presentations, self-study etc. or a combination of some of these components.

3. The learning outcomes of each course will be defined before the start of a semester.

4. Following are the course types:

   i. **Core Course (CC):** This is a course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of Master of Computer Application.

   ii. **Elective Course:** An elective course is a course, which can be chosen from a pool of courses. It is intended to support the discipline of study by providing an expanded scope, enabling exposure to another discipline/domain and nurturing a student's proficiency and skill. An elective may be of following types:

   a) **Discipline Elective Courses (DE):** It is an elective course that adds proficiency to the students in the discipline.

b) **Specialization Elective Courses (SE):** This is a course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of Bachelor of Computer Application with Specialization in Cloud Computing/Big Data Analytics/Data Science/Blockchain Technology/Cyber Forensics & Internet Security/Artificial Intelligence & Machine Learning.

iii. **Obligatory Courses:**

a) **Mandatory Courses (MC):** It can be taken from among a pool of foundation courses, which aim at value-based education. They may provide hands-on training to improve competencies and skills or provide education on human, societal, environmental and national values.

b) **Internship/Training/Project/Dissertation (PTI):** Course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project

c) **Humanities, Social Sciences & Management (HSM):** It is an elective course taken from non-engineering disciplines (humanities, social sciences and management) that broadens the perspective of an engineering student.

d) **Basic Science Courses (BSC):** It is based upon content that leads to fundamental knowledge enhancement in sciences, and basic application principles.

e) **General Studies Courses (GSC):** Course designed to encourage and enrich the students for the technical and professional exams.

f) **Extra-curricular activities (ECA):** An extracurricular activity or extra academic activity is an activity, performed by students, that falls outside the realm of the normal curriculum of university education.

5. Each credit course contributes certain credits to the programme. A course can be offered either as a full course (4 credits) or as a half course (2 credits). A full course is conducted with 3 hours of lectures and either 1 hour of tutorial or 2 hours of practical work per week. A half course is conducted with 2 hours of lectures. There are also some exceptional electives with 3 credits and 1 credit.

Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week Or 2 Hr. Practical (Lab)/week	0.5 Credits Or 1 Credit

6. A project work/dissertation is considered as a special course involving application of the knowledge gained during the course of study in exploring, analyzing and solving complex problems in real life applications. A candidate completes such a course with an advisory support by a faculty member.
7. **Mandatory Courses** may be offered. They do not carry credits but aim at expanding knowledge or bridging deficiency in knowledge or skill.
8. A course may have pre-requisite course(s) that are given in the Semester-wise Course Allocation scheme.
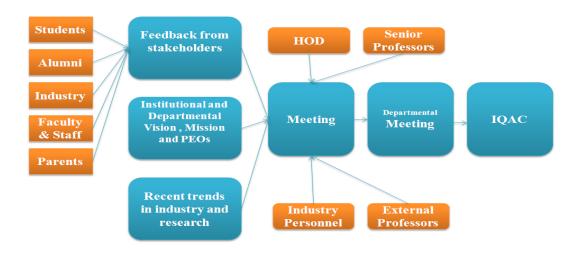9. A student can opt for a course only if he/she has successfully passed its pre- requisite(s).

10. A student has to register for all courses before the start of a semester.
11. **Program codes:** Bachelor of Computer Application(BCA)
12. **Departmental Course Codes:** The codes for departmental core courses and discipline-specific electives are specific to each discipline. The first two characters are derived from departmental codes listed above. The third character is 'C' for core courses and 'D' for discipline-specific courses and 'INT' for Dissertation/Project/Training/Internship. This is followed by a digit sequence number:

   i. MCACyyy: Core Course

   ii. MCDyyy: Discipline-Specific Elective Courses

   iii. MCPyyy: Professional Specific Elective Courses

   iv. XXXyyy: Specialization Specific Elective Courses (Depends on the Specialization)

   v. INTyyy: Project/Training/Internship/ Dissertation

13. **Common Elective Course Codes:** All disciplines will follow a common code as shown below. The 3-digit sequence number 'yyy' is taken from the respective tables of different types of courses.

   i. HSMyyy: Humanities, Social Sciences & Management Course

   ii. BSCyyy: Basic Science Course

   iii. MCyyy: Mandatory Course

   iv. GSCyyy: General Studies Courses

   Here, yyy is a three digit number.

14. The opting of a course by the student will depend upon the requisites for that course and with the consent of the course advisor.

PROCESS FOR DESIGNING THE PROGRAM CURRICULUM

The process for designing the program curriculum involves consideration of the following aspects:

i) Feedback from stakeholders

ii) Institutional and Departmental Vision, Mission and PEOs

iii) Recent trends in industry and research

SCHEME – SEMESTER WISE COURSE ALLOCATION

First Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	MCA101	Programming for Problem Solving using Python	3	0	2	0	4
2.	CC	MCA102	Data Structures Using C	3	0	2	0	4
3.	CC	MCA103	E-Commerce	3	0	0	0	3
4.	DE	----	Discipline Elective-I	3	0	2	0	4
5.	BSC	BSC101	Discrete Mathematics	3	0	0	0	3
6.	HSM	HSM101	Communication, Professional Writing & Technical Seminar	2	0	2	0	3
7.	GSC	MCA193	Computer System & Office Automation Tools Lab	0	0	2	0	1
8.	GSC	MGSC101	ESP & SDP-I	2	0	0	2	2
9.	ECA	ECA101	Extra-curricular activities	-	-	-	-	-
			Total	19	0	10	2	24

#Students will undergo a mandatory Induction Program

Suggestive Choice Based Subjects

Sl No.	Type	Subject Code	Topic	L	T	P	Credit Points
3	DE	MCD101	Computer Organization and Architecture	3	0	2	4
4	DE	MCD102	Processor Architecture	3	0	2	4

TITLE OF COURSE: PROGRAMMING FOR PROBLEM SOLVING USING PYTHON
COURSE CODE: MCA101
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and basic mathematics.

Introduction:
Python is developed by Guido van Rossum started implementing Python in 1989. Python is a very simple programming language so even if you are new to programming, you can learn python without facing any issues. Learning Python gives the programmer a wide variety of career paths to choose from. Python is an open-source (free) programming language that is used in web programming, data science, artificial intelligence, and many scientific applications. Learning Python allows the programmer to focus on solving problems, rather than focusing on syntax. Its relative size and simplified syntax give it an edge over languages like Java and C++, yet the abundance of libraries gives it the power needed to accomplish great things.

Course Outcomes (CO):
After completion of the course, students will able:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Read, write, execute by hand simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, and dictionaries.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓		✓						✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓
CO5	✓		✓		✓				✓

Course Contents:
Module 1: INTRODUCTION TO PYTHON (2)
Python Installation, Writing some basic programs, Installation using pip, Operators in Python, Assignment Operator
Module-2: ALGORITHMIC PROBLEM SOLVING (3)
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.
Module-3: DATA, EXPRESSIONS, STATEMENTS (4)
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list;

variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

Module-4: CONTROL FLOW, FUNCTIONS (7)

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

Module-5: LISTS, TUPLES, DICTIONARIES (5)

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

Module 6: OBJECT ORIENTED PROGRAMMING IN PYTHON (4)

Classes in Python, Constructor, Creation of methods in class, Polymorphism in Python, Inheritance concept, Method overriding concept

Module-7: INPUT AND OUTPUT IN PYTHON (3)

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules,

Module 8: ADVANCED MODULES IN PYTHON (5)

Packages; Illustrative programs: word count, copy file, NumPy packages, Matplotlib Scipy, Scikitlearn (Overview), Pandas

Module 8: Overview Machine Learning (4)

Introduction: Supervised Learning – Basic Overview, Distance Based, Tree Based. Unsupervised Learning – Clustering Approach, Some Implementation without Function calling

Text Books
1. Allen B. Downey, ``Think Python: How to Think like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers.
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

References
1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

TITLE OF COURSE: PROGRAMMING FOR PROBLEM SOLVING USING PYTHON LAB
COURSE CODE: MCA191
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and basic mathematics.

Course Outcomes (CO):
After completion of the course, students will able:
CO1: Write, test, and debug simple Python programs.
CO2: Implement Python programs with conditionals and loops.
CO3: Develop Python programs step-wise by defining functions and calling them.
CO4: Use Python lists, tuples, dictionaries for representing compound data.
CO5: Read and write data from/to files in Python.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓		✓						✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓
CO5	✓		✓		✓				✓

PLATFORM NEEDED: All experiment must be done using Python 3.x Windows/Linux (3.7 or 3.8 preferred or Anaconda).

Course Contents:
Assignment 1: Implementation of various operators in python
Assignment 2: Design of different patterns, accessing lists and other structures using loops. Implementation of different conditional statements.
Assignment 3: Function definition, Invocation, keyword argument implementation, Lambda function.
Assignment 4: Fundamental Data structure programs
Assignment 5: Advanced operations in data structures
Assignment 6: Creation of classes and objects in Python
Assignment 7: Polymorphism and Inheritance concept in Python.
Assignment 8: Creation of different file, Accessing .xlsx and CSV files using pandas
Assignment 9: Implementation of mathematical computation using Numpy and Scipy
Assignment 10: Implementation of mathematical computation using Numpy and Scipy
Assignment 11: Implementation of mathematical computation using Numpy,Scipy,Pandas
Assignment 12: Implementation of graphs, charts and figures using Matplotlib
Assignment 13: Mathematical Problem Solving.
Assignment 14: Supervised/Unsupervised Learning

List of Experiments
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

Text Books
1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers.
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

References
1. John V Guttag, ―Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python, Mc-Graw Hill Education (India) Private Ltd, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

TITLE OF COURSE: DATA STRUCTURES USING C
COURSE CODE: MCA102
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in mathematics and programming languages.

Introduction:
This course examines data structures and algorithms basics using C. The Topics to be covered (tentatively) include: an introduction to programming and problem solving in C with basic concepts such as conditionals, loops, functions, lists, strings and tuples; Time and space analysis of algorithms; Linear Data structures like array, linked list, stack, queue; Non-linear Data structures like graph and tree; Sorting; Searching and Hashing.

Course Outcomes (CO):

In this course we will study the basic components of data structure and algorithm. Students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to design & implement any data structure properly.
CO2: Students would be able to implement any problem by writing their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to write efficient program.
CO4: To become an efficient programmer

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Basics of python: data types, assignment statements, control flow, strings, lists, functions, simple input output.
Module-2: Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.
Module-3: Linear Data structures–Array, Matrix, Linked List, Stack, Queue and Recursion with their types, different operations and applications
Module-4: Nonlinear Data structures–Graph, Trees, Minimum spanning tree with their types, different operations and applications.
Module-5: Sorting, Searching and Hashing- Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort. Sequential search and binary search. Hashing functions, collision resolution techniques

Text Books
1. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. "Data Structures in C" by Aaron M. Tenenbaum.

References
1. "Data Structures" by S. Lipschutz.
2. "Data Structures Using C" by Reema Thareja.
3. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.

TITLE OF COURSE: DATA STRUCTURES USING C LAB
COURSE CODE: MCA192
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic concepts in mathematics and programming languages.

Introduction: This course examines data structures and algorithms basics using C. The Topics to be covered (tentatively) include: an introduction to programming and problem solving in C with basic concepts such as conditionals, loops, functions, lists, strings and tuples; Time and space analysis of algorithms; Linear Data structures like array, linked list, stack, queue; Non-linear Data structures like graph and tree; Sorting; Searching and Hashing.

Course Outcomes (CO):
In this course we will study the basic components of data structure and algorithm. Students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any data structure properly.
CO2: Students would be able to implement any problem by writing their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to write efficient program.
CO4: To become an efficient programmer

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Exercises that must be done in this course are listed below:
Experiment 1: Implementation of array operations
Experiment 2: Stacks and Queues: adding, deleting elements
Experiment 3: Circular Queue: Adding & deleting elements
Experiment 4: Merging Problem: Evaluation of expressions operations on multiple stacks & queues
Experiment 5: Implementation of linked lists: inserting, deleting, and inverting a linked list.
Experiment 6: Implementation of stacks & queues using linked lists, Polynomial addition, and Polynomial multiplication
Experiment 7: Sparse Matrices: Multiplication, addition.
Experiment 8: Recursive and Non-recursive traversal of Trees
Experiment 9: Threaded binary tree traversal. AVL tree implementation
Experiment 10: Application of Trees. Application of sorting and searching algorithms

Text Books
1. Data Structures and Algorithms in Python: Michael H. Goldwasser, Roberto Tamassia, Michael T. Goodrich, Publisher: John Wiley & Sons
2. Data Structure and Algorithmic Thinking with Python: Narasimha Karumanchi; Careermonk publication.

References

1. Problem Solving in Data Structures & Algorithms Using Python: Programming Interview Guide: Hemant Jain; Createspace Independent Pub

2. Data Structures and Algorithms Using Python: Necaise Rance D; Wiley publisher

TITLE OF COURSE: E-COMMERCE
COURSE CODE: MCA103
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts of programming languages.

Introduction:

This course examines E-Commerce concepts, and Business technique basics. The Topics to be covered (tentatively) include: Introduction, Business to Business E-Commerce, Legal issues, Security Issues, Business to Consumer E-Commerce, E-business,

Objectives:

In this course we will study the basic components of an E-Commerce, their functions, mechanisms, policies and techniques used in their implementation and examples from popular E-Commerce application. The way different modules in the E-Commerce interact and work together to provide the basic services of an E-Commerce.

Course Outcomes (CO):
CO1: Understand the theory and logic behind the design and construction of E-Business.
CO2: You will differentiate between various E-commerce functionalities in terms of performance.
CO3: Become aware of the issues in the management of resources like EDI, SET, RSA etc.
CO4: Know the problems in the design of E-Commerce and study the probable solutions.
CO5: Understanding various type of Business policies.
CO6: An overview of advanced E-Commerce and compare the technical aspects of all the advanced E-Commerce.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓				✓
CO2	✓					✓	✓		✓
CO3	✓	✓	✓					✓	✓
CO4	✓				✓				✓
CO5	✓			✓					✓
CO6	✓								✓

Course Contents:

Module I: Definition, Scope of E-Commerce, Hardware requirements, E-Commerce and Trade Cycle, Electronic Markets, Electronic Data Interchange and Internet Commerce.

Module II: Electronic Markets, Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational E-commerce.

Module III: Risks: Paper Document vs. Electronic document, Authentication of Electronic document, Laws, legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, Service provider liability, Enforceable online contract.

Module IV: Security Solutions: Symmetric and Asymmetric Cryptosystems, RSA, DES, and Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Electronic cash over internet, Internet Security.

Module V: Consumer trade transaction, Internet, Page on the Web, Elements of E-Commerce with VB, ASP, SQL.

Module VI: Internet book shops, Software supplies and support, Electronic Newspapers, Internet Banking, Virtual auctions, Online Share Dealing, Gambling on the net, E-Diversity, Case studies through internet.

Text Books

1. E- Commerce-Strategy, Technologies & Applications by David Whitley, TMH.

2. Beginning E-Commerce with VB, ASP, SQL Server7.0 & MTS by Mathew Reynolds, Wrox Publishers.

References

1. E-Commerce-The cutting edge of business by Kamlesh, K.Bajaj, TMH.

TITLE OF COURSE: COMPUTER ORGANIZATION AND ARCHITECTURE
COURSE CODE: MCD101
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts on computer system.

Introduction:

This course examines the basic organization of digital computer and discuss about all the components of it like memory, ALU, Input-Output devices etc. The Topics to be covered (tentatively) include:

Necessity of digital computer, Basic working principal of digital computer, Processing of high level computer language at the hardware level, Basic concept of microprocessor, Basic design of ALU and control Module, Various addressing modes and bus structure, I/O subsystem, Concept of pipeline, Memory Module

Course Outcomes (CO):

Upon successful completion of the course, a student will be able to:
CO1: An ability to understand theory of Digital Design and Computer Organization to provide an insight of how basic computer components are specified.
CO2: An ability to understand the functions of various hardware components and their building blocks.
CO3: An ability to understand and appreciate Boolean algebraic expressions to digital design.
CO4: An in depth understanding of sequential & Combinational circuits.
CO5: An in depth understanding of realization of different combinational/sequential circuits.
CO6: An in depth understanding of different stages of an instruction execution.

CO7: An in depth understanding of how different hardware components are related and work in coordination.
CO8: An ability to understand computer buses and input/output peripherals.
CO9. An ability to understand memory hierarchy and design of primary memory.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓				✓	✓
CO2	✓	✓	✓			✓			✓
CO3	✓								✓
CO4	✓								✓
CO5	✓			✓			✓		✓
CO6	✓					✓		✓	✓
CO7	✓	✓	✓	✓	✓				
CO8	✓						✓		
CO9	✓								

Course Contents:
Module-1: Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes. Commonly used number systems. Fixed and floating point representation of numbers.
Module-2: Overflow and underflow. Design of adders - ripple carry and carry look ahead principles. Design of ALU. Fixed point multiplication -Booth's algorithm. Fixed point division-Restoring and non-restoring algorithms. Floating point - IEEE 754 standard.
Module-3: Memory Module design with special emphasis on implementation of CPU-memory interfacing. Memory organization, static and dynamic memory, memory hierarchy, associative memory, Cache memory, Virtual memory. Data path design for read/write access.
Module-4: Design of control Module - hardwired and micro programmed control. Introduction to instruction pipelining. Introduction to RISC architectures. RISC vs CISC architectures. I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA.

Text Books
1. Computer Organization and Architecture: Designing for Performance, William Stallings, Prentice-Hall India
2. Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Tata McGraw Hill
3. Computer Architecture A Quantitative Approach, John L Hennessy and David Patterson, Morgan Kaufman
4. Structured Computer Organization, Andrew S. Tanenbaum, Prentice-Hall India

References
1. Computer Architecture & Parallel Processing. Kai Hwang & Briggs, Tata McGraw Hill

2. Computer System Architecture, M. M. Mano, PHI.
3. Computer Organization & Architecture, P N Basu, Vikas Publication

TITLE OF COURSE: COMPUTER ORGANIZATION & ARCHITECTURE LAB
COURSE CODE: MCD191
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Concept of basic components of a digital computer, Basic concept of Fundamentals & program structures, Basic number systems, Binary numbers, Representation of signed and unsigned numbers, Binary Arithmetic as covered in Basic Computation & Principles of Computer Programming, Boolean Algebra, Karnaugh Maps, Logic Gates.

Introduction:
Computer Organization and Architecture is the study of internal working, structuring and implementation of a computer system. Organization of computer system is the way of practical implementation which results in realization of architectural specifications of a computer system.

Course Outcomes (CO):
On completion of the course students will be able to
CO1: Use Xilinx ISE or online platform (www.edaplayground.com) independently
CO2: To programme VHDL
CO3: To analyze industry problem and design digital circuits
CO4: Extend the idea of an integrated environment elsewhere

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	√	√	√		√				√
CO2	√	√	√		√				√
CO3	√	√	√		√				√
CO4		√	√		√				√

Course Contents:
Experiment-1: HDL introduction
Experiment-2: Basic digital logic base programming with HDL
Experiment-3: 8-bit Addition, Multiplication, Division
Experiment-4: 8-bit Register design
Experiment-5: Memory unit design and perform memory operations.
Experiment-6: 8-bit simple ALU design
Experiment-7: 8-bit simple CPU design
Experiment-8: Interfacing of CPU and Memory.

Text Books
1. Computer Organization and Architecture: Designing for Performance, William Stallings, Prentice-

Hall India
2. Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Tata McGraw Hill
3. Computer Architecture A Quantitative Approach, John L Hennessy and David Patterson, Morgan Kaufman
4. Structured Computer Organization, Andrew S. Tanenbaum, Prentice-Hall India

References
1. Computer Architecture & Parallel Processing. Kai Hwang & Briggs, Tata McGraw Hill
2. Computer System Architecture, M. M. Mano, PHI.
3. Computer Organization & Architecture, P N Basu, Vikas Publication

TITLE OF COURSE: PROCESSOR ARCHITECTURE
COURSE CODE: MCD102
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge of logic circuits -combinational and sequential

Introduction:

The objective of the course is to expose to the students to the architecture and instruction set of typical 8-bit microprocessor. It also deals with Assembly Language Programming using a macro-assembler. Input-output techniques and important programmable support chips used in microprocessor-based systems are discussed in detail.

Course Outcomes (CO):
CO1: To understand the structure, function and characteristics of computer systems.
CO2: To understand the design of the various functional Modules and components of computers.
CO3: To identify the elements of modern instructions sets and their impact on processor design.
CO4: To explain the function of each element of a memory hierarchy
CO5: To identify and compare different methods for computer I/O.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓				✓	✓
CO2	✓		✓			✓			✓
CO3	✓			✓					
CO4	✓						✓		✓
CO5	✓	✓		✓			✓		✓

Course Contents:
Module 1: Computer Architecture and Organization-Review, Fundamentals of Computer Design, Technology Trends Cost Performance Analysis, Parallel Processing Architectures- Taxonomy- SISD, MISD, SIMD, MIMD, PRAM models.

Module 2: Data and Resource Dependencies, Program Partitioning and Scheduling, Control Flow vs. Data Flow. Network topologies-Static, Dynamic, Types of Networks, RISC vs. CISC, Memory Hierarchy, Virtual Memory.

Module 3: Concepts of Pipelining, Instruction Pipelining, dynamic pipelining, arithmetic pipelines. Multiprocessors- Multistage Networks, Cache Coherence, Synchronization, Message- passing.

Module 4: Vector Processing Principles- Instruction types, Compound, Vector Loops, Chaining. Array Processors- Structure, Algorithms.

Module 5: Data Flow Architecture- Graphs. Petri Nets, Static and Dynamic DFA, VLSI Computations. Parallel Programming Models, Languages, Compilers.

Text book:

1. Computer Architecture and Parallel Processing- Kai Hwang and A. .Brigggs International Edition, McGraw Hill

2. Advanced Computer Architecture: D. Sima, T. fountain, P. Kacsuk, Pearson

Reference Book:

1. Parallel Computer Architecture: D. Culler, J.P.Singh, A.Gupta, Elsevier

TITLE OF COURSE: PROCESSOR ARCHITECTURE LAB
COURSE CODE: MCD192
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge of logic circuits -combinational and sequential

Introduction:

The objective of the course is to expose to the students to the architecture and instruction set of typical 8-bit microprocessor. It also deals with Assembly Language Programming using a macro-assembler. Input-output techniques and important programmable support chips used in microprocessor-based systems are discussed in detail.

Course Outcomes (CO):
CO1: To understand the structure, function and characteristics of computer systems.
CO2: To understand the design of the various functional Modules and components of computers.
CO3: To identify the elements of modern instructions sets and their impact on processor design.
CO4: To explain the function of each element of a memory hierarchy
CO5: To identify and compare different methods for computer I/O.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓				✓	✓
CO2	✓		✓			✓			✓
CO3	✓			✓					
CO4	✓						✓		✓
CO5	✓	✓		✓			✓		✓

Course Contents:

Module 1: Elements of Computers, limitations of Computers. The Evolution of Computers-Mechanical Era, Electronic Computers, the Later Generations. The VLSI Era-Integrated Circuits, Processor Architecture, System Architecture. Processor-Level Components, Processor-Level Design. CPU Organization –Fundamentals.

Module 2: Data Representation – Basic Formats, Fixed-Point Numbers, Floating-Point Numbers. Instruction Sets-Instruction Formats, Instruction Types, Programming Considerations. Floating-Point Arithmetic.

Module 3: Instruction Pipelines, Pipeline Performance, Superscalar Processing. Memory Technology-Memory Device Characteristics, Random Access Memories, Serial Access Memories. Memory System-Multilevel Memories, Address Translation, Memory Allocation. Caches – Main Features, Address Mapping, Structure versus Performance. Introduction to parallel computer models.

Text book:
1. Computer Architecture and Parallel Processing- Kai Hwang and A. .Brigggs International Edition, McGraw Hill
2. Advanced Computer Architecture: D. Sima, T. fountain, P. Kacsuk, Pearson

Reference Book:
Parallel Computer Architecture: D. Culler, J.P.Singh, A.Gupta, Elsevier

TITLE OF COURSE: DISCRETE MATHEMATICS
COURSE CODE: BSC101
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: The readers are expected to have a reasonably good understanding of elementary algebra and arithmetic

Introduction:
To develop logical thinking and its application to computer science (to emphasize the importance of proving statements correctly and de-emphasize the hand-waving approach towards correctness of an argument). The subject enhances one's ability to reason and ability to present a coherent and mathematically accurate argument.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Write an argument using logical notation and determine if the argument is or is not valid.
CO2: Demonstrate the ability to write and evaluate a proof or outline the basic structure of and give examples of each proof technique described.
CO3: Understand the basic principles of sets and operations in sets.
CO4: Prove basic set equalities.
CO5: Apply counting principles to determine probabilities.
CO6: Demonstrate an understanding of relations and functions and be able to determine their properties.
CO7: Demonstrate different traversal methods for trees and graphs.
CO8: Model problems in Computer Science using graphs and trees.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓				✓
CO2	✓	✓	✓	✓					✓
CO3	✓			✓					✓
CO4	✓			✓					
CO5				✓					✓
CO6				✓					✓
CO7		✓	✓		✓			✓	
CO8		✓	✓		✓				

Course Contents:
Module 1: Sets and Counting Techniques
Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic. Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination, Disjunctive and Conjunctive Normal Form.
Module 2: Propositional Logic
Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by conditional.
Module 3: Algebraic Structures and Morphism
Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation
Module 4: Advanced Algebraic Structure and Boolean Algebra
Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function.
Module 5: Graphs and Trees
Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, chromatic number, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distance methods.

Text Books
1. Satya narayana & shyam Prasad :discrete mathematics and graph theory, PHI
2. Kishor shinde: Discrete Structure, Everest publishing house

3. Hari Parihar&Ritu Agarwal, discrete mathematical structures, ashirwad

TITLE OF COURSE: COMMUNICATION, PROFESSIONAL WRITING & TECHNICAL SEMINAR
COURSE CODE: HSM101
L-T-P: 2-0-0
CREDITS: 2

Introduction: This course will help the students to get idea about the professional world.

Objectives:

The course is designed to provide students and faculty with a means for assessment of technical competence of students as well as written, oral, and presentation communication skills that are critically important for success in their professional careers.

Course Outcomes (CO):
On successful completion of this module, students should be able to learn:
CO1: How to write professional letter etc.
CO2: Public speaking
CO3: Use the English language more effectively.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							✓		✓
CO2							✓		✓
CO3							✓		✓

Course Contents:
Module-1: **Elements of Communication:** Definition and Meaning of communication, Process of Communication, Essential components of the Process of Communication, Importance and Objectives of Communication, Differences between general and technical communication.
Module-2: **Types of Communication:** Extra personal communication, Intrapersonal communication, Interpersonal communication, Organizational communication, ass communication
Module-3: Verbal and Non-Verbal Communication: Verbal communication, Oral Communication, Advantages of Oral Communication, limitation/Disadvantages of Oral Communication, Non-verbal communication, Body Languages, Sign Languages, Space Languages, Paralanguages, Time Languages, Haptics or Languages of Touch, Color Languages, difference between verbal and non-verbal communication.
Module-4: Formal and Informal Channels of Communication: Down ward Communication, Upward Communication, Horizontal /Lateral Communication, Diagonal /Clockwise Communication, and Merits & demerits of each type of communication.
Module-5: Barriers to Communication: Physical Barrier, Semantic/language Barrier, Socio psychological Barrier, Organizational / hierarchical Barrier, Emotional Barrier, Cultural Barrier, Information overload, Poor listening, Wrong assumption, Selective perception,

Methods to overcome barriers to Communication, Qualities of Good Communication

Module-6: Composition: Need and function of Business Letter, planning and layout of Business Letter, kinds of Business Letter, Drafting of business Letter: Sales, Credit, Enquiry, Order, Claim, Complaint, Job Applications, etc.

Module-7: Preparation of Notices& circular, Memo, Declaration, Telephone etiquettes, E-mail writing

Text Books:
1. Hari Mohan Prasad, "Objective English", Tata Mcgraw Hill
2. A.Amin,R.Eravelly & F.J.Ibrahim, "Grammar Builder Level", ISBN :9780521744843

TITLE OF COURSE: COMMUNICATION, PROFESSIONAL WRITING & TECHNICAL SEMINAR LAB
COURSE CODE: HSM191
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic Grammar, Comprehension, Writing skills.

Introduction:
To enable students listen, speak, read and write effectively for academic purposes and face real life situations

Course Outcomes (CO):
On successful completion of this module, students should be able to learn:
CO1: How to write professional letter etc.
CO2: Public speaking
CO3: Use the English language more effectively.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							✓		✓
CO2							✓		✓
CO3							✓		✓

Course Contents:
Module-1
Listening: Listening Skill & its sub skills helps the students to improve their concentration power, simultaneously honing their vocabulary. (Assignment: Listening to passages read aloud and then answering the questions set from that passage, and so forth), like- Dialogue Practice Sessions, Oral Comprehension. Conversation Practice Sessions: Situational Dialogue, Role Play, Use of Audio aids for Conversation Practice, Use of Video Clips for Conversation Practice

Module-2

Presentation: It helps to teach students effective communication through innovative methods of learning, like Individual Presentation, Group Presentation, Using Powerpoint/OHP in Presentation, Project Work on PowerPoint Presentation, Paper Presentation. Public Speaking and Soft Skills: Just A Minute (JAM) Sessions

Module- 3

Grammar and Vocabulary: Students will be able to communicate ideas effectively and powerfully using correct grammar and appropriate vocabulary. Related areas include topics like-Connectives, Modifiers, Idiomatic Usage, Online exercises on Grammar and Vocabulary. Report Writing: Report Writing - Principles and Practice

Module-4

GROUP DISCUSSION: Prepares MCA first year students for various aspects of their social and professional lives through interactive sessions, handouts, workshops, self-assessment, peer assessment, and teacher assessment. Related activities include, Group Discussion - Principles and Practice

Text Books

1. Advanced English Communication Skills Lab, Lakshminarayan, Paperback, 2015
2. English Language Laboratories-A Comprehensive Manual, Nira Konar, (OUP), 2016
3. Advanced Grammar in Use with Answers: A Self-Study Reference and Practice Book for Advanced Learners of English 3rd Edition, Martin Hewings, Paperback, 2015
4. Communication Skills, Sanjay Kumar and Pushpa Lata,(OUP),2015

References

1. English Grammar, Wren and Martin, Regular Edition
2. The Art of Public Speaking, 10th Edition, Stephen E. Lucas , McGraw-Hill, 2008

TITLE OF COURSE: COMPUTER SYSTEM & OFFICE AUTOMATION TOOLS LAB
COURSE CODE: MCA193
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts on computer system.

Introduction:

Office automation tools would enables the students in crafting Professional word documents, Excel Spreadsheets, Power Point Presentations

Course Outcomes (CO):

This course will introduce the students to various office automation tools. To reach this goal, the following objectives need to be met:

CO1: Develop a greater understanding of working with word documents using its various features.

CO2: Implement various formatting techniques, page style, table creation, mail merge in MS Word.

CO3: Implement various formatting techniques, formulas, charts and templates in MS Excel.

CO4: Understand power point techniques of formatting a presentation and adding effects to it.

CO5: Develop an understanding of using databases through MS Access.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓				✓				✓
CO2	✓			✓			✓		✓
CO3	✓							✓	
CO4	✓	✓	✓		✓				✓
CO5	✓			✓		✓		✓	

Course Contents:

Module-1: Introduction to MS Word:

Working with Documents-Opening & Saving files, Editing text documents, Inserting, Deleting, Cut, Copy, Paste, Undo, Redo, Find, Search, Replace, Formatting page & setting Margins, Converting files to different formats, Importing & Exporting documents, Sending files to others, Using Tool bars, Ruler, Using Icons, using help. **Formatting Documents**-Setting Font styles, Font selection-style, size, color etc, Type face-Bold, Italic, Underline, Case settings, Highlighting, Special symbols, Setting Paragraph style, Alignments, Indents, Line Space, Margins, Bullets & Numbering.

Setting Page style-Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, Setting Footnotes & end notes–Shortcut Keys; Inserting manual page break, Column break and line break, Creating sections & frames, Anchoring & Wrapping, Setting Document styles, Table of Contents, Index, Page Numbering, date & Time, Author etc., Creating Master Documents, Web page.

Creating Tables-Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula. **Drawing**-Inserting Clip Arts, Pictures/Files.

Tools –Word Completion, Spell Checks, Mail merge, Templates, Creating contents for books, Creating Letter/Faxes, Creating Web pages, Using Wizards, Tracking Changes, Security, Digital Signature.

Printing Documents –Shortcut keys.

Module-2: Introduction to MS Excel:

Spread Sheet & its Applications : Opening Spreadsheet, Menus-main menu, Formula Editing, Formatting, Toolbars, Using Icons, Using help, Shortcuts, Spreadsheet types. Working with Spreadsheets-opening, Saving files, setting Margins, Converting files to different formats(importing, exporting, sending files to others), Spread sheet addressing-Rows, Columns & Cells, Referring Cells & Selecting Cells–Shortcut Keys.

Entering & Deleting Data-Entering data, Cut, Copy, Paste, Undo, Redo, Filling Continuous rows, columns, Highlighting values, Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Manual breaks.

Setting Formula-Finding total in a column or row, Mathematical operations (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae.

Formatting Spreadsheets-Labeling columns & rows, Formatting-Cell, row, column & Sheet, Category-Alignment, Font, Border & Shading, Hiding/Locking Cells, Anchoring objects, Formatting layout for Graphics, Clipart etc., Worksheet Row & Column Headers, Sheet Name,

Row height & Column width, Visibility-Row, Column, Sheet, Security, Sheet Formatting & style, Sheet background, Colouretc, Borders & Shading–Shortcut keys. Working with sheets–Sorting, Filtering, Validation, Consolidation, and Subtotal. Creating Charts -Drawing. Printing. Using Tools – Error checking, Spell Checks, Formula Auditing, Creating & Using Templates, Pivot Tables, Tracking Changes, Security, Customization.

Working with sheets–Sorting, Filtering, Validation, Consolidation, and Subtotal. Creating Charts - Drawing. Printing.

Module-3: Introduction to MS Power Point:

Introduction to presentation –Opening new presentation, Different presentation templates, Setting backgrounds, Selecting presentation layouts. **Creating a presentation** -Setting Presentation style, Adding text to the Presentation. Formatting a Presentation-Adding style, Color, gradient fills, Arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation-Inserting pictures, movies, tables etc into presentation, Drawing Pictures using draw. **Adding Effects to the Presentation**-Setting Animation & transition effect.

Module-4: Introduction to MS Access:

Introduction, Planning a Database, Starting Access, Access Screen, Creating a New Database, Creating Tables, Working with Forms, Creating queries, Finding Information in Databases, Creating Reports, Types of Reports, Printing & Print Preview–Importing data from other databases viz.MS Excel etc

Database Concepts –Creating a New Database, Creating Tables, Working with Forms, Creating queries, Finding Information in Databases, Creating Reports, Types of Reports, Printing and Printing preview– Operating with other databases

MS-Word:

Week1-Task1: Creation of a document, saving a document in desire location by using SAVE AS option, editing the document, usage of SAVE option, Usage of functions like Cut, Copy, Paste.

1. Write steps for creating a document and save that document in D drive?
2. Edit the existing document and save the changes?
3. Write steps for copying the text and pasting it on next page?
4. Write steps for cutting the unwanted text?

Week 2-Task 2: Highlighting the text, changing the color of text. Changing text attributes, Applying different types of bullets and numberings to text.

1. Write steps for highlighting the text?
2. Write steps for making text Bold, Underline and Italic?
3. Write steps for applying different types of numbering?
4. Write steps for applying different customized Bullets; use any picture as a bullet?

Week3-Task3: Creating tables, altering the table by adding additional rows and columns.

Deleting a particular row or column, splitting the cells and merging the cells. Applying different types of Table Auto Formats to tables.

1. Write steps for creating a table with 10 rows and 7 columns?
2. Write steps for aligning the text in the center of the cell and apply the different?
3. Write steps for adding one row below 5th row and add one column in between 5th and 6th column?
4. Write steps for merging the 6 columns of a last row and split the 2nd column in to 2 sub columns?
5. Write steps for applying Table Auto format to the above table?

Week4-Task4: Mail Merge, Inserting page numbers. Adding Header and Footer to each page in a document .Using Spell check function to check the spellings of text. Finding the synonyms of a particular word. Printing the document

1. Write steps for inserting page numbers on each page?
2. Write complete steps for Mail Merge?
3. Write steps for adding header and footer to each page of a document?
4. What do you mean by spell check? How the spell check will be used in a document?

5. What is the process for finding the synonyms of a given word?

MS- Excel:

Week5-Task5: Creating the worksheet, Entering text in to cells, renaming the worksheet, Adding a new worksheet and deleting a worksheet from a workbook. Saving the workbook by using SAVE option. Using formula function to calculate mathematical operations like SUM, AVG…

1. write the no of rows and columns in worksheet
2. Steps for renaming a work sheet?
3. Steps for adding new work sheet?
4. Create a worksheet for calculating marks of 10 students, perform total of marks by using Sum formula.
5. Find the average of a number from the list of 20 numbers.

Week6-Task6: Highlighting the cells, changing the color of text in cells. Giving borders to cells.
Sorting the given data in Ascending or Descending order.

1. Write steps for highlighting the cells.
2. Write steps for changing the color of text in cells.
3. Write steps for giving borders to cells.
4. Sort the given data in ascending order and descending order.

Week7-Task7: Using Logical functions. Inserting charts like Line chart, Pie chart, Bar chart to convert the information in graphical representation. Statistical functions.

1. Create a mark sheet of 10 students and perform Sum, average, result.
2. Calculate the rank and division of above students.
3. Convert the given mark sheet into different types of charts.
4. Use statistical functions to calculate Mean, Median, Mode, Standard Deviation, Variance, and Co-relation.

MS-PowerPoint:

Week 8-Task 8: Creating power point presentation by using slides, inserting a new slide in a presentation, Applying different slide Layouts, deleting a particular slide, saving the presentation

1. Write steps for inserting a new slide into presentation.
2. Write steps for applying different slide layouts to each slides.
3. Create a PPT with minimum of 5 slides by applying different layouts to each slide.
4. How will you delete the unwanted slide from your presentation?

Week 9-Task 9: Inserting of text boxes and Word Art option for entering the text into a slide,
Inserting pictures, charts and Tables in a slide, viewing the presentation in Slide show.

1. Insert the text into slide by taking one text box.
2. Write headings or Titles by using Word Art.
3. Insert different pictures and charts into your presentation.
4. Create a PPT of min 5 slides insert some pictures and text boxes in slides and view this presentation by Slide show, and write steps to do this.

Week 10-Task 10: Applying different slide design to slides, Applying different slide color schemes and Animation Schemes to a presentation, applying the effects to the text and Images of a slide by using custom animation, applying the effects to the slides by using slide transition schemes.

1. Write steps for applying different slide designs to each slide.
2. Write steps for applying different slide Color scheme to each slide.
3. Write steps for applying different slide animation scheme to each slide.
4. Apply custom animation to text and images.
5. Create a PPT of minimum 10 slides and apply different attributes to your presentation.

MS-Access:

Week 11-Task 11:

1. Write steps for opening Ms-Access
2. Write steps for saving Database and Table
3. Create a Student Database with the following details:

Student Name
Number
Total Marks
Address.
Week 11-Task 11:
1. Create an employee database with your own fields and prepare reports:

Text Books
1. Microsoft Office 2007 Bible by John Walkenbach, Herb Tyson, FaitheWempen
2. Fundamentals of Computers by V.Rajaraman

References
1. Computer Fundamentals by P.K.Sinha
2. A Conceptual Guide To MS Office by R. Gabriel Gurley

TITLE OF COURSE: ESP & SDP-I
COURSE CODE: MGSC101
L-T-P: 2-0-2
CREDITS: 2

Pre-requisite: Basic concepts in mathematics, English

Introduction:
The Topics to be covered (tentatively): Aptitude, Indian Constitution and Governance, Basic English and Data Interpretation**.**

Course Outcomes (CO):
Students are expected to be capable numerical problems, literature, and basic of Indian constitution. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any basic numerical problem properly.
CO2: Students would be able to know basic English language and communicate with the society.
CO3: Students would be able to know basic Indian constitution.
CO4: Students would be able to stress management by doing Yoga

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Essential Studies for Professionals-I
Section-A: Employment Enhancement Skills:
Module-1: Number System: Numbers, Face value and place value of a digit, Types of numbers,

Tests of Divisibility, Factorial of a number, Modulus of a number, greatest integral value, Multiplication by short cut methods, Division Algorithm.

Module-2: HCF and LCM of Numbers:
Factors and Multiples, HCF or GCD, LCM, Product of two numbers, Co-primes, HCF and LCM of fractions, HCF and LCM of decimal fractions, Comparison of fractions,

Module-3: Average & Percentage:
Concepts, Results on population, Results on Depreciation

Module-4: Profit and Loss:
Cost Price, Selling Price, Profit or Gain, Loss

Section B: Yoga, Games and Meditation:
Module-5: Asana sitting postures and Karate, Asana lying in supine & prone position and karate, Surya Namaskar, Asana standing posture and Karate, Kriyas, Pranayam and Karate, Meditation and Karate, Meditative posture and Karate, Tratak, Kapalbhati and Meditation.
Meditation and Stress Management, Meditation, Stretching and Self Defense. Meditation, Kicking and Punching of Karate. (Games and Sports will be evaluated on the basis of the participation and performance in different sports events that the students shall participate in).

Section C: Skill Development for Professionals-I
Module-1: Parts of speech: Introduction, Brief discussion of Parts of speech, noun, Kinds of Noun, Rules & Application. Pronoun, Examples, Rules & Application, Verb, Kinds of Verb, Rules & Application, Definition of Tense, Different types of Tenses, Examples, Rules & Application, Adjective, Kinds of Adjective, Rules & Application, Adverb, Kinds of Adverb, Rules & Application, Preposition, Examples, Rules & Application, Interjection, Examples, Rules & Its Application, Conjunction, Examples, Rules & Application, Articles, Examples, Rules & Application English Grammar.
Vocabulary- : Synonyms, Antonyms with examples, one word Substitution, Idioms & Phrases, Spotting Errors.
Reading Comprehension (Level I)

Module-2: Indian Constitution and Governance: Historical background (in brief) - The company Rule (1773-1858), the crown rule (1858-1947), making of constitutions, features of constitution. The Preamble- Ingredients, keywords, amendment of preamble. Part & schedule, Citizenship (in brief) - Constitutional provisions, Citizenship act, Comparing PIO & OCI card holders, Fundamental Rights- Concept & different articles, Right to equality, prohibition of discrimination on certain ground, Equality of opportunity, abolition of untouchability & titles, right to freedom, right to education, right against exploitation, right to freedom of religion, cultural & educational rights, different writes & scopes, DPSP- Classification of directive principle, sanctioned of directive principal, criticism, Distinction between fundamental rights & directive principle List of Fundamental duties, criticism, significance, Verma committee. Features of parliament govt. Features of Presidential Govt. Merits & Demerits. Duties of Honorable President & Vice President & their selection, Provision & scopes, Duties of PM, CM & Governor & their selections

Module-3: Data Interpretation Level-I
Newspaper reading: The Hindu & Economic Times

Text Books
1. Quantitative Aptitude for Competitive Examinations by R S Aggarwal
2. Introduction to the Constitution of India, by D D Basu

3. The Constitution of India by Dr. B.R. Ambedkar Under Chairmanship of Dr. Rajendra Prasad Including Coloured Preamble, Signatures

References
1. The Constitution of India by Dr. B.R. Ambedkar 2020.

Second Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	MCA204	Object Oriented Programming using Java	3	0	2	0	4
2.	CC	MCA205	Design and Analysis of Algorithm	3	0	2	0	4
3.	CC	MCA206	Operating System	3	0	2	0	4
4.	BSC	----	Mathematics	3	0	2	0	4
5.	DE	----	Discipline Elective-II	3	0	0	0	3
6.	HSM	HSM202	Human Resource Development and Organizational Behavior	3	0	0	0	3
7.	GSC	MGSC202	ESP & SDP-II	2	0	0	2	2
8.	ECA	ECA201	Extra-curricular activities	-	-	-	-	-
			Total	20	0	8	2	24

Suggestive Choice Based Subjects

Sl No.	Type	Subject Code	Topic	L	T	P	Credit Points
1	DE	MCD203	System Analysis & Design	3	0	0	3
2	DE	MCD204	Management of Information System	3	0	0	3
3	BSC	BSC202	Computer Oriented Numerical Method	3	0	2	4
4	BSC	BSC203	Numerical & Statistical Computing	3	0	2	4

TITLE OF COURSE: OBJECT ORIENTED PROGRAMMING USING JAVA
COURSE CODE: MCA204
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge in basic concepts of data structures, algorithms and familiarity with programming languages such as C.

Introduction:

This course presents a conceptual and practical introduction to imperative and object oriented programming, exemplified by Java. As well as providing grounding in the use of Java, the course will cover general principles of programming in imperative and object oriented frameworks. The course should enable you to develop platform independent, secure and robust programs for mobile, internet and distributed systems.

Course Outcomes (CO):
This course will teach the basic concepts and techniques which form the object oriented programming paradigm. To reach this goal, the following objectives need to be met:
CO1: Explain what constitutes an object-oriented approach to programming and identify potential benefits of Object-oriented programming over other approaches.
CO2: Explain the benefits of object oriented design and the types of systems in which it is an appropriate methodology.
CO3: Apply an object-oriented approach to developing applications of varying complexities.
CO4: Augment a class definition using constructors, member functions and custom input/output operators to add functionality to a programming solution.
CO5: Read from and write to files using objects from the standard input output library and custom file operators for future restoration.
CO6: Model specialization using single inheritance and abstract base classes to minimize code duplication.
CO7: Design and compile java programs manipulating strings and text documents.
CO8: Model polymorphic behavior of objects using coercion, overloading and function templates.
CO9: Be able to write simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles.
CO10: Apply understanding of Git version control system to manage files for large and small projects.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓			✓			✓
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓				✓		
CO4	✓	✓			✓	✓			✓
CO5	✓		✓			✓			
CO6	✓	✓		✓			✓		
CO7	✓	✓			✓				
CO8	✓	✓				✓		✓	

CO9	✓	✓	✓	✓					✓
CO10	✓	✓					✓	✓	

Course Contents:

Module-1: Concepts of object oriented programming language: Difference between OOP and other conventional programming – advantages and disadvantages. Object, Class, relationship among classes – association, aggregation, composition, dependency. Abstraction, Inheritance, Encapsulation, Polymorphism.

Module-2: Concepts of java programming : Advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling concepts- String (discuss charAt() , compare To(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), to CharArray() , to LowerCase(), toString(), toUpperCase() , trim() , valueOf() methods) & String Buffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(), ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods), concept of mutable and immutable string, command line arguments, basics of I/O operations – keyboard input using BufferedReader & Scanner classes.

Module-3: Inheritance, Interface & Packages: Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages.

Module-4: Exception Handling: Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes.

Module-5: Multithreaded Programming: Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads.

Module-6: GUI Programming with Java: Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener, I/O in applets, use of repaint(), getDocumentBase(), getCodeBase() methods, layout manager (basic concept), Creation of buttons (JButton class only) & text fields.

Module-7: Software version control: Centralized and Distributed version control systems. Concepts of Repository, Copy, Add, Check in, Checkout, Rollback, Tag, Branch, Merge, Conflict, Resolve, Lock. Version control best practices. Version control software-Git

Text Books
1. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – , Tata Mc Graw Hill.
2. Herbert Schildt, Java:The Complete Reference (Tata McGraw Hill Education Private ,7th Ed).

References
1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – Tata McGraw Hill
4. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
5. Ivor Horton's Beginning Java 2 SDK – Wrox

TITLE OF COURSE: OBJECT ORIENTED PROGRAMMING USING JAVA LAB
COURSE CODE: MCA294
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Students must have already registered for the course "Object Oriented Programming Using Java".

Introduction:
Students will be able to strengthen their problem solving ability by applying the characteristics of an object oriented approach.

Course Outcomes:
Students will be able to apply an object-oriented approach to develop applications of varying complexities.
CO1: Explain what constitutes an object-oriented approach to programming and identify potential benefits of Object-oriented programming over other approaches.
CO2: Explain the benefits of object oriented design and the types of systems in which it is an appropriate methodology.
CO3: Apply an object-oriented approach to developing applications of varying complexities.
CO4: Augment a class definition using constructors, member functions and custom input/output operators to add functionality to a programming solution.
CO5: Read from and write to files using objects from the standard input output library and custom file operators for future restoration.
CO6: Model specialization using single inheritance and abstract base classes to minimize code duplication.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓				✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓		✓			✓	✓		
CO4	✓	✓			✓	✓			✓
CO5	✓		✓	✓				✓	
CO6	✓			✓			✓		✓

Course Contents:
Module-1: Concepts of Java Programming: Class, object creation with source code compilation and execution
Module-2: Data structure using Java: Stack, Queue, and Linked List.
Module-3: String Handling and IO Operations: Methods of String and String Buffer class, Input operations using Scanner and Buffered Reader.
Module-4: Reusability Features Of Java: Inheritance, Packages, Access Specifiers.
Module-5: Exception Handling & Multithreading: User defined exception, usage of exception handling

keywords, Thread creation and execution.
Module-6: GUI Programming: Applets, User Interface using Swing.
Module-7: Version Control: Git commands, Project and Branch creation, File addition, Issue tracker.

List of Experiments

1. Class creation with main method and steps of source code compilation and execution.
2. Design a stack and a queue and different types of linked lists for different operations.
3. Implement method overloading and method overriding.
4. Implement different types of inheritance and use of super keyword.
5. Abstract class and interface creation to implement abstraction.
6. Package creation and program using access specifiers.
7. Implement checked and unchecked exceptions through exception handling keywords.
8. Implement multi-thread application using thread class and runnable interface.
9. Calculator application using Java swing.
10. Implement version control using Git commands.

Text Books

1. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – , Tata Mc Graw Hill.
2. Herbert Schildt, Java:The Complete Reference (Tata McGraw Hill Education Private ,7th Ed).

References

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – Tata McGraw Hill
4. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
5. Ivor Horton's Beginning Java 2 SDK – Wrox

TITLE OF COURSE: DESIGN AND ANALYSIS OF ALGORITHM
COURSE CODE: MCA205
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in mathematics and programming languages.

Introduction:

This course covers basic concepts of design and analysis of algorithm. The Topics to be covered (Tentatively) include: Complexity Analysis, Divide and Conquer, Priority queue, Dynamic Programming, Branch and Bound, Backtracking, Greedy Method, Disjoint set manipulation, Lower bound Theory, Graph traversal algorithm, Network Flow, String matching problem, Amortize Analysis, Matrix Manipulation Algorithm, Notion of NP-completeness and Approximation Algorithms.

Course Outcomes (CO):

The objective of the course is to get an overview of design and analysis of algorithms with an emphasis on the resource utilization in terms of time and space. Various techniques in development of algorithms will be implemented, so that the effect of problem size and architecture design on the efficiency of the algorithm is appreciated. Proving the correctness of the algorithms is one of the objectives for this course.

To reach this goal, the following objectives need to be met:

CO1: Understand the different complexity analysis according different problem. You will examine the algorithms used for various operations on operating systems.

CO2: Visualize different types of algorithm techniques. Become aware of the issues in the management of resources like processor, memory and input-output.

CO3: Know about lower bound concept of sorting techniques and different disjoint set manipulation.

CO4: Understand how to traverse a graph and the maximum flow of a network and also pattern matching of a text.

CO5: Understand the basic principle of different classes of problems like P, NP, and NP-complete.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓			✓	✓
CO2	✓	✓		✓					✓
CO3	✓	✓	✓	✓					✓
CO4	✓	✓	✓	✓					✓
CO5	✓	✓		✓	✓			✓	✓

Course Contents:

Module-1:
Complexity Analysis of an algorithm, Different Asymptotic notations – their mathematical significance

Module-2:
Basic method, use, Examples of Divide and Conquer algorithm, Dynamic Programming, Greedy Method, Branch and bound methods, Backtracking and their complexity.

Module-3:
Basic concept of Lower Bound Theory, Disjoint set manipulation, Amortized Analysis.

Module-4:
Basic method and example of Graph traversal algorithm, String matching problem, Network Flow, Matrix Manipulation Algorithm.

Module-5:
Basic concept of Notion of NP-completeness, Approximation Algorithms.

Text Books
1.T. H. Cormen, C. E. Leiserson, R. L. Rivest & C. Stein, "Introduction to Algorithms", 3rd ed, PHI.
2. Biswajit Bhowmik,"Design and analysis of algorithm", 2ndedition, katson publication.

References
1. E.Horowitz and Shani "Fundamentals of Computer Algorithms", 2nd ed, Orient Black Swan.
2. A. Aho, J. Hopcroft and J. Ullman "The Design and Analysis of computer Algorithms", Pearson.

TITLE OF COURSE: DESIGN AND ANALYSIS OF ALGORITHM LAB
COURSE CODE: MCA295
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic concepts in mathematics and programming languages.

Introduction:
This course covers basic concepts of design and analysis of algorithm. The Topics to be covered (tentatively) include: Complexity Analysis, Divide and Conquer, Priority queue, Dynamic Programming, Branch and Bound, Backtracking, Greedy Method, Disjoint set manipulation, Lower bound Theory, Graph traversal algorithm, Network Flow, String matching problem, Amortize Analysis, Matrix Manipulation Algorithm, Notion of NP-completeness and Approximation Algorithms.

Course Outcomes (CO):
The objective of the course is to get an overview of design and analysis of algorithms with an emphasis on the resource utilization in terms of time and space. Various techniques in development of algorithms will be implemented, so that the effect of problem size and architecture design on the efficiency of the algorithm is appreciated. Proving the correctness of the algorithms is one of the objectives for this course.
To reach this goal, the following objectives need to be met:
CO1: Understand the different complexity analysis according different problem. You will examine the algorithms used for various operations on operating systems.
CO2: Visualize different types of algorithm techniques. Become aware of the issues in the management of resources like processor, memory and input-output.
CO3: Know about lower bound concept of sorting techniques and different disjoint set manipulation.
CO4: Understand how to traverse a graph and the maximum flow of a network and also pattern matching of a text.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓			✓	✓
CO2	✓	✓		✓					✓
CO3	✓	✓	✓	✓					✓
CO4	✓	✓	✓	✓					✓

Recommended Systems/Software Requirements:
1. Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100 MB free disk space.
2. Turbo C or TC3 complier in Windows XP or Linux Operating System

Course Contents:
Exercises that must be done in this course are listed below:

Exercise No.1:
>Implement Binary Search using Divide and Conquer approach
> Implement Merge Sort using Divide and Conquer approach
Exercise No.2:
>Implement Quick Sort using Divide and Conquer approach
> Find Maximum and Minimum element from an array of integer using Divide and Conquer approach
Exercise No.3:
>Find the minimum number of scalar multiplication needed for chain of matrix
Exercise No.4:
>Implement all pair of Shortest path for a graph (Floyed Warshall Algorithm)
>Implement Single Source shortest Path for a graph (Bellman Ford Algorithm) Exercise No.5:
>Implement 15 Puzzle Problem
Exercise No.6:
>Implement 8 Queen Problem
>Graph Coloring Problem
Exercise No.7:
>Knapsack Problem orJob sequencing with deadlines
>Implement Single Source shortest Path for a graph (Dijkstra Algorithm) Exercise No.8: (implement any one of the following problem):
>Minimum Cost Spanning Tree by Prim's Algorithm
>Minimum Cost Spanning Tree by Kruskal's Algorithm
Exercise No.9: (implement any one of the following problem):
>Implement Breadth First Search (BFS)
>Implement Depth First Search (DFS)
Exercise No.10:
>Implement Naïve algorithm for string matching.

Text Book:
1. T. H. Cormen, C. E. Leiserson, R. L. Rivest & C. Stein, "Introduction to Algorithm", 3rd ed, PHI.
2. E.Horowitz and Shani "Fundamentals of Computer Algorithms", 2nd ed, Orient Black Swan.

TITLE OF COURSE: OPERATING SYSTEM
COURSE CODE: MCA206
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in mathematics and basic computing.

Introduction:

This course examines operating system design concepts, data structures and algorithms, and systems programming basics. The Topics to be covered (tentatively) include:
• Computer and operating system structures
• Process and thread management
• Process synchronization and communication
• Memory management

- Virtual memory
- File system
- I/O subsystem and device management
- Selected examples in networking, protection and security

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Understand the theory and logic behind the design and construction of operating systems.
CO2: You will examine the algorithms used for various operations on operating systems.
CO3: You will differentiate between various operating systems functionalities in terms of performance.
CO4: Become aware of the issues in the management of resources like processor, memory and input-output.
CO5: Know the problems in the design of operating system and study the probable solutions.
CO6: Learn to calculate the performance of CPU scheduling and disk scheduling
CO7: Learn File systems and methods of accessing
CO8: Understanding various security threats
CO9: An overview of advanced operating systems and compare the technical aspects of all the advanced operating systems

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓		✓					✓
CO3	✓		✓	✓					✓
CO4	✓	✓	✓		✓				✓
CO5	✓		✓	✓					✓
CO6	✓	✓	✓	✓					✓
CO7	✓		✓						✓
CO8	✓	✓	✓	✓	✓	✓			✓
CO9	✓		✓		✓				✓

Course Contents:
Module-1:
Introduction, Operating system structure - Monolithic systems, Layered systems, Virtual machines, Client-Server model.
Module-2:
Process Management – process creation, deletion, inter process communication tools: pipe, FIFO, shared memory, process synchronization, synchronization primitives and Classical IPC problems.
Module-3:
Process scheduling, Processor Allocation - Allocation Model, Design issues for processor allocation algorithms, Threads and Deadlock.
Module-4:
Memory Management, paging scheme, segmentation, virtual memory concept, page replacement

algorithms, threshing, working set model, issues in Virtual memory management.

Module-5:

File System management. Input output management, Disk scheduling, Case study of UNIX/LINUX.

Text Books

1. Silberschatz, P. Galvin and Greg Gagne, "Operating System Concepts", Wiley International Company.
2. A.S. Tanenbaum, Modern Operating Systems, Prentice Hall India.

References

1. J. Archer Harris, Operating systems – Schuam's outlines, Tata Mc Graw Hill.
2. Gary Nutt, Operating Systems – A modern perspective, Pearson Education.

TITLE OF COURSE: OPERATING SYSTEM LAB
COURSE CODE: MCA296
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts in mathematics and basic computing.

Introduction:

1. To learn and understand system calls related to files, processes, signals, semaphores and implement system programs based on that.
2. To provide an understanding of the design aspects of operating system.
3. To provide an efficient understanding of the language translation peculiarities by designing a complete translator for a mini language.

Course Outcomes (CO):

The students will have a detailed knowledge of the concepts of process and shared memory, aware of a variety of approaches to process management and main-memory management, including interference, deadlock, scheduling, fragmentation, thrashing, learn the basics behind file systems and input output systems and understand the fundamentals of network and distributed operating systems. Upon the completion of Operating Systems practical course, the student will be able to:

CO1: Understand and implement basic services and functionalities of the operating system using system calls.
CO2: Use modern operating system calls and synchronization libraries in software/ hardware interfaces.
CO3: Understand the benefits of thread over process and implement synchronized programs using multithreading concepts.
CO4: Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
CO5: Implement memory management schemes and page replacement schemes.
CO6: Simulate file allocation and organization techniques and understand the concepts of deadlock in operating systems and implement them in multiprogramming system.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			

CO2	✓	✓		✓				✓	
CO3	✓		✓	✓		✓	✓		
CO4	✓	✓			✓			✓	✓
CO5	✓								
CO6	✓	✓		✓	✓		✓		✓

Course Contents:
Exercises that must be done in this course are listed below:
Experiment 1: CPU scheduling
Experiment 2: File allocation Strategy
Experiment 3: Simulate MVT, MFT (Multiprogramming Fixed and Variable)
Experiment 4: Simulate all File Organization Techniques
Experiment 5: Simulate Banker's Algorithm for Dead Lock Avoidance
Experiment 6: Simulate Banker's Algorithm for Dead Lock Prevention
Experiment 7: Simulate all page replacement Strategies
Experiment 8: Simulate Paging Technique of Memory Management
Experiment 9: Shell programming (cut, grep, sed)
Experiment 10: Process

Text Book:
1. Maurice J. Bach, Design of the UNIX Operating System, PHI.

Recommended Systems/Software Requirements:
Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB
RAM and 100 MB free disk space.
Turbo C or TC3 complier in Windows XP or Linux Operating System.

TITLE OF COURSE: COMPUTER ORIENTED NUMERICAL METHOD
COURSE CODE: BSC202
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic mathematics and statistics.

Introduction: This course offers an advanced introduction to numerical linear algebra. Topics include direct and iterative methods for linear systems, Eigen value decompositions and QR/SVD factorizations, stability and accuracy of numerical algorithms, the IEEE floating point standard, sparse and structured matrices, preconditioning and linear algebra software. Problem sets require some knowledge of MATLAB

Course Outcomes (CO):
The students will learn:
CO1: Students are able to understand the nature and operations of Numerical Analysis.
CO2: Student is expected to solve real-life and Engineering applications.
CO3: Formulate and solve mathematical model (linear programming problem) for a physical situations like production, distribution of goods and economics.

CO4: Solve the problem of transporting the products from origins to destinations with least transportation cost.
CO5: Identify the resources required for a project and generate a plan and work schedule.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓					✓
CO2	✓		✓		✓				✓
CO3	✓		✓		✓				✓
CO4	✓		✓		✓				✓
CO5	✓		✓		✓				✓

Course Contents:
Module 1: Approximation in numerical computation: Approximation of numbers, Types of errors, Calculation of errors.
Module 2: Interpolation: Finite Differences and Divided differences, Newton forward/backward Interpolation, Lagrange's method and Newton's divided difference method.
Module 3: Numerical integration: Trapezoidal rule and Simpson's 1/3 rule.
Module 4: Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.
Module 5: Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method and order of convergence.
Module 6: Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method.

Text Books
1. Dutta& Jana: Introductory Numerical Analysis(All course).
2. Dr.B.S.Grewal:Numerical Methods in Engineering &science(All Course).
3. Jain, Iyengar ,& Jain: Numerical Methods (Problems and Solution).

References
1. Baburam: Numerical Methods, Pearson Education.

TITLE OF COURSE: COMPUTER ORIENTED NUMERICAL METHOD LAB
COURSE CODE: BSC292
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic mathematics and statistics.

Introduction:
This course provides an introduction to the basic concepts and techniques of numerical solution of algebraic equation, system of algebraic equation, numerical solution of differentiation, integration, statistical and ANOVA methods and their inter-relations and applications to computer science and engineering, and science areas and develops problem solving skills with both theoretical and

computational oriented problems.

Course Outcomes (CO):

In this course we will study to develop the mathematical skills in the areas of numerical methods, theory and applications of numerical methods in a large number of engineering subjects which require solutions of linear systems, finding eigen values, eigenvectors, interpolation and applications, solving ODEs, PDEs and dealing with statistical problems like testing of hypotheses. To reach this goal, the following objectives need to be met:

CO1: Apply numerical methods to find our solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations.

CO2: Apply various interpolation methods and finite difference concepts.

CO3: Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.

CO4: Work numerically on the ordinary differential equations using different methods through the theory of finite differences.

CO5: Work numerically on the partial differential equations using different methods through the theory of finite differences

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓					
CO2	✓		✓	✓					
CO3	✓		✓	✓					
CO4	✓		✓	✓			✓		
CO5	✓		✓	✓			✓		

Course Contents:

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler's and Runga-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

Text Books:

1. Introductory method of numerical analysis, Sastry S.S
2. Computer Programming in fortran 77, Rajaraman V
3. Numerical methods: for scientific and engineering computation,Mahinder Kumar Jain

References

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.

3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

TITLE OF COURSE: NUMERICAL & STATISTICAL COMPUTING
COURSE CODE: BSC203
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: High School Mathematics

Introduction:
Mathematics is the science that deals with the logic of shape, quantity and arrangement. Math is all around us, in everything we do. It is the building block for everything in our daily lives, including mobile devices, architecture (ancient and modern), art, money, engineering, and even sports.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Apply the concept and techniques of differential and integral calculus to determine curvature and evaluation of different types of improper integrals.
CO2: Understand the domain of applications of mean value theorems to engineering problems.
CO3: Apply the knowledge for addressing the real life problems which comprises of several variables or attributes and identify optimum points of different surfaces of higher dimensions.
CO4: Learn the tools of power series to analyze engineering problems and apply the concept of convergence of infinite series in many approximation techniques in engineering disciplines.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓						✓
CO3	✓	✓	✓	✓					✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Course Contents:
Module-1: Introduction: Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation Solution of Algebraic and Transcendental Equation: Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding complex roots, Muller's method, Rate of convergence of Iterative methods, Polynomial Equations.
Module-2: Interpolation: Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula, Central Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation,
Module-3: Numerical Integration and Differentiation: Introduction, Numerical differentiation Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule.

Module-4: Solution of differential Equations: Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution

Module-5: Statistical Computation: Frequency chart, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubic splines, Regression Analysis, Linear and Non linear Regression, Multiple regression, Statistical Quality Control methods.

Text Books:
1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
2. Gerald & Whealey, "Applied Numerical Analyses", AW

References
1. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.
2. Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi
3. T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods,TMH
4. Pradip Niyogi, "Numerical Analysis and Algorithms", TMH

TITLE OF COURSE: NUMERICAL & STATISTICAL COMPUTING LAB
COURSE CODE: BSC293
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: High School Mathematics

Introduction:
Mathematics is the science that deals with the logic of shape, quantity and arrangement. Math is all around us, in everything we do. It is the building block for everything in our daily lives, including mobile devices, architecture (ancient and modern), art, money, engineering, and even sports.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Apply the concept and techniques of differential and integral calculus to determine curvature and evaluation of different types of improper integrals.
CO2: Understand the domain of applications of mean value theorems to engineering problems.
CO3: Apply the knowledge for addressing the real life problems which comprises of several variables or attributes and identify optimum points of different surfaces of higher dimensions.
CO4: Learn the tools of power series to analyze engineering problems and apply the concept of convergence of infinite series in many approximation techniques in engineering disciplines.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓						✓

CO3	✓	✓	✓	✓					✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Practical List:

1. Develop a C program to find a root of a non-linear equation using Bisection method.
2. Develop a C program to find a root of a non-linear equation using False Position method.
3. Develop a C program to find a root of a non-linear equation using Secant method.
4. Develop C program to find a root of a non-linear equation using Newton-Raphson method.
5. Develop a C program to find a root of a non-linear equation using Barirstow's method
6. Develop a C program to implement Simpsons 1/3rd Rule.
7. Develop a C program to solve linear equation using Gauss Elimination method.
8. Develop a C program to solve linear equation using Gauss Seidel method.
9. Develop a C program to compute the Gauss Jacobi Interactive methods
10. Develop a C program to compute the interpolation value using Newton's Forward Difference formula.
11. Develop a C program to compute the interpolation value using Newton's Backward Difference formula.
12. Develop a C program to compute derivatives of a tabulated function at a specified value using the Newton interpolation approach.
13. Develop a C program to implement Simpsons 3/8th Rule.
14. Develop a C program to implement Runge- Kutta 2nd order method.
15. Develop a C program to implement fitting of straight line.
16. Write a program to find mean for direct series.
17. Write a program to find median for direct series.
18. Write a program to calculate different percentiles.
19. Write a program to calculate mode for discrete distribution.
20. Write a program to calculate harmonic and geometric means for any distribution.
21. Write a program to calculate probability using binomial distribution and Poisson distribution.

Text Books:

1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
2. Gerald & Whealey, "Applied Numerical Analyses", AW

References

1. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.
2. Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi
3. T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods,TMH
4. Pradip Niyogi, "Numerical Analysis and Algorithms", TMH

TITLE OF COURSE: SYSTEM ANALYSIS & DESIGN
COURSE CODE: MCD203
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is assumed of basic concepts of object orientation and basic knowledge of databases.

Introduction:
Course introduces the systems development life cycle of a computer system. Content includes the investigation, analysis, design, implementation and evaluation phases of a business system, tools (e.g. CASE) and techniques used by the systems analyst.

Course Outcomes (CO):
Upon completion of this course, the student will be capable of applying the fundamental skills that are needed by the systems analyst for business data processing. The student will be able to explain the role of information systems in the business environment and will be able to demonstrate competence in performing the steps involved in the development of a simple system:
CO1: Describe principles, concepts and practice of System Analysis and Design process.
CO2: Explain the processes of constructing the different types of information systems
CO3: Apply object oriented concepts to capture a business requirements
CO4: Design and Develop of Information Systems in real world business environment

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			
CO4	✓	✓					✓	✓	✓

Course Contents:
Module-1: System Concept and Information System Environment: System Concepts and Information Systems Environment: The System Concept: Definition, Characteristics of Systems, Elements of a System, Open and Closed System, Formal and Informal Information Systems, Computer based Information Systems, Management Information System, Decision Support System, General Business Knowledge, and Interpersonal Communicational System.
Module-2: System Development Life Cycle: System Development Life Cycle: Recognition of needs, Impetus for System Change, Feasibility Study, Analysis, Design, Implementation, Post implementation and Maintenance. Role of the Systems Analyst, The Analyst/User Interface, Behavioral issues. Case Study on SDLC.
Module-3: System Planning and Information Gathering: Systems Planning and Initial Investigation: Strategies for Determining Information Requirement, Problem Definition & Project initiation, Background Analysis, Fact Analysis, Review of Written, Documents, Onsite Observations, Interviews and Questionnaires, Fact Analysis, Performance Analysis, Efficiency Analysis, Service Analysis.
Information Gathering: need, Information about the firms, Information gathering tools, Interviewing, Arranging the Interview, Guides to a Successful Interview, Types of Interviews and Questionnaires, The Structured and Unstructured Alternatives. Case Study on Information Gathering.
Module-4: Feasibility Study and System Analysis: Feasibility Study: System performance, Economic Feasibility, Technical Feasibility, Behavioral, Feasibility, Steps in Feasibility

Analysis. Tools of Structured Analysis: The Dataflow Diagram (DFD), Data Dictionary, Decision Trees and Structured English. Case Study on Tools.

Module-5: System Design and System Security: Input/output and Forms Design: Input Design, CRT Screen Design, Output Design, and Requirements of form Design. H/W / S/W Selection, Make V/s Buy decision and Maintenance. Documentation: Importance, Types of documentation, Security, Disaster/ Recovery and Ethics in System Development: Threats to System Security, Control, Measures, Disaster/ recovery planning.

Text Books:
1. System Analysis & Design, Shelly Cashman Series, Thomson Press 10th Edition, 2013
2. System Analysis and Design, Kendall and Kendall, Prentice Hall, 9thEdition, 2013

References
1. Systems Analysis and Design, Howryskiewycz, PHI, 5thEdition, 2000
2. Structured System Analysis and Design, S.A Kelkar, Prentice Hall, India, 2004
3. System Analysis and Design Methods, Whitten, Bentley, 9thEdition, 2005
4. System Analysis and Design, Elias M. Awad, 2ndEdition, 2003

TITLE OF COURSE: MANAGEMENT OF INFORMATION SYSTEM
COURSE CODE: MCD204
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is assumed of basic concepts of databases.
Introduction:
This course helps students see the connection between information systems (IS) and business performance. The use of information and communication technologies (ICT) by individuals and organizations dominates the business world. There is a fundamental change going on in the way that organizations run businesses and interact with each other.
Course Outcomes:
At the end of the course, you will be able to:
CO1: Explain basic concepts for IT/IS management
CO2: Discuss organizational, business and strategic issues surrounding IT/IS, and
CO3: Analyze and evaluate uses of strategic IT/IS in practice.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			

Course Contents:
Module1: **Management Information System (MIS):** Definition, Characteristics, Subsystems of MIS (Activity and Functional subsystems),Structure of MIS; Reasons for failure of MIS.Understanding Major Functional Systems: Marketing & Sales Systems, Finance & Accounting Systems, Manufacturing & Pro

duction Systems, Human Resource Systems, Inventory Systems;their sub systems, description and organizational levels.

Module2: Decision Support Systems (DSS): Definition, Relationship with MIS, Evolution of DSS, Characteristics, classification, objectives, components, applications of DSS.

Module-3: ERP, CRM, SCM : ERP (Enterprise Resource Planning): Concepts of ERP, architecture of ERP, Generic modules of ERP, Applications of ERP, concept of XRP (extended ERP),Features of commercial software like SAP, Oracle Apps, MSDynamics NAV, Peoplesoft.

CRM (Customer Relationship Management): Concepts of CRM, Features of CRM (acquisition and retention), Features of commercial software like I2-Rhythm, SIEBEL

SCM (supply Chain Management): Concepts of SCM, drivers of SCM, inbound & outbound,
Definition, brief description and applicability of: eProcurement, eTailing, eLogistics,eCollaboration, eIntegration, Case studies for ERP, CRM, SCM

Module 4: Database Management Systems (DBMS) [e.g. MSAccess/ Oracle/ MS SQL Server / MySQL etc.]: What is a DBMS. Need for using DBMS. Concepts of tables, records, attributes, keys, integrity constraints, 3-schema architecture, data independence, SQL: DDL & DML concepts, SQL commands [ANSI standard].

Module 5: Data Warehousing and Data Mining : Concepts of Data warehousing, data mart, meta data, multidimensional modeling, Online Analytical Processing (OLAP), Online Transaction Processing (OLTP), Knowledge Management System (KMS), Active Knowledge Management Server (AKMS) Features of commercial software like Informatica, Data mining concepts, knowledge discovery v. data mining, data mining applications. Case studies on data warehousing / data mining

Module 6: Outsourcing: Concepts of BPO, KPO, Business Process Outsourcing: Concept & Application, Advantages & Disadvantages, Types of outsourcing, Resource Requirements, Technical framework of automated outsourcing, Documentation: contracts, Service Level Agreements (SLA), Non-disclosure Agreements (NDA), Other Applications – Remote Transaction Processing.

Text Books:
1. Dan W. Paterson, Introduction to Artificial Intelligence & Expert System, PHI./Pearson Education.
2. Davis & Olson, Management Information System, Tata McGraw Hill
3. ISRD, Introduction to Database Management Systems, Tata McGraw Hill

References
1. Ivan Bayross : SQL & PL/SQL , BPB
2. Leon : ERP, Leon Tech Press
3. Loney & Koch: The Oracle 9i Complete Reference, Oracle Press

TITLE OF COURSE: Human Resource Development and Organizational Behavior
COURSE CODE: HSM202
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite:
Basic knowledge of general Management

Introduction:
The main objective of this course is to help the students to acquire and develop skill to take rational decisions. People have always been regarded as important in managing organizations.

Course Outcomes (CO):

During the study of this course,

CO1: student would come to know about the theory and application of human resource management, the broad range of influences acting on human resource management, about the human resources planning and policies through its information system, training and development of human capital of the organization.

CO2: This course emphasis on the knowledge of performance assessment methods, improvements and resultant in terms of employee service condition reviews. Compensation and workers participation in management including the discipline matters and strategic human resources management

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1			✓		✓	✓		✓	✓
CO2			✓		✓	✓		✓	✓

Course Contents:

Module 1: Introduction:
Human resources in Organizations, role of Human Resource Management; the historical background, personnel Management, Human Resource Development, Typical Organizational setup of a Human Resource Management department.

Module 2: Human Resource Planning:
Supply and Demand Forecasting methods, Manpower Inventory, Career Planning, Succession Planning, Personnel Policy, Human Resource Information System (HRIS), Recruitment and Selection: Process, Sources, Methods of selection, Interviewing Method, Skills and Errors Performance Appraisal Systems: Purpose, Methods, Appraisal instruments, 3600 Appraisal HR Score Card, Errors in appraisal, Potential Appraisal, Appraisal Interview.

Module 3: Human Resource Development:
Policy and Programs, Assessment of HRD Needs, HRD, Methods: Training and Non-Training. Compensation Management: Wages- Concepts, Components; System of Wage Payment, Fringe Benefits, Retirement Benefit.

Module 4: Workers' Participation in Management:
Concept, Practices and Prospects in India, Quality Circles and other Small Group Activities. Discipline Management: Misconduct, Disciplinary action, Domestic Enquiry, Grievance Handling

Module 5: Strategic HRM:
Meaning, Strategic HRM vs Traditional HRM, SHRM Process, Nature of e-HRM, e-Recruitment & Selection ,e-Performance Management, e-Learning

Text Books
1. Agarwala T.-Strategic Human Resource Management, OUP
2. Aswathappa,K.-Human Resource Management, Tata McGraw Hill

References

JyothiP. & Venkatesh, D. N.-Human Resource, Management

TITLE OF COURSE: ESP & SDP-II
COURSE CODE: MGSC202
L-T-P: 2-0-2
CREDITS: 2

Pre-requisite: Basic concepts in mathematics, English

Introduction:
The Topics to be covered (tentatively): Aptitude, Indian Constitution and Governance, Basic English and Data Interpretation**.**

Course Outcomes (CO):
Students are expected to be capable numerical problems, literature, and basic of Indian constitution. To reach this goal, the following objectives need to be met:

CO1: Students would be able to design & implement any basic numerical problem properly.
CO2: Students would be able to know basic English language and communicate with the society.
CO3: Students would be able to know basic Indian constitution.
CO4: Students would be able to stress management by doing Yoga

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Essential Studies for Professionals-II
Section-A: Employment Enhancement Skills

Module 1: Ratio and Proportion
Ratio, Proportion, Proportional, Comparison of Ratios, Compounded Ratios, Duplicate Ratio, Triplicate Ratio, Variation.

Module 2: **Time, Work and Distance**
Time, Speed and Distance, Relative Speed

Module 3: Alligation or Mixture
Alligation, Mean price, Rule of Alligation

Module 4: Clocks and Calendar
Clocks, Odd days, Leap Year, Ordinary year, Counting of odd days, Day of the week related to odd days.

Module 5: Permutations and Combinations
Factorial n, Permutations, Combinations.

Module-6: Logical Reasoning
1) Cube Dice, Miscellaneous Problems

2) Data Sufficiency
a) Problems on Blood Relation, ages, Numbers b) Logical Test Based on Data Sufficiency
3) Non Verbal Reasoning
a) Image Formation b) Water –Images c) Mirror Image
d) Image completion
e) Paper Cutting and Folding

Section B: Yoga, Games and Meditation
Module-1: Asana sitting postures and Karate, Asana lying in supine & prone position and karate, Surya Namaskar, Asana standing posture and Karate, Kriyas, Pranayam and Karate, Meditation and Karate, Meditative posture and Karate, Tratak, Kapalbhati and Meditation.
Meditation and Stress Management, Meditation, Stretching and Self Defense. Meditation, Kicking and Punching of Karate. (Games and Sports will be evaluated on the basis of the participation and performance in different sports events that the students shall participate in).

Section C: Skill Development for Professionals -II
Course Contents:

Module-1: Listening

Listening to stories, newspaper articles, Oral Comprehension, Dialogue/ Conversation

Module-2: Speaking

Group discussion, debate, Oral Presentation, Just A Minute (JAM)

Language Function Permission – Request, Order

Practice of Phonetics, Pronunciation, Voice modulation, Accent and voice through passage reading

Story-telling, Role play model (telephonic conversation, situation)
Module-3: Reading Comprehension

Read and analyze through passages, diagrams, graphics, technical and non-technical passages

Learn to read Global, inferential, Contextual Comprehension.

Story writing, Passage writing, Essay writing, Rearranging Jumbled Sentences, Word formation: Prefixes and Suffixes, Homonyms and Homophones, Question and Answer – Comprehension Passages.
Module-4: Indian Constitution and Governance

Central State relation, Interstate relation,

Supreme Court-Appointment of Chief Justice, Acting Chief Justice, Qualification, Oath or Affirmation, Tenure of Judge, Removal of Judges, Salaries & allowance, Adhoc Judge, Procedure of the court, write jurisdiction, Power of Judicial review.

High Court-Appointment of Chief Justice, Acting Chief Justice, Qualification, Oath or Affirmation, Tenure of Judge, Removal of Judges, Salaries & allowance, Adhoc Judge, Procedure of the court, write jurisdiction, Power of Judicial review

Duties & Powers of **Attorney & Advocate General** (in brief)

Panchayati Raj- Three tier system, Different committees recommendation

Municipality, Municipal Council & Corporation, Official Languages & related Articles.

UPSC (in brief): Formation, Related Articles, Scope & Power, Duties of **CAG**, Formation **SPSC**, Related Articles, Scope & Power.

Election Commission (in brief) - Related Articles, Power & Function & Provision of Election

Emergency Provisions (in brief)- Related Articles, Conditions Application, Supreme power during emergency.

National Commission for SC/ST/OBC (in brief)**:** Function of the commissions, Special offer & related articles for SC/ST/OBC

Different amendments (in brief) of Indian Constitution & the related articles
Module-5: Data Interpretation level-II
Newspaper reading: The Hindu & Economic Times

Text Books
g)   Quantitative Aptitude for Competitive Examinations by R S Aggarwal
h)   Introduction to the Constitution of India, by D D Basu
i)   The Constitution of India by Dr. B.R. Ambedkar Under Chairmanship of Dr. Rajendra Prasad Including Coloured Preamble, Signatures

References
1.   The Constitution of India by Dr. B.R. Ambedkar 2020

Third Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1	CC	MCA307	Database Management System	3	0	2	0	4
2	CC	MCA308	Data Communication & Computer Networks	3	0	2	0	4
3	CC	MCA309	Android Application Development	3	0	0	0	3
4	CC	MCA310	Software Project Management	3	0	2	0	4
5	DE	----	Discipline Elective-III	3	0	2	0	3
6	PE/SE	----	Professional/Specialization Elective-I	3	0	0	0	3
7.	GSC	MGSC303	ESP & SDP-III	2	0	0	1	2
8.	PTI	INT301	Project-I	0	0	0	1	1
9.	ECA	ECA301	Extra-curricular activities	-	-	-	-	-
			Total	20	0	8	2	24

Suggestive Choice Based Subjects

Sl No	Type	Subject Code	Topic	L	T	P	Credit Points
1	DE	MCD305	Web Development with ASP.NET	3	0	2	4
2	DE	MCD306	Web Programming with PHP	3	0	2	4
3	DE	MCD307	ERP Systems	3	0	2	3

TITLE OF COURSE: DATABASE MANAGEMENT SYSTEM
COURSE CODE: MCA307
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of data structure and programming language.

Introduction: To understand the design of databases, to acquire knowledge on parallel and distributed databases and its applications. The usage and applications of Object Oriented and Intelligent databases and the emerging databases like Mobile, XML, Cloud and Big Data.

Course Outcomes (CO):
CO1: Select the appropriate high performance database like parallel and distributed database
CO2: Model and represent the real world data using object oriented database
CO3: Design a semantic based database to meaningful data access
CO4: Embed the rule set in the database to implement intelligent databases
CO5: Represent the data using XML database for better interoperability
CO6: Handle Big data and store in a transparent manner in the cloud
CO7: To solve the issues related to the data storage and retrieval

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			
CO4	✓	✓			✓		✓	✓	✓
CO5	✓					✓			
CO6	✓			✓			✓		✓
CO7	✓	✓			✓				

Course Contents:
Module-1 PARALLEL AND DISTRIBUTED DATABASES: Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies
Module-2 INTELLIGENT DATABASES: Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL- Spatial

Databases- Spatial Data Types - Spatial Relationships- Spatial Data Structures-Spatial Access Methods-Spatial DB Implementation.

Module-3 XML DATABASES: XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

Module-4 MOBILE DATABASES: Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols

Module-5: MULTIMEDIA DATABASES: Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.

Text Book

1. Raghu Ramakrishnan "Database Management System", Mc Graw Hill Publications, 2000.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, ―Advanced Database Systems‖, Morgan Kaufmann publishers,2006.
3. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011

References

1. C.J.Date, A.Kannan, S.Swamynathan, ―An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.
2. Henry F Korth, Abraham Silberschatz, S. Sudharshan, ―Database System Concepts‖, Sixth Edition, McGraw Hill, 2011.
3. R. Elmasri, S.B. Navathe, ―Fundamentals of Database Systems‖, Sixth Edition, Pearson Education/Addison Wesley, 2010.
4. Vijay Kumar, ―Mobile Database Systems‖, John Wiley & Sons, 2006.
5. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.

TITLE OF COURSE: DATABASE MANAGEMENT SYSTEM LAB
COURSE CODE: MCA397
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts of data structure and programming language.

Introduction: To understand the design of databases, to acquire knowledge on parallel and distributed databases and its applications. The usage and applications of Object Oriented and Intelligent databases and the emerging databases like Mobile, XML, Cloud and Big Data.

Course Outcomes (CO):
CO1: Select the appropriate high performance database like parallel and distributed database
CO2: Model and represent the real world data using object oriented database
CO3: Design a semantic based database to meaningful data access
CO4: Embed the rule set in the database to implement intelligent databases
CO5: Represent the data using XML database for better interoperability
CO6: Handle Big data and store in a transparent manner in the cloud
CO7: To solve the issues related to the data storage and retrieval

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			
CO4	✓	✓			✓		✓	✓	✓
CO5	✓					✓			
CO6	✓			✓			✓		✓
CO7	✓	✓			✓				

Course Contents:

Exercises that must be done in this course are listed below:

Exercise No.1:

ER Model: An entity-relationship model (ERM) is an abstract and conceptual representation of data. Entity-relationship modeling is a database modeling method, used to produce a type of conceptual schema or semantic data model of a system.

Exercise No. 2:

EER Model: In computer science, the enhanced entity-relationship (EER) model is a high-level or conceptual data model incorporating extensions to the original entity-relationship (ER) model, used in the design of databases. It was developed by a need to reflect more precisely properties and constraints that are found in more complex databases.

Exercise No. 3:

Relational Model: The relational model for database management is a database model based on first-order 4predicate logic, first formulated and proposed in 1969 by E.F. Codd. The model uses the concept of a mathematical relation, which looks somewhat like a table of values -as its basic building block, and has its theoretical basis in set theory and first-order predicate logic.

Exercise No. 4:

1 NF: First normal form (1NF or Minimal Form) is a normal form used in database normalization. A relational database table that adheres to 1NF is one that meets a certain minimum set of criteria. These criteria are basically concerned with ensuring that the table is a faithful representation of a relation and that it is free of repeating groups.

Exercise No. 5:

2 NF: Second normal form (2NF) is a normal form used in database normalization. 2NF was originally defined by E.F. Codd in 1971. A table that is in first normal form(1NF) must

Exercise No. 6:

3 NF: The Third normal form (3NF) is an important form of database normalization. 3NF is said to hold if and only if both of the following conditions hold: • The relation R (table) is in second normal form (2NF) • Every non-prime attribute of R is non-transitively dependent (i.e. directly dependent) on every candidate key of R.

Exercise No. 7:

BCNF: A relation R is in Boyce-Codd normal form (BCNF) if and only if every determinant is a

candidate key. 4The definition of BCNF addresses certain (rather unlikely) situations which 3NF does not handle.

Exercise No. 8:

SQL-1: In this Lab., we discuss basic SQL operations like creating a table, deleting a table, changing the schema of the table, primary key and foreign key constraints on a table and creating indexes on tables.

Exercise No. 9:

SQL-2: Its scope includes efficient data insert, query, update and delete, schema creation and modification, and data access control. In this lab., we discuss SQL operations for populating the tables like inserting into a table, deleting values from a table, and updating the content of the tables.

Text Books

1. Silberschatz, Korth and Sudarshan, "Database System Concepts", 6thEdition,McGraw Hill, 2010
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edi, Pearson, Addison Wesley,2010
3. Ivan Bayross, "The programming language of oracle", 5thEdition, BPB Publication 2016

References

1. "Database Systems: A Practical Approach to design, Implementation and Management". Thomas Connolly, Carolyn Begg; Third Edition, Pearson Education.
2. "Fundamentals of Database Systems" Elmasri, Navathe, Pearson Education.
3. Bipin C Desai, An Introduction to Database Systems, Galgotia. Publications Pvt Limited, 2001
4. "An Introduction to Database Systems", C.J.Date, Pearson Education.
5. "A first course in Database Systems", Jeffrey D. Ullman, Jennifer Windon, Pearson, Education.
6. "Data Management: databases and organization", Richard T. Watson, Wiley.
7. "Data Modeling Essentials", Graeme C. Simxion, Dreamtech.
8. Introduction to Data Base Management, Naveen Prakash, Tata McGraw Hill
9. "Oracle 10g manuals".

TITLE OF COURSE: DATA COMMUNICATION & COMPUTER NETWORKS
COURSE CODE: MCA308
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic idea of computer science, hardware, softwares etc
Introduction:

This course is to provide students with an overview of the concepts and fundamentals of data communication and computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols. The course is supplemented by a practical component covered in CS692 concurrently.

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:
CO1: Independently understand basic computer network technology.

CO2: Understand and explain Data Communications System and its components.
CO3: Identify the different types of network topologies and protocols.
CO4: Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
CO5: Identify the different types of network devices and their functions within a network
CO6: Understand and building the skills of subnetting and routing mechanisms.
CO7: Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.
CO8: Analyze the features and operations of various application layer protocols such as Http, DNS etc

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			
CO4	✓	✓			✓		✓	✓	✓
CO5	✓					✓			
CO6	✓			✓			✓		✓
CO7	✓	✓			✓				
CO8	✓	✓				✓		✓	

Course Contents:
Module--1: Introduction; Data communications: components, data representation (ASCII,ISO etc.), direction of data flow(simplex, half duplex, full duplex); Networks: distributed processing, network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, internet today; Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.
Physical layer: Overview of data(analog & digital), signal(analog &digital), transmission (analog & digital)& transmission media (guided & non-guided); TDM, FDM, WDM; Circuit switching: time division & space division switch, TDM bus; Telephone network;
Module--2: Data link layer: Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;
Medium access sub layer: Point to point protocol, LCP, NCP, FDDI, token bus,token ring; Reservation, polling, concentration; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA; Traditional Ethernet, fast Ethernet;
Module--3: Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : Internet address, classful address, subnetting; Routing : techniques, static vs. dynamic routing , routing table for classful address; Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols.
Transport layer: Process to process delivery; UDP; TCP; Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets; Quality of service: techniques to improve QoS.

Module--4: Application layer: DNS; SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography, user authentication, security protocols in internet, Firewalls.
Modern topics: ISDN services &ATM; DSL technology, Cable modem, SONET. Wireless LAN: IEEE 802.11; Introduction to blue-tooth, VLAN's, Cellular telephony & Satellite network.

Text Books:
1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) "– TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng& Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Miller, data Communication & Network, Vikas

Reference Books:
1. Kurose and Rose "Computer networking -A top down approach featuring the internet" Pearson Edu.
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

TITLE OF COURSE: DATA COMMUNICATION & COMPUTER NETWORKS LAB
COURSE CODE: MCA398
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic idea of computer science, hardware, softwares etc

Introduction:

This practical course provides students with hands on training regarding the design, troubleshooting, modeling and evaluation of computer networks. In this course, students are going to experiment in a real and simulation based test-bed networking environment, and learn about network design and troubleshooting topics and tools such as: network addressing, Address Resolution Protocol, basic troubleshooting tools (like ping, ICMP), IP routing (e.g. RIP), TCP and UDP,DHCP,ACL and many others. Student will have to build some simple networking models using the tool and perform simulations that will help them evaluate their design approaches and expected network performance.

Course Outcomes:

The students will have a detailed knowledge network topology, Local area network, IP addressing, familiarization with network simulator, idea about networking devices, network cable and connectors, different types routing protocols, concept of remote access and different types of application layer protocol. Upon the completion of Computer network practical course, the student will be able to:

CO1: Learn various network commands.
CO2: Understand and implement basic of Network and Network Topology.
CO3: To get idea about IP addressing schemes.
CO4: Understand the benefits of network.
CO5: Configure and simulate various protocols.
CO6: Access remote desktop.
CO7: Connect to different computer using LAN.

CO8:   Understand the concepts of access control.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓						✓	✓
CO3	✓		✓	✓		✓			✓
CO4	✓	✓			✓		✓		
CO5	✓			✓		✓			
CO6				✓		✓	✓		✓
CO7	✓	✓			✓				
CO8	✓	✓		✓		✓		✓	

Course Contents:

Exercises that must be done in this course are listed below:

Experiment 1: Study of different types of Network cables and practically implements the cross-wired cable and straight through cable using clamping tool.

Experiment 2: Familiarization with some network devices.

Experiment 3: Study of Network IP.

Experiment 4: Connect the computers in LAN.

Experiment 5: Introduction to Packet Tracer.

Experiment 6: Configure network topology using packet tracer.

Experiment 7: Configure network topology using packet tracer to find the routing path by IPRoute Command.

Experiment 8: Network Configuration using distance vector routing protocol.

Experiment 9: Configuration of DHCP Protocol

Experiment 10: Telnet Configuration.

Experiment 11: Configuration of Access Control List.

Text Book:

1.   B. A. Forouzan – "Data Communications and Networking (3rd Ed.)"– TMH

Reference Book:

1. Authorized Self-Study Guide "Interconnecting Cisco Network Devices, Part 1(ICND1), 2nd Edition, January, 2008.

Recommended Systems/Software Requirements:

CAT-5/CAT-6 Cables, RJ 45, Cutter, Clamping Tool, Router, Switch and Hub.

Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100 MB free disk space.

Turbo C or TC3 complier in Windows XP or Linux Operating System.

TITLE OF COURSE: Android Application Development
COURSE CODE: MCA309
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Android programming is based on Java programming language so basic understanding on Java programming would be helpful in learning Android application development.

Introduction:

This course covers the fundamentals of Android programming using the Android SDK. Topics discussed in this course include: fundamental concepts in Android programming -activities and intents, designing user interface using views, data persistence, content providers, messaging and networking, location-based services, and developing android services.

Course Outcomes (CO):
CO1: To demonstrate their understanding of the fundamentals of Android operating systems.
CO2: To demonstrate their skills of using Android software development tools.
CO3: To demonstrate their ability to develop software with reasonable complexity on mobile platform.
CO4: To demonstrate their ability to deploy software to mobile devices.
CO5: To demonstrate their ability to debug programs running on mobile devices.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			
CO4	✓	✓			✓		✓	✓	✓
CO5	✓					✓			

Course Contents:

Module-1: **Introduction to Android Operating System:** Android OS design and Features – Android development framework, SDK features, Installing and running applications on Eclipse platform, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools

Module-2: **Android application components**: Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages,

Runtime Configuration Changes. **Android Application Lifecycle:** Activities, Activity lifecycle, activity states, monitoring state changes

Module-3: **Android User Interface:** Measurements – Device and pixel density independent measuring units. Layouts – Linear, Relative, Grid and Table Layouts. User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers.

Module-4: Event Handling – Handling clicks or changes of various UI components. **Fragments** – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.

Module-5: Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS. **Broadcast Receivers** – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity. **Notifications** – Creating and Displaying notifications, Displaying Toasts.

Module-6: Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference.
Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update).

Module-7: Advanced Topics: Alarms – Creating and using alarms. **Using Internet Resources** – Connecting to internet resource, using download manager. **Location Based Services** – Finding Current Location and showing location on the Map, updating location.

Text Books
1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013
3. Headfirst Android Development, Dawn Griffiths, 1st edition, O′Reilly.

References
1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013

TITLE OF COURSE: SOFTWARE PROJECT MANAGEMENT
COURSE CODE: MCA310
L-T-P: 3-0-0

CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and computer architecture.

Introduction:
Software engineering concepts include the collection of tools, procedures, methodologies, and accumulated knowledge about the development and maintenance of software-based systems. This course is strongly suggested for any student planning to take an internship in Computer Science. After an overview of the phases of the software lifecycle, current methodologies, tools, and techniques being applied to each phase will be discussed in depth with localized exercises given to reinforce learning of concepts.

Course Outcomes (CO):

This course will serve to broaden the student's understanding of the issues and latest developments in the area of software development and maintenance. To reach this goal, the following objectives need to be met:

CO1: Define the current state of software development and maintenance characterized as "the software crisis.

CO2: Understand the multidimensional aspect of software engineering, which is the current best attempt at solving the software crisis.

CO3: Become familiar with popular models of the software development and maintenance process.

CO4: Using the waterfall model, study the inputs, outputs, and processes present in each phase.

CO5: Study the core concepts present in several popular methodologies and be able to identify strengths and weaknesses of each.

CO6: Understand the requirement and design approach to develop a software product.

CO7: Study existing CASE tools to be able to identify automate tasks through the use of such tools.

CO8: Understand the testing techniques to develop an error free software product.

CO9. Briefly investigate problems present in project management and understand the estimation, techniques during a software development cycle.

C10. Consider the issues and techniques present in confidence gaining measures residing in each phase of the software lifecycle.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓				✓		
CO4	✓	✓			✓			✓	✓
CO5	✓		✓			✓			
CO6	✓	✓		✓			✓		
CO7	✓	✓			✓				
CO8	✓	✓				✓		✓	

CO9	✓	✓	✓					✓	✓
CO10	✓	✓			✓			✓	

Course Contents:

Module 1: Software Development Organization and Roles: The Management Spectrum; Organizational Structure; Types of Organizational Structures – Hierarchical Organizational Structure, Flat Organizational Structure, Matrix Organizational Structure, Networked Organizational Structure, T-form Organization; Job Roles in Software Development.

Module 2: Overview of Project Management: Project Management – Definitions; Factors Influencing Project Management – Project Manager, Project Management Activities, Stakeholders; Project Communication; Project Development Phases; Project Charter; Statement of Work (SoW); Project Management Associations.

Module 3: Project Planning: Tasks in Project Planning; Work Breakdown Structures (WBS); Planning Methods; Development Life Cycle Models; A Generic Project Model.

Module 4: Estimation and Budgeting of Projects: Software Cost Estimation; COCOMO Model; Budgeting.

Module 5: Project Scheduling: Scheduling Techniques – Program Evaluation and Review Technique (PERT), Gantt Chart, Critical Path Method (CPM), Automated Tools.

Module 6: Project Monitoring and Controlling: Project Status Reporting; Project Metrics; Earned Value Analysis (EVA); Project Communication Plan & Techniques; Steps for Process Improvement.

Module 7: Risk Management: Concepts of Risks and Risk Management; Risk Management Activities; Effective Risk Management; Risk Categories; Aids for Risk Identification; Potential Risk Treatments; Risk Components and Drivers; Risk Prioritization.

Module 8: Configuration Management: Software Configuration Management (SCM) – Baselines, Software Configuration Items (SCI); SCM Process; Identification of Objects in the Software Configuration; Version Control; Change Control; Configuration Audit; Status Reporting; Goals of SCM.

Module 9: Team Development and Conflict Management: Basic Concepts; Organization Types – Centralized-control team organization, Decentralized-control team organization, Mixed-control team organization; Case Study 1: Open-Source Development Team Organization; An Assessment of Team Organizations; Case Study 2: Nokia Software Factories; Team Discipline; Conflict Management.

Module 10: Software Quality Assurance: Software Quality Assurance Activities; Software Qualities; Software Quality Standards – ISO Standards for Software Organization, Capability Maturity Model (CMM), Comparison between ISO 9001 & SEI CMM, Other Standards.

Module 11: Computer Aided Software Engineering (CASE) Tools: CASE Concepts; Classification of CASE Tools; Steps for CASE Tool Implementation; Integrated CASE Environments; Architecture of CASE Environment.

Module 12: Testing Techniques: Software Testing Concepts; Types of Software Testing – Manual Testing, Automated Testing; Black Box Testing; White Box Testing Techniques.

Module 13: Software Re-Engineering: Software Maintenance Problems; Redevelopment vs. Reengineering; Business Process Reengineering; Software Reengineering Process Model; Technical Problems of Reengineering.

Text Books
1. Software Engineering: A practitioner's approach: Roger S. Pressman, McGraw-Hill Pub. (6th Edi).
2. Fundamentals of Software Engineering: Mall, Rajib, Prentice Hall of India, New Delhi (2nd Edition).

References
1. Software Testing Techniques, B. Beizer.
2. Structured Systems Analysis: Tools and Techniques, Gane and Sarson.

3. Software Engineering, Sommerville, Addison Wesley.
4. Modern Structured Analysis, E.Yourdon.
5. An Integrated approach to Software Engineering: PankajJalote, Narosa PublishingHouse.
6. Structured design, E. Yourdon and L.Constantine.
7. Fundamentals of Software Engineering: Ghezzi, Jazayeri, Mandriol, PHI

TITLE OF COURSE: SOFTWARE PROJECT MANAGEMENT LAB
COURSE CODE: MCA390
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts in data structures, programming languages, and computer architecture.

Introduction:
Software engineering concepts include the collection of tools, procedures, methodologies, and accumulated knowledge about the development and maintenance of software-based systems. This course is strongly suggested for any student planning to take an internship in Computer Science. After an overview of the phases of the software lifecycle, current methodologies, tools, and techniques being applied to each phase will be discussed in depth with localized exercises given to reinforce learning of concepts.

Course Outcomes (CO):

This course will serve to broaden the student's understanding of the issues and latest developments in the area of software development and maintenance. To reach this goal, the following objectives need to be met:
CO1: Define the current state of software development and maintenance characterized as "the software crisis.
CO2: Understand the multidimensional aspect of software engineering, which is the current best attempt at solving the software crisis.
CO3: Become familiar with popular models of the software development and maintenance process.
CO4: Using the waterfall model, study the inputs, outputs, and processes present in each phase.
CO5: Study the core concepts present in several popular methodologies and be able to identify strengths and weaknesses of each.
CO6: Understand the requirement and design approach to develop a software product.
CO7: Study existing CASE tools to be able to identify automate tasks through the use of such tools.
CO8: Understand the testing techniques to develop an error free software product.
CO9. Briefly investigate problems present in project management and understand the estimation, techniques during a software development cycle.
C10. Consider the issues and techniques present in confidence gaining measures residing in each phase of the software lifecycle.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓	✓			
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓				✓		

CO4	✓	✓			✓			✓	✓
CO5	✓		✓			✓			
CO6	✓	✓		✓			✓		
CO7	✓	✓			✓				
CO8	✓	✓				✓		✓	
CO9	✓	✓	✓					✓	✓
CO10	✓	✓			✓			✓	

Course Contents:

Module 1: Create Project Plan
▪ Specify project name and start (or finish) date. ▪ Identify and define project tasks. ▪ Define duration for each project task. ▪ Define milestones in the plan ▪ Define dependency between tasks

Module 2: Create Project Plan contd.
▪ Define project calendar. ▪ Define project resources. ▪ Specify resource type and resource rates ▪ assign resources against each task ▪ Baseline the project plan

Module 3: Execute and Monitor Project Plan
▪ Update % Complete with current task status. ▪ Review the status of each task. ▪ Compare Planned vs Actual Status ▪ Review the status of Critical Path ▪ Review resources assignation status

Module 3: Generate Dashboard and Reports
▪ Dashboard (Project Overview, Cost Overview, Upcoming Tasks), Resource Reports (Over-allocated Resources, Resource Overview), Cost Reports (Earned Value Report, Resource Cost Overview, Task Cost Overview)

Text Books
1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management, Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
2. Robert K. Wysocki Effective Software Project Management – Wiley Publication, 2011.

References
1. Watts S. Humphrey: An Introduction to the Team Software Process, 1st Edition, Addison- Wesley International Publications, 2000.
2. Watts S. Humphrey, A Discipline to Software Engineering, 1st Edition, Pearson Education, 2008.
3. Pankaj Jalote, Software Project Management in Practice, 1st Edition, Pearson Education, 2011
4. Chris Kemerer, Software Project Management Readings and Cases, 1st Edition, Pearson Edu, 2011

TITLE OF COURSE: WEB DEVELOPMENT WITH ASP.NET
COURSE CODE: MCD305
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in HTML, CSS, and Other programming

knowledge.

Introduction: To learn and understand Web design. It is a process of conceptualizing, planning, and building a collection of electronic files that determine the layout, color, text styles, structure, graphics, images, and use of interactive features that deliver pages to your site.

Course Outcomes (CO):
CO1: Learn the technologies of the .NET framework
CO2: Know the object oriented aspects of C#
CO3: Be aware of application development in .NET
CO4: Learn web based applications on .NET (ASP.NET)

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓			✓			✓
CO4	✓	✓	✓		✓		✓		✓

Course Contents:
Module-1: Concepts of networking, Web and HTML. Introduction with Web, Network, Website, Server, Client side, Server side and other terms related to basic website designing concept. Introduction with HTML language.
Module-2: Introduction with .net. Introduction of Microsoft .net, Explain features and phases of the object oriented approach. (C#) Basic Syntax, Reading and writing to a console, Data Types, Type Conversion, Variables, Constants.
Module-3: SQL Server, Introduction with SQL Server, Role of a Database Server, SQL language, Working With Database (Table concepts), SQL query (Data Definition Language, Data Manipulation Language, Data Control Language)
Module-4: Database Integration in ASP.NET Connectivity between web pages and data base with the help of Internal and external data source.
Module-5: Hands on C# language. Introduction of C# and programing basic of C#, Programs on different problems in C#. Introduction with core PHP, Core PHP introduction and programming concepts. Quick start with PHP programs. Database Integration in PHP.

**Text
Books**
 1. Learning Web Design, Book by Jennifer Niederst Robbins
 2. NET 4.5 Programming Black Book, Kogent learning solutions inc.
 3. Professional PHP 6, Publisher: Wiley

**Reference
s**
 1. Desktop PC with minimum of 166 MHZ or faster processor with at least 1 GB RAM & 160 GB disk.
 2. Visual studio 2012, Microsoft sql server 2008 R2

TITLE OF COURSE: WEB DEVELOPMENT WITH ASP.NET LAB
COURSE CODE: MCD395
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts in HTML, CSS, and Other programming knowledge.

Introduction: To learn and understand Web design. It is a process of conceptualizing, planning, and building a collection of electronic files that determine the layout, color, text styles, structure, graphics, images, and use of interactive features that deliver pages to your site.

Course Outcomes (CO):
CO1: Apply critical thinking and problem solving skills required to successfully design and Implement a web site.
CO2: Demonstrate the ability to analyze, identify and define the technology required to build and implement a web site.
CO3: Apply critical thinking and problem solving skills required to successfully design and implement a web site.
CO4: Demonstrate the ability to analyses, identify and define the technology required to build and implement a web site.
CO5: Demonstrate knowledge of artistic and design components that are used in the creation of a web site.
CO6: Utilize and apply the technical, ethical and interpersonal skills needed to function in a cooperative environment.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓	✓		✓				✓	✓
CO3	✓	✓				✓	✓		✓
CO4	✓	✓			✓		✓	✓	✓
CO5	✓	✓				✓		✓	✓
CO6	✓	✓		✓					✓

Course Contents:
1. Concepts of networking, Web and HTML. Introduction with Web, Network, Website, Server, Client side, Server side and other terms related to basic website designing concept. Introduction with HTML language.
2. Introduction with .net. Introduction of Microsoft .net, Explain features and phases of the object-oriented approach. (C#) Basic Syntax, Reading and writing to a console, Data Types, Type Conversion, Variables, Constants.
3. SQL Server, Introduction with SQL Server, Role of a Database Server, SQL language, Working With Database (Table concepts), SQL query (Data Definition Language, Data Manipulation Language, Data Control Language)

4. Database Integration in ASP.NET Connectivity between web pages and data base with the help of Internal and external data source.

Exercises that must be done in this course are listed below:
Experiment 1: Create a form in HTML for entering value for some specific fields. (Registration Page)
Experiment 2: Create table in SQL for storing data of registration page. (Using sql query)
Experiment 3: Create a webpage to show the data which is entered in sql tables through Registration page.
Experiment 4: Create a web page to file upload option, so user can upload document on website.
Experiment 5: Create a webpage to show the uploaded document.
Experiment 6: assemble all the web page to create a website for a specific organization. (Minor project).
Experiment 7: Create master page for previous developed pages.
Experiment 8: Apply validators for all fields which are used in previous developed pages.
Experiment 9: Major project.

Text Book:
1.   Learning Web Design, Book by Jennifer Niederst Robbins
2.   NET 4.5 Programming Black Book, Kogent learning solutions inc.

Recommended Systems/Software Requirements:
1.   Desktop PC with minimum of 166 MHZ or faster processor with at least 1 GB RAM and 160 GB disk.
2.   Visual studio 2012, Microsoft SQL server 2008 R2

TITLE OF COURSE: WEB PROGRAMMING WITH PHP
COURSE CODE: MCD306
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in computer networks and programming languages.

Introduction:
This course will enable students to
  1. Illustrate the Semantic Structure of HTML and CSS
  2. Compose forms and tables using HTML and CSS
  3. Design Client-Side programs using JavaScript and Server-Side programs using PHP
  4. Infer Object Oriented Programming capabilities of PHP
  5. Examine JavaScript frameworks such as jQuery and Backbone

Course Outcomes (CO):
After studying this course, students will be able to

CO1: Adapt HTML and CSS syntax and semantics to build web pages.
CO2: Construct and visually format tables and forms using HTML and CSS.
CO3: Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.
CO4: Appraise the principles of object oriented development using PHP.
CO5: Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3		2						2	3	
CO2	2				2		2	2	1		2
CO3	2	3		2					2	2	
CO4	1		2			1		2	2		3
CO5	1		2	1	1		2		2	2	1

Course Contents:

Module-1: Introduction to PHP, Installing Web servers, PHP configuration in IIS & Apache Web server. Data types in PHP, Variables, Constants, operators and Expressions. PHP Operator: Conditional Structure - if, switch case & Looping Structure - for, while, do while, foreach.

Module-2: Introduction to Arrays: Initialization of an array, Iterating through an array, Sorting arrays, Array Functions, Functions: Defining and Calling Functions, Passing by Value and passing By references, Inbuilt Functions: String Function, Math Function, Date Function and Miscellaneous Function.

Module-3: Working with Forms: Get and Post Methods, Query strings, HTML form controls and PHP, Maintaining User State: Cookies, Sessions and Application State. Working with Files: Opening and Closing Files, Reading and Writing to Files, Getting Information on Files.

Module-4: PHP Database Connectivity: Introduction to MYSQL, Creating database and other operations on database, connecting to a database, Use a particular database, Sending query to database, Parsing of the query results, Checking data errors.

Module-5: JavaScript: JavaScript Variables and Data Types, Statement and Operators, Control Structure, Functions, Executing deferred scripts, Objects, Messaging in a JavaScript, Dialog Boxes, Alert Boxes, Confirm Boxes, Prompt Boxes, JavaScript with HTML, Events, Events Handlers, Forms, Forms array, Forms Handling and Validations.

Module-6: Introduction to AngularJS, AngularJS core concepts: way data binding Angular Modules Controller, Scopes and Views, Controllers, scope and root Scope, scope communication, emit, broadcast dependency Injection

Module-7: Introduction to ReactJS, React Components: React component Render function, Component API, Component lifecycle, State, Props, Mixins, JSX

Module-8: Introduction to Node JS Introduction to Node JS, Advantages of Node JS, Node JS Modules: Functions, Buffer, Module, Modules Types, Node Package Manager: What is NPM, Installing Packages Locally, Installing package globally, Traditional Web Server Model Node, js Process Model

Text Books:
1. Steven Holzner, "The Complete Reference - PHP", Tata McGraw Hill, 2008
2. Tim Converse, Joyce Park "PHP Bible", 2nd Edition
3. Dave W. Mercer, Allan Kent, Steven D. Nowicki, David Mercer, Dan Squier, Wankyu Choi with HeowEide-Goodman, Ed Lecky-Thompson, Clark Morgan "Beginning PHP5"

Reference Books:

1. PHP and MySQL Web Development (Developer's Library) 5th Edition, Luke Welling Laura Thomson,2016
2. Mike McGrath, "PHP & MySQL in easy Steps", Tata McGraw Hill, 2012.
3. David Sklar and Adam Trachtenberg, PHP Cookbook, Third Edition, O'Reilly Media, 2014.

TITLE OF COURSE: WEB PROGRAMMING WITH PHP LAB
COURSE CODE: MCD396
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is assumed of basic concepts in computer networks and programming languages.

Introduction:
To learn and understand Web design. It is a process of conceptualizing, planning, and building a collection of electronic files that determine the layout, color, text styles, structure, graphics, images, and use of interactive features that deliver pages to your site.

Course Outcomes (CO):
CO1: Apply critical thinking and problem-solving skills required to successfully design and implement a web site.
CO2: Demonstrate the ability to analyze, identify and define the technology required to build and implement a web site.
CO3: Apply critical thinking and problem-solving skills required to successfully design and implement a web site.
CO4: Demonstrate the ability to analyze, identify and define the technology required to build and implement a web site.
CO5: Demonstrate knowledge of artistic and design components that are used in the creation of a web site.
CO6: Utilize and apply the technical, ethical and interpersonal skills needed to function in a cooperative environment.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2
CO1	3		2						2	3	
CO2	2				2		2	2	1		2
CO3	2	3		2					2	2	
CO4	1		2			1		2	2		3
CO5	1		2	1	1		2		2	2	1
CO6	1		2		2			1	1	1	

Course Contents:

1. Concepts of networking, Web and HTML. Introduction with Web, Network, Website, Server, Client side, Server side and other terms related to basic website designing concept. Introduction with HTML language.
2. Introduction with .net. Introduction of Microsoft .net, Explain features and phases of the object-oriented approach. (C#) Basic Syntax, Reading and writing to a console, Data Types, Type Conversion, Variables, Constants.
3. SQL Server, Introduction with SQL Server, Role of a Database Server, SQL language, Working with Database (Table concepts), SQL query (Data Definition Language, Data Manipulation Language, Data Control Language)
4. Hands on C# language. Introduction of C# and programing basic of C#, Programs on different problems in C#. Introduction with core PHP, Core PHP introduction and programing concepts. Quick start with PHP programs. Database Integration in PHP.

Exercises that must be done in this course are listed below:

Exercise No. 1: a. Install and configure PHP, web server and MYSQL.
　　　　　　　　b. Write a program to print "Welcome to PHP".
Exercise No. 2: Write a simple PHP program using expressions and operators.
Exercise No. 3: Write a PHP program to demonstrate the use of Decision making control
　　　　　　　　structures using-
　　　　　　　　　　　a. If statement
　　　　　　　　　　　b. If-else statement
　　　　　　　　　　　c. Switch statement
Exercise No.4: Create a form in PHP for entering value for some specific fields. (Registration Page)
Exercise No.5: Create table in SQL for storing data of registration page. (Using sql query)
Exercise No.6: Create a webpage to show the data which is entered in sql tables through
　　　　　　　　registration page.
Exercise No. 7: Create a web page to file upload option, so user can upload document on
　　　　　　　　website.
Exercise No. 8: Create a webpage to show the uploaded document.
Exercise No. 9: assemble all the web page to create a website for a specific organization. (Minor
　　　　　　　　project).
Exercise No. 10: Create master page for previous developed pages.
Exercise No. 11: Apply validators for all fields which are used in previous developed pages.
Exercise No. 12: Major project.

Text Book:

1. Learning Web Design, Book by Jennifer Niederst Robbins
2. Professional PHP 6, **Publisher:** Wiley

Recommended Systems/Software Requirements:

Desktop PC with minimum of 166 MHZ or faster processor with at least 1 GB RAM and160 GB disk space. Visual studio 2012, Microsoft sql server 2008 R2

TITLE OF COURSE: ERP SYSTEMS
COURSE CODE: MCD307
L-T-P: 3-0-0

CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of programming language.

Introduction:

The role of IT infrastructure Computer applications for management support has been ever increasing with every development in business functions. Many organizations including manufacturing, banks, insurance firms, government agencies extensively use computerized analysis in their decision-making. Companies have realized the importance of linking the various functions of management in order to develop a thorough networking of business functions. Companies are developing distributed systems that permit uncomplicated accessibility to data saved in several locations. Managers can make better decisions because they have access to more accurate information. This course introduces the fundamentals of the ERP environment, which is accepted as the basic platform to understand the business processes upon which the support systems are built.

Course Outcomes (CO):
CO1: Understand and recognize the significance of ERP in today's business context.
CO2: Understand and appreciate the percolation of ERP into core business processes and as an enabler for extending its scope to back and forth the supply chain for organizations.
CO3: Understand the relationship between technological motivations with business justification when ERP implementation is done which has strategic implications for the business.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓					✓		✓	✓
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓		✓		✓		

Course Contents:
Module 1 - Introduction to ERP, Evolution and the integrated systems approach, Need of ERP in today's business context – Before and After of ERP for Business, ERP Design, and System Architecture, Modules of ERP and ERP Vendors.
Module 2- Role of Business Process Engineering in ERP, GAP Analysis, Relationship between ERP and components of Management Support Systems like MIS, DSS, ESS, DW&BI.
Module 3- Project Management and ERP, Evaluation and selection of a suitable ERP Package – Product Vendor vs. Implementation Vendor analysis.
Module 4 - ERP for Large Organization vs ERP for SMEs, Project planning, Implementation team training & testing, End user training & Going Live, Post Evaluation & Maintenance.
Module 5 - Integration of ERP with SCM, CRM and PLM, ERP adoption models – The role of SAAS model and Cloud Computing in ERP adoption.

Text Books
1. Enterprise Resource Planning, Mary Sumner, Pearson Education, Fourth Impression 2009
2. Enterprise Resource Planning, Ellen F. Monk, Bret J. Wagner, Cengage Learning, First Indian Reprint 2009

References
  1. Managing Business with SAP – Linda Lau (Idea Group Inc.)
  2. Enterprise Resource Planning by S Sadagopan – PHI

TITLE OF COURSE: ERP SYSTEMS LAB
COURSE CODE: MCD397
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts of C++ language.

Introduction:
The role of IT infrastructure Computer applications for management support has been ever increasing with every development in business functions. Many organizations including manufacturing, banks, insurance firms, government agencies extensively use computerized analysis in their decision-making. Companies have realized the importance of linking the various functions of management in order to develop a thorough networking of business functions. Companies are developing distributed systems that permit uncomplicated accessibility to data saved in several locations. Managers can make better decisions because they have access to more accurate information. This course introduces the fundamentals of the ERP environment, which is accepted as the basic platform to understand the business processes upon which the support systems are built.

Course Outcomes (CO):
CO1: Understand and recognize the significance of ERP in today's business context.
CO2: Understand and appreciate the percolation of ERP into core business processes and as an enabler for extending its scope to back and forth the supply chain for organizations.
CO3: Understand the relationship between technological motivation with business justification when ERP implementation is done which has strategic implications for the business.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓					✓		✓	✓
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓		✓		✓		

Course Contents:
1 Introduction and Overview and review of Enterprise Level and ERP Concepts
2 Business and IT Integration Trends Case: To be determined
3 Review of Project Planning & Management concepts Case on ERP Project Planning: "NIBCO"s „Big Bang"" by Brown and Vessey
4 Case #1: "Adopting SAP at Siemens Power Corporation"
5 Life Cycle concepts: 1) development life cycle rationale. 2) traditional ERP life cycles 3) accelerated ERP life cycles
6 Enterprise process modeling concepts. Enterprise process modeling tools and techniques
7 ERP Implementation Challenges and Success Factors
8 Business Process Reengineering (BPR and ERP) ERP Fits and Misfits Analysis
9 ERP Requirements Management
10 ERP Project Team Selection, Development and Project Communications

11 Change Management & Control ERP Configuration and Control
12 Data migration and Data Cleansing
13 Quality Assurance
14 ERP Risk Management
15 ERP Method Engineering

Text Books
1. Enterprise Resource Planning, Mary Sumner, Pearson Education, Fourth Impression 2009
2. Enterprise Resource Planning, Ellen F. Monk, Bret J. Wagner, Cengage Learning, First Indian Reprint 2009

References
1. Managing Business with SAP – Linda Lau (Idea Group Inc.)
2. Enterprise Resource Planning by S Sadagopan – PHI

TITLE OF COURSE: ESP & SDP-III
COURSE CODE: MGSC303
L-T-P: 2-0-0
CREDITS: 2

Pre-requisite: Basic concepts in mathematics and Basic English languages.

Introduction:
This course examines economy, governance. The Topics to be covered, (tentatively): Economic Affairs, Quantitative Aptitude, Reasoning, Ancient & Medieval History.

Course Outcomes (CO):
In this course we will study the basic components of Indian economy and Reasoning. Students are expected to be capable of understanding their advantages and drawbacks, how to implement them it all over the country, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Understand the values of tax payment and mutual Fund
CO2: Understand the values of literature, languages etc.
CO3: Understand Working & Policies, Money Market & Capital Market.
CO4: Know about different short cut techniques to solve any kind of aptitudes.
CO5: Know about different short cut techniques to solve any kind of reasoning.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓	✓	✓		✓
CO2		✓			✓			✓	
CO3	✓	✓							✓
CO4	✓	✓	✓		✓	✓		✓	

		✓				✓		✓	
CO5		✓				✓		✓	

Course Contents:

Section A: Employment Enhancement Skills-III

Module-1: GK & CA, National income: Concept of GDP, GNP, NNP both in FC & MP, PCI

Tax: Concept of TAX, objective of TAX, Direct & Indirect Tax, Progressive, Regressive & Proportional tax.

Module-2: Market structure: Perfect competition, monopoly, oligopoly, duopoly, monophony, duopoly, Oligopoly. SEBI, IRDA, NHB –Working & Policies, Money Market & Capital Market, functions of Banks & Types of accounts, cheques & loans, Mutual Fund, Banking Terminologies.

Module-3: Science, Technology, Literature (with current updates): Monuments, sculptures, Literature, Languages, Visual arts – paintings etc. Performing arts – classical and folk dances, puppetry etc. ,Religious diversity, Satellite, GPS, SIM, GSM, CDMA, Indian Regional Navigation Satellite System (IRNSS), NAVIC,WIFI, SIM, GPRS, ISRO, NASA.

Module-4: Ancient & Medieval History at a glance: From Indus valley civilization to Pre-Foreign (British, Dutch, French) Invasion. Current Affairs.

Section B: Skill Development for Professional – III

Module-1: Quantitative Aptitude: Basic concept of SI & CI, different formulas & their applications, concept of Growth & Contraction of Business. Data Interpretation- Tables, pie chart, histogram, Bar chart, solution tricks & techniques. Quant Review- Miscellaneous problems from different chapters & short cuts. Indices & Surds- Basic concept, Formulae & their applications, Finding out the square roots, Elimination of Surds, Equation solve. Quadratic Equation-Polynomials, degree, powers, Equation & factors Solution. Progression- Concept of AP, GP & HP

Module-2: Reasoning:

Syllogism: a) Logical Venn diagram b) The If Else Statement

Puzzles a) Seating Arrangement b) Classification c) Seating Arrangement with Blood relations

Machine Input-Output: a) Pattern Based I/O

Inequality: a) Coded Inequality, b) Jumbled Inequality, c) Conditional inequality

Sentence: a) Sentence Corrections b) Fill the blanks with appropriate words/articles/ preposition/ verbs/adverbs/conjunction. **d**) Reading Comprehension (Advance Level) d) Vocabulary

Module-3: Advanced Data Interpretation level-III

Newspaper reading: The Hindu & Economic Times

Text Books
1. Quantitative Aptitude for Competitive Examinations by R S Aggarwal
2. The Indian Economy-An Analysis of Economic Survey 2019-20 & Budget 2020-21 bySanjiv Verma
3. Indian Financial System by Sujatra Bhattacharyya

References
1. Indian Economy for Civil Services, Universities and Other Examinations by Ramesh Singh Indian Financial System, by Pathak PEARSON publisher

Fourth Semester Syllabus

Sl No.	Type	Subject Code	Topic	L	T	P	S	Credit Points
1.	CC	MCA411	System Administration & Linux	3	0	2	0	4
2.	CC	MSC412	Data Mining & Warehousing	3	0	0	0	3
3.	CC	MCA413	Compiler Design	3	0	2	0	4
4.	BSC	BSC403	Operation Research & Optimization Technique	3	0	2	0	3
5.	PE/SE	----	Professional/Specialization Elective-II	3	0	2	0	3
6.	PE/SE	----	Professional/Specialization Elective-III	3	0	0	0	3
7.	GSC	MGSC404	ESP & SDP-IV	2	0	0	1	2
8.	PTI	INT402	Project-II	0	0	0	1	1
9.	ECA	ECA401	Extra-curricular activities	-	-	-	-	-
			Total	20	0	8	2	23

TITLE OF COURSE: SYSTEM ADMINISTRATION & LINUX
COURSE CODE: MCA411
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Participants should be proficient with a Unix editor, understand file and directory structures, and understand shell mechanisms as well as basic fundamentals of shell programming.

Introduction:

Participants will be able to install and maintain a Unix/Linux server, connect a Unix/Linux server to the network, and share resources on the network.

Course Outcomes (CO):
CO1: Use multiple computer system platforms, and understand the advantages of each.
CO2: Install and administer network services.
CO3: Protect and secure users' information on computer systems.
CO4: Use the command line interface for system administration.
CO5: Demonstrate strategies for planning/designing systems.
CO6: Install and manage disks and file systems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓					✓	✓
CO2	✓	✓		✓				✓	✓
CO3	✓								
CO4	✓	✓							✓
CO5	✓		✓			✓			
CO6	✓			✓				✓	

Course Contents:
Module 1 - The System Administrator, Information resources: Books, Internet, Online documents. System administrator duties and tasks.
Module 2- Boot and Shutdown, Run levels, Processes and daemons, Configure startup scripts.
Module 3- User Management, Add user. User groups. User and system security. Collapse, User environment (Workshop), Shell startup scripts, what not to do in startup scripts, other dot files.
Module 4 - File Management. (Workshop), File system structure, Expand Manage disk storage, Manage disk storage, Links: hard, symbolic, Expand Permission.
Module 5 – Networking, Expand Network concepts overview, Network concepts overview, Name to address translation, File sharing with NFS. (Workshop), NIS. (Workshop), Services and intend. (Workshop).

Text Books
1. Thomas A. Limoncelli, Christine Hogan, Strata R. Chalup , The Practice of System and Network Administration , 2nd ed., 2007
2. Mark Burgess , Principles of Network and System Administration , 2004

References
1. Aeleen Frisch, Essential System Administration, 3rd ed., 2002
2. Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, UNIX and Linux System Administration, 4th ed., 2010

TITLE OF COURSE: SYSTEM ADMINISTRATION & LINUX LAB
COURSE CODE: MCA491
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Participants should be proficient with a Unix editor, understand file and directory structures, and understand shell mechanisms as well as basic fundamentals of shell programming.

Introduction:

Participants will be able to install and maintain a Unix/Linux server, connect a Unix/Linux server to the network, and share resources on the network.

Course Outcomes (CO):
CO1: Use multiple computer system platforms, and understand the advantages of each.
CO2: Install and administer network services.
CO3: Protect and secure users' information on computer systems.
CO4: Use the command line interface for system administration
CO5: Demonstrate strategies for planning/designing systems.
CO6: Install and manage disks and file systems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓					✓	✓
CO2	✓	✓		✓				✓	✓
CO3	✓								
CO4	✓	✓							✓
CO5	✓		✓			✓			
CO6	✓			✓				✓	

Course Contents:
Week 1 - System Startup and Operation
Week 2 - Disk Partitioning and File system Installation
Week 3 – File system and Device Manipulation
Week 4 - Process and Log Analysis
Week 5 - Startup Scripts and Configuration Files
Week 6 - User/Group Security and Permissions
Week 7 - Print Spooling, File Formats and Media Access
Week 8 - Backup

Week 9 - Scheduling Maintenance Functions
Week 10 - Firewalls, Security and Privacy
Week 11 - DNS Service: Concepts and Client Resolver
Week 12 - DNS Service: Configuration
Week 13 - File and Print Service: Concepts and Operation
Week 14 - File and Print Service: Configuration and Cross-Platform Issues

Text Books

1. Thomas A. Limoncelli, Christine Hogan, Strata R. Chalup , The Practice of System and Network Administration , 2nd ed., 2007
2. Mark Burgess , Principles of Network and System Administration , 2004

References

1. Aeleen Frisch, Essential System Administration, 3rd ed., 2002
2. Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, UNIX and Linux System Administration, 4th ed., 2010

TITLE OF COURSE: DATA MINING & WAREHOUSING
COURSE CODE: MSC412
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in data base management system, and mathematics.

Introduction:

The recent years have generated explosive expansion of digital data stored in computer databases as well as increased pressure on companies to keep competitive advantage. This has put Data Mining (DM) as a key method for extracting meaningful information from the flood of digital data collected by businesses, government, and scientific agencies.

Course Outcomes (CO):

This course will serve to broaden the student's understanding of the issues and latest developments in the area of data mining. To reach this goal, the following objectives need to be met:

CO1: To understand the basic principles, concepts and applications of data warehousing and data mining

CO2: To introduce the task of data mining as an important phase of knowledge recovery process.

CO3: Ability to do Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment.

CO4: Have a good knowledge of the fundamental concepts that provide the foundation of data mining.

CO5: Design a data warehouse or data mart to present information needed by management in a form that issuable for management client.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓								✓

CO2	✓	✓		✓							✓	✓
CO3	✓	✓	✓		✓				✓		✓	✓
CO4	✓											✓
CO5	✓				✓					✓		✓

Course Contents:

Module 1:

Overview of Data warehousing, Strategic information and the need for Data warehousing, Defining a Data warehouse, Evolution of Data warehousing, Data warehousing and Business Intelligence.

Module 2:

The Building Blocks of Data warehouse, Defining features – Subject-oriented data, Integrated data, Time-variant data, Nonvolatile data, Data granularity, Data warehouses and Data marts, Architectural Types – Centralized, Independent data marts, Federated, Hub-and-Spoke, Data mart bus, Overview of components - Source Data, Data Staging, Data Storage, Information Delivery, Metadata, and Management and Control components. Definition and architecture in the areas of Data acquisition, Data storage, and Information delivery Distinguishing characteristics – Different objectives and scope, Data content, Complex analysis for faster response, Flexible and Dynamic, Metadata-driven etc Architectural Framework – supporting flow of data, and the Management and Control module Technical architecture – Data acquisition, Data storage, and Information delivery.

Module 3:

Business Requirements and Data warehouse: Dimensional nature of Business data and Dimensional Analysis, Dimension hierarchies and categories, Key Business. Metrics (Facts), Requirement Gathering methods and Requirements Definition Document (contents). Distinction between architecture and infrastructure, understanding of how data warehouse infrastructure supports its architecture Components of physical infrastructure, Hardware and Operating systems for data warehouse, Database Software, Collection of Tools, Data warehouse Appliances – evolution and benefits. Business Requirements and Data Design – Structure for Business Dimensions and Key Measurements, Levels of detail. Business Requirements and the Architecture plan, Business Requirements and Data Storage Specifications, Business Requirements and Information Delivery Strategy.

Module 4:

Understanding the importance of Metadata, Metadata types by functional areas – Data acquisition, Data storage, and Information delivery, Business Metadata – overview of content and examples, Technical Metadata – overview of content and examples, Metadata Requirements, Sources of Metadata, Metadata management – challenges, Metadata Repository, Metadata, integration and standards.

Module 5:

Concepts of Data warehouse architecture – Definition and architecture in the areas of Data acquisition, Data storage, and Information delivery, Distinguishing characteristics – Different objectives and scope, Data content, Complex analysis for faster response, Flexible and Dynamic, Metadata-driven etc Architectural Framework – supporting flow of data, and the Management and Control module. Technical architecture – Data acquisition, Data storage, and Information delivery. Design decisions, Basics of Dimensional modeling, E-R modeling versus Dimensional modeling, The STAR schema – illustration, Dimension Table, Fact Table, Factless Fact Table, Data granularity, STAR schema keys – Primary, Surrogate, and Foreign, Advantages of the STAR schema, STAR schema examples. Overview

of ETL, Requirements of ETL and steps Data extraction – identification of sources and techniques Data transformation – Basic tasks, Transformation types, Data integration and consolidation, Transformation for dimension attributes, Data loading – Techniques and processes, Data refresh versus update, Procedures for Dimension tables, Fact tables : History and incremental loads ETL Tool options.

Module 6:

Distinction between architecture and infrastructure, Understanding of how data warehouse infrastructure supports its architecture Components of physical infrastructure, Hardware and Operating systems for data warehouse, Database Software, Collection of Tools,Overall concept of Online Analytical Processing (OLAP), OLAP definitions and rules, OLAP characteristics Major features and functions of OLAP – General features, Dimensional analysis, Hypercubes, Drill Down and Roll Up, Slice and Dice, Rotation, Uses and Benefits Familiarity with OLAP models – Overview of variations, MOLAP, ROLAP, HOLAP, DOLAP, Database OLAP, Web OLAP. Web-enabled Data Warehouse – adapting data warehouse for the web Web-based information delivery – Browser technology for data warehouse and Security issues OLAP and Web – Enterprise OLAP, Web-OLAP approaches, OLAP Engine design. Data warehouse Appliances – evolution and benefits

Module 7:

Overview of Data mining – Definition, Knowledge Discovery Process (Relationships, Patterns, Phases of the process), OLAP versus Data mining, Some aspects of Data mining – Association rules, Outlier analysis, Predictive analytics etc), Concepts of Data mining in a Data warehouse environment, Major Data Mining techniques – Cluster Detection using R Language, Decision Trees, Memory-based Reasoning, Link Analysis, Neural, Networks, Genetic Algorithms etc, Data Mining Applications in industry – Benefits of Data mining using R Language, Discussion on applications in Customer Relationship, Management (CRM), Retail, Telecommunication, Biotechnology, Banking and Finance etc.

Textbooks:
1. Data Mining Technology, Third Edition by Arun K Pujari, Universities Press, India
2. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India
3. Alex Berson, Stephen J. Smith, "Data Warehousing Data Mining & OLAP", Tata McGrow- Hill References

References:
1. Data Warehousing, Data Mining, & OLAP – Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill
2. Data warehouse Toolkit by Ralph Kimball, Wiley India
3. Gajendra Sharma,"Data Mining Data Warehousing and OLAP", S.K.KATARIA & SONS

TITLE OF COURSE: COMPILER DESIGN
COURSE CODE: MCA413
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of Automata Theory.
Introduction: This course examines compiler design concepts, phases of compiler in detail and cousins of compiler. The Topics to be covered (tentatively) include:
• Introduction to Compiler

- Lexical Analysis
- Syntax Analysis
- Type Checking
- Intermediate Code Generation
- Code Generation
- Code Optimization

Course Outcomes (CO):

CO1: Student able to apply the knowledge of lex tool & yacc tool to develop a scanner & parser.

CO2: Student able to design & conduct experiments for Intermediate Code Generation in compiler.

CO3: Student able to design & implement a software system for backend of the compiler.

CO4: Student able to deal with different translators.

CO5: Student able to develop program to solve complex problems in compiler

CO6: Student able to learn the new code optimization techniques to improve the performance of a program in terms of speed & space.

CO7: Student able to acquire the knowledge of modern compiler & its features.

CO8: Student able to learn & use the new tools and technologies used for designing a compiler

CO9: Student able to use the knowledge of patterns, tokens & regular expressions for solving a problem in the field of data mining.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓
CO5	✓	✓	✓		✓		✓	✓	
CO6	✓			✓			✓		
CO7	✓	✓	✓	✓			✓	✓	
CO8	✓	✓	✓	✓			✓	✓	
CO9	✓	✓	✓	✓			✓	✓	

Course Contents:

Module-1: Introduction to Compiling: Compilers, Analysis-synthesis model, The phases of the compiler, Cousins of the compiler.

Lexical Analysis: The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

Module-2: Syntax Analysis: The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.

Syntax directed translation: Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Module-3: Type checking: Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions

Run time environments: Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.

Module-4: Intermediate code generation: Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Code optimization: Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.

Code generations: Issues in the design of code generator, a simple code generator, Register allocation & assignment.

Text Books

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" – PHI
3. Tremblay and Sorenson Compiler Writing-McgrawHill International.
4. Chattopadhyay , S- Compiler Design (PHI)

References

1. J. Archer Harris, Operating systems – Schuam's outlines, Tata Mc Graw Hill.
2. Gary Nutt, Operating Systems – A modern perspective, Pearson Education

TITLE OF COURSE: COMPILER DESIGN LAB
COURSE CODE: MCA493
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Knowledge is also assumed of basic concepts of Automata Theory.
Introduction:
This course examines compiler design concepts, phases of compiler in detail and cousins of compiler.
The Topics to be covered (tentatively) include:
• Introduction to Compiler
• Lexical Analysis
• Syntax Analysis
• Type Checking
• Intermediate Code Generation
• Code Generation
• Code Optimization

Course Outcomes (CO):
CO1: Student able to apply the knowledge of lex tool & yacc tool to develop a scanner & parser.
CO2: Student able to design & conduct experiments for Intermediate Code Generation in compiler.
CO3: Student able to design & implement a software system for backend of the compiler.
CO4: Student able to deal with different translators.
CO5: Student able to develop program to solve complex problems in compiler
CO6: Student able to learn the new code optimization techniques to improve the performance of a program in terms of speed & space.

CO7: Student able to acquire the knowledge of modern compiler & its features.
CO8: Student able to learn & use the new tools and technologies used for designing a compiler
CO9: Student able to use the knowledge of patterns, tokens & regular expressions for solving a problem in the field of data mining.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓
CO5	✓	✓	✓		✓		✓	✓	
CO6	✓			✓			✓		
CO7	✓	✓	✓	✓			✓	✓	
CO8	✓	✓	✓	✓			✓	✓	
CO9	✓	✓	✓	✓			✓	✓	

Course Contents:
1. Design and implement a lexical analyzer for given language using C and the lexical analyzer should ignore redundant spaces, tabs and new lines.
1. Implementation of Lexical Analyzer using Lex Tool
3. Generate YACC specification for a few syntactic categories.
 a) Program to recognize a valid arithmetic expression that uses operator +, – , * and/.
 b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
 c) Implementation of Calculator using LEX and YACC
 d) Convert the BNF rules into YACC form and write code to generate abstract syntax tree
4. Write program to find ε – closure of all states of any given NFA with ε transition.
5. Write program to convert NFA with ε transition to NFA without ε transition.
6. Write program to convert NFA to DFA
7. Write program to minimize any given DFA.
8. Develop an operator precedence parser for a given language.
9. Write program to find Simulate First and Follow of any given grammar.
10. Construct a recursive descent parser for an expression.
11. Construct a Shift Reduce Parser for a given language.
12. Write a program to perform loop unrolling.
13. Write a program to perform constant propagation.
14. Implement Intermediate code generation for simple expressions.

Text Books
1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" – PHI

3.Tremblay and Sorenson Compiler Writing-McgrawHill International.
4. Chattopadhyay , S- Compiler Design (PHI)

References
1.   J. Archer Harris, Operating systems – Schuam's outlines, Tata Mc Graw Hill.
2.   Gary Nutt, Operating Systems – A modern perspective, Pearson Education

TITLE OF COURSE: OPERATION RESEARCH & OPTIMIZATION TECHNIQUE
COURSE CODE: BSC403
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic mathematical concept.

Introduction:

The goal of this course is to provide a very common simple intuition enables one to make right decisions and especially show how mathematics is applied to solve fundamental engineering problems. The Topics to be covered (tentatively) include: Linear programming problems, Transportation and Assignments problems, Inventory Controls, Game Theory, Network Analysis, and Queue Theory

Course Outcomes:
CO1: Student completing the first unit of this course would be expected to find the solution of linear programming problems using Graphical method and simplex method.
CO2: At the end of second unit student will be able to assign different jobs to the different person to have the optimum efficiency of working and similar in transportation problems.
CO3: After the completion of the third unit, student will be able to calculate the shortest path of the graph by several methods and Algorithms.
CO4: At the end of forth unit student will be able find the optimal no. of servers such that the sum of cost of service and waiting is minimized.
CO5: At Student completing the fifth unit of this course would be expected to find the solution of Nonlinear programming problems using several methods.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓				✓
CO2	✓		✓	✓					✓
CO3	✓								✓
CO4	✓		✓						✓
CO5	✓	✓					✓	✓	

Course Contents:
Module 1: (Linear Programming Problems)
Basic LPP and Applications, LP Problem Formulation, Simultaneous Equations and Graphical Method, Simplex Method, Big-M Method, Duality Theory, Transportation Problems and Assignment Problem

Module 2: (Network Analysis)
Shortest Path; Floyd Algorithm, Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).

Module 3: (Inventory Control):
Introduction to EOQ Models of Deterministic and Probabilistic, Safety Stock; Buffer Stock.

Module 4: (Game Theory):
Introduction;2-PersonZero-sumGame;SaddlePoint;Mini-MaxandMaxi – Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance.

Module 5: (Queuing Theory):
Introduction, Axiomatic Derivation of the Arrival &Departure (Poisson Queue).Poisson Queue Models :(M/M/1:∞/FIFO) and (M/M/1: N/FIFO).

Text Books:

1. H.A.Taha,"Operations Research", Pearson
2. P. M. Karak–"Linear Programming and Theory of Games", ABS Publishing House
3. Ghosh and Chakraborty,"Linear Programming and Theory of Games", Central Book Agency
4. Ravindran, Philips and Solberg- "Operations Research", WILEYINDIA

References:

1. Kanti Swaroop— "Operations Research", Sultan Chand &Sons
2. Rathindra P. Sen—"Operations Research: Algorithms and Applications", PHI
3. R. Panneersel vam- "Operations Research", PHI
4. A.M. Natarajan,P.Balasubramani and A.Tamilarasi- "Operations Research", Pearson
5. M.V.Durga Prasad "Operations Research", CENGAGE Learning

TITLE OF COURSE: OPERATION RESEARCH & OPTIMIZATION TECHNIQUE LAB
COURSE CODE: BSC493
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basic mathematical concept.

Introduction:

The goal of this course is to provide a very common simple intuition enables one to make right decisions and especially show how mathematics is applied to solve fundamental engineering problems. The Topics to be covered (tentatively) include: Linear programming problems, Transportation and Assignments problems, Inventory Controls, Game Theory, Network Analysis, and Queue Theory

Course Outcomes:
CO1: Student completing the first unit of this course would be expected to find the solution of linear programming problems using Graphical method and simplex method.
CO2: At the end of second unit student will be able to assign different jobs to the different person to have the optimum efficiency of working and similar in transportation problems.
CO3: After the completion of the third unit, student will be able to calculate the shortest path of the graph by several methods and Algorithms.
CO4: At the end of forth unit student will be able find the optimal no. of servers such that the sum of cost of service and waiting is minimized.

CO5: At Student completing the fifth unit of this course would be expected to find the solution of Nonlinear programming problems using several methods.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓				✓
CO2	✓		✓	✓					✓
CO3	✓								✓
CO4	✓		✓						✓
CO5	✓	✓					✓	✓	

Course Contents:
• Introduction to Operations Research (OR)
• Introduction to Foundation mathematics and statistics
• Linear Programming (LP), LP and allocation of resources, LP definition, Linearity requirement
• Maximization Then Minimization problems.
• Graphical LP Minimization solution, Introduction, Simplex method definition, formulating the Simplex model.
• Linear Programming – Simplex Method for Maximizing.
• Simplex maximizing example for similar limitations, Mixed limitations
• Example containing mixed constraints, Minimization example for similar limitations.
• Sensitivity Analysis: Changes in Objective Function, Changes in RHS, The Transportation Model
• Basic Assumptions.

Text Books:

1. H.A.Taha,"Operations Research", Pearson
2. P. M. Karak–"Linear Programming and Theory of Games", ABS Publishing House
3. Ghosh and Chakraborty,"Linear Programming and Theory of Games", Central Book Agency
4. Ravindran, Philips and Solberg- "Operations Research", WILEYINDIA

References:

1. Kanti Swaroop— "Operations Research", Sultan Chand &Sons
2. Rathindra P. Sen—"Operations Research: Algorithms and Applications", PHI
3. R. Panneersel vam- "Operations Research", PHI
4. A.M. Natarajan,P.Balasubramani and A.Tamilarasi- "Operations Research", Pearson
5. M.V.Durga Prasad "Operations Research", CENGAGE Learning

TITLE OF COURSE: ESP & SDP-IV
COURSE CODE: MGSC404
L-T-P: 2-0-0
CREDITS: 2

Pre-requisite: Basic concepts in mathematics and economics.

Introduction: This course examines Taxes in India and market structure. The Topics to be covered

(tentatively) include: National income, Market structure, Science & Technology, Logical Reasoning.

Course Outcomes (CO):

In this course we will study the basic components of upcoming Science & technology. Students are expected to be capable of understanding the Indian Tax system, their advantages and drawbacks, how to implement in Indian Economy, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Know about many books and authors.

CO2: Gain knowledge about important dances & festivals of Indian states.

CO3: Understand the values of Important about banks like payment banks, small banks & license system.

CO4: Know about many learning techniques.

CO5: Know about different short cut techniques to solve any kind of aptitudes.

CO6: Know about different short cut techniques to solve any kind of reasoning.

CO7: Know about different short cut techniques to solve any kind of communicating problems.

CO8: Know about different short cut techniques to solve any kind of societal problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓
CO5	✓	✓	✓		✓		✓	✓	
CO6	✓			✓			✓		
CO7	✓	✓	✓	✓			✓	✓	
CO8	✓	✓	✓	✓			✓	✓	

Section A: Employment Enhancement Skills-IV
Course Contents:

Module-1: GK & CA, Modern History& National Movement.Indian Geography at a glance (Physical, Regional & Economic)

Tax: Concept of TAX, objective of TAX, Direct & Indirect Tax, Progressive, Regressive & Proportional tax.

Module-2: Calendar etc. capitals of countries, currency of countries, important dates, Sports football, hockey etc. recent events & awards too.

Module-3: Important books & authors, Important Hydropower dams, atomic power plant s, important national parks, Minster & portfolio & constituencies, Population census, Persons in news - most famous, popular recent only,

Module-5: Important dances & festivals of Indian states, International Head Quarters & world organization, important president & pm elected from various countries

Module-6: Important about banks like payment banks, small banks & license system, Awards, Sports, Books & author, National & International affairs.

Section B: Skill Development for Professional – IV
Module-1: Quantitative Aptitude: Permutation & Combination. Probability- basic concepts of probability, different theorems & applications, binomial, poison & normal Distributions. Geometry- Concept of different shapes like triangle, quadrilateral, rectangle, square, circle etc. different theorems & their applications. Mensuration- Formulae on triangles, square, Rhombus, parallelogram, sphere, circle, cone, pyramid etc. Application based problem solving. Coordinate Geometry- Locus, Straight lines, Circle etc

Module-2: Reasoning:

Puzzles: Seating Arrangement

a) Circular seating arrangement

b) Square seating Arrangement

c) Line Arrangement, Calendar and Clock, Miscellaneous Problems

Sentence: a) Sentence Corrections b) Fill the blanks with appropriate words/articles/ preposition/ verbs/adverbs/conjunction. **d**) Reading Comprehension (Advance Level) d) Vocabulary
Logical Reasoning: Alphanumeric series, Analogies, Artificial Language, Blood Relations, Calendars, Cause and Effect, Clocks, Coding-Decoding, Critical path, Cubes and cuboids. Data Sufficiency, Decision Making, Deductive Reasoning/Statement Analysis, Dices, Directions
Embedded Images, Figure Matrix, Input-Output, Mirror and Water Images, Odd One Out, Picture Series and Sequences, Paper Folding, Puzzles, Pattern Series and Sequences, Order & Ranking, Seating Arrangements, Shape Construction, Statement and Assumptions, Statement and Conclusions, Syllogism
Module-4: Advanced Data Interpretation level-IV
Newspaper reading: The Hindu & Economic Times

Text Books
1. The Oxford Handbook of Tax System in India: An Analysis of Tax Policy and Governance (Oxford Handbooks) by Mahesh C. Purohit, Vishnu Kanta Purohit
2. Taxation of Income from Non Resident Indian under Direct Tax Law - 2019 Edition by Ram Dutt Sharma

References
1. Marketing Management | marketing cases in the Indian context | Fifteenth Edition | By Pearson by Philip Kotler, Keven Lane Keller
2. A Modern Approach to Logical Reasoning, by R.S. Aggarwal

 # Students can opt any Professional Track/Specialization from the following table from 3rd Semester onwards:

Professional Specific Elective Courses:

Subject Code	IOT, Cybersecurity & Blockchain Track	Subject Code	AI & Machine Learning Track
MCP301	Cyber Security	MCP302	Deep Learning
MCP403	Security Identity & Risk Management	MCP404	Soft Computing
MCP405	Embedded Systems	MCP406	Machine Learning Techniques
MCP407	Blockchain Technology	MCP408	Natural Language Processing
MCP409	Block Chain Business Application & Implication	MCP410	Computer Vision
MCP411	Emerging Areas, The Merkle Tree and Cryptocurrencies	MCP412	Human Computer Interaction

Specialization Specific Course:

Subject Code	Big Data Analytics	Subject Code	Data Science
BDA301	Big Data Analytics	DS301	Data Mining & Data Ware Housing
BDA402	Big Data Modeling & Management	DS402	Data Science with Python
BDA403	Big Data Integration & Modeling	DS403	Introduction to Data Analysis
BDA404	Machine Learning With Big Data	DS404	Data Visualization
BDA405	Managing Big Data with SQL	DS405	Data Scientist's Tool Box

Specialization Specific Course:

Subject Code	Cloud Computing	Subject Code	Block Chain
CC301	Introduction Cloud Computing	BC301	Blockchain Basics
CC402	Introduction to Cloud Security	BC402	Blockchain Component & Architecture
CC403	Cloud Adaptation and Migration	BC403	Transaction on Block Chain
CC404	Cloud Architecture & Development Model	BC404	Block Chain Opportunity Analysis
CC405	AWS Fundamental	BC405	Bit Coin and Crypto Currency

Specialization Specific Course:

Subject Code	Artificial Intelligence & Machine Learning	Subject Code	Cyber Forensics & Internet Security
AIML301	Introduction to Artificial Intelligence	IS301	Introduction to Cryptography
AIML402	Machine Learning Techniques	IS402	Introduction to Cyber Security
AIML403	Computer Vision	IS403	Digital Forensics
AIML404	Application of Machine Learning in Industries	IS404	Cyber Laws & IPR

Subject Code	Artificial Intelligence & Machine Learning	Subject Code	Cyber Forensics & Internet Security
AIML405	Recommended System	IS405	Intrusion Detection and Prevention System
AIML406	Human Computer Interaction	IS406	Ethical Hacking

Professional Elective Courses
IOT, Cybersecurity & Blockchain Track

TITLE OF COURSE: CYBER SECURITY
COURSE CODE: MCP301
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic knowledge of computer science. Ethical values are very much required.

Introduction:
Computer security, cyber security or information technology security is the protection of computer systems and networks from the theft of or damage to their hardware, software, or electronic data, as well as from the disruption or misdirection of the services they provide.

Course Outcomes (CO):
At the end of this course, students will be expected to be able to:
CO1: Assess the current security landscape, including the nature of the threat, the general status of common vulnerabilities, and the likely consequences of security failures;
CO2: Critique and assess the strengths and weaknesses of general cyber security models, including the CIA triad;
CO3: Appraise the interrelationships among elements that comprise a modern security system, including hardware, software, policies, and people;
CO4: Assess how all domains of security interact to achieve effective system-wide security at the enterprise level.
CO5: Compare the interrelationships among security roles and responsibilities in a modern information-driven enterprise—to include interrelationships across security domains (IT, physical, classification, personnel, and so on);
CO6: Assess the role of strategy and policy in determining the success of information security;
CO7: Estimate the possible consequences of misaligning enterprise strategy, security policy, and security plans;

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓							✓
CO2	✓	✓			✓				✓
CO3	✓	✓		✓					✓
CO4	✓	✓		✓					✓
CO5	✓	✓		✓	✓				✓
CO6	✓	✓		✓					✓

CO7	✓	✓		✓	✓			✓

Course Contents:
Module 1: Introduction to Cyber Security
Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

Module 2: Cyber Security Vulnerabilities and Cyber Security Safeguards
Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

Module 3: Securing Web Application, Services and Servers
Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Module 4: Intrusion Detection and Prevention
Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

Module 5: Cryptography and Network Security
Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

Module 6: Cyberspace and the Law
Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.

Module 7: Cyber Forensics
Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

Text Books
1. Jon Erickson, Hacking: The Art of Exploitation (2nd Ed.)
2. Christopher Hadnagy, Social Engineering: The Science of Human Hacking

References
1. Simon Singh, The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography

TITLE OF COURSE: SECURITY IDENTITY & RISK MANAGEMENT
COURSE CODE: MCP403
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in digital network security.

Introduction:
This course examines Security Identity & Risk Management. The Topics to be covered (tentatively) include: an introduction to security management, Threats, Risks and SANS 20, Risk modeling and IT risk framework, Forensic and Exam review, Legal and ethical issues in computer security.

Course Outcomes (CO):
In this course we will study the basic Security Identity & Risk Management. Students are expected to be capable of understanding the Legal and ethical issues in computer security, their advantages and drawbacks, how to implement them in digital world, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to understand the role of Security Management in information technology systems
CO2: Student would be able to understanding of the role of firewalls, guards, proxy servers and intrusion detection in networks on a Linux OS with traffic analysis
CO3: Student would be able to evaluate the residual risk of a protected network
CO4: Student would be able to apply legal and ethical standards in the Information Security context.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Introduction to security management and to the different cyber security courses taught at Morgan State. cyber risks, basic computer security and network security concepts.
Module-2: Threats, Risks and SANS 20 Critical Controls Overview SANS 20 critical control for security management, cyber security concepts: Threats, Vulnerabilities. SANS 20 critical controls for security management vulnerabilities and threats will be presented, key terms.
Module-3: Risk modeling and IT risk framework, A novel risk framework, Numerical risk computation. Quantification of risk and costs associated with attacks are explained and determined compare the advantages and disadvantages of various risk assessment methodologies. Balance the defense and control to minimize cost associated with successful breach.
Module-4: Risk decisions and IT risk framework analysis. IT risk framework reasonable decisions to minimize the cost of a cyber-attack based on simulation of the risk, evaluate and categorize risk.
Module-5: Risk management: NIST 800-30 and 800-39 documents. Assess security risks and costs based on NIST 800-30/39 document and discuss risk assessment from NIST POV. Various risk, analysis methodologies and decisions on risk management issues based on the NIST guidelines and Program a risk assessment model to relation between risk and system security policy.
Module-6: Forensic and incident response. Monitoring, forensics and incident response. Security monitoring, identify key concepts in forensic analysis, and make recommendation on incident response given any scenario.
Module-7: More on Incident response. We will have a closer look of the NIST SP800-61 document and identify SP800-61 key goals. Also, incident response mechanisms will be explained as well as how to select the best response possible in any given situation.
Module-8: Forensic and Exam review. NIST SP800-86 document, network forensics. Cyber forensics

will be studied in details, the best forensic analysis in any given situation.

Module-9: Forensic SP800-86 document, handle an incident, integrate forensic techniques into incident response, and use data from data files for forensic analysis, use data from operating systems for forensic analysis. Lastly, detect and prevent intrusion.

Module-10: Supply Chain Risk Management Practices, NIST SP800-161 (Supply Chain Risk Management Practices for Federal Information Systems and Organizations), identify core components ICT SCRM controls, integrate ICT SCRM into organization wide risk management, and identify ICT supply chain threat events.

Module-11: Policy, legal and ethical implications of the security management, data security and its importance. Legal, Ethical and compliance issues regarding data security and identity theft. Identify the risk of identity theft, distinguish different data handling policies, and explain different federal and statewide policies related to cyber security and acts addressing issues of data security such as HIPAA/FERPA.

Module-12: Legal and ethical issues in computer security: Evaluating legal, ethical and compliance issues regarding computer security. The key legal terms in computer security such as Patents, copyrights, and IP in Information Concept. Identify different computer crimes, examine a computer fraud case for ethical issues, and comply by the rules of the ethics as dealing with cybercrimes.

Text Books

1. Security Awareness—Applying Practical Security in Your World, 4th Ed. Mark Ciampa Copyright © 2014 Course Technology, ISBN-13: 978-1-111-64418-5

References

1. Computer Forensics and Cyber Crime, An Introduction, 3rd Ed. Marjie Britz, Copyright © 2013 Pearson/Prentice Hall, ISBN-13: 978-0-13-267771-4

TITLE OF COURSE: EMBEDDED SYSTEMS
COURSE CODE: MCP405
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concept of C, CO, Digital Communication etc.

Introduction:
To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform built around
A modern embedded processor like the Intel ATOM.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
CO1: Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
CO2: Become aware of the architecture of the ATOM processor and its programming aspects (assembly Level)
CO3: Become aware of interrupts, hyper threading and software optimization.
CO4: Design real time embedded systems using the concepts of RTOS.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1	✓	✓		✓					✓
CO2	✓	✓	✓	✓	✓				✓
CO3	✓	✓	✓	✓	✓				✓
CO4	✓		✓		✓				✓

Course Contents:
Module-1: Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice. Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML

Module-2: Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them. Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them.

Module-3: Embedded Serial communication, Study of basic communication protocols like SPI, SCI (RS232, RS485), I2C, 10 CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network

Module-4: Real time operating system: POSIX Compliance , Need of RTOS in Embedded system software, Foreground/Background systems, multitasking, context switching, IPC, Scheduler policies, Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS.

Text Books
1. Raj Kamal, Embedded Systems Architecture, Programming, and Design. (2/e), Tata McGraw Hill, 2008.
2. K.V. Shibu, Introduction To Embedded Systems, Tata McGraw, 2009.
3. Peter Barry and Patric Crowley, Intel architecture for Embedded system .

References
1. http://www.tomshardware.com/reviews: Pierre Dandumont, Intel and Declining Power Consumption, 2008.
2. http://download.intel.com/design/intarch/papers/323101.pdf: V. Sanjay, Prashant Paliwal,
3. Guidelines for migrating to Intel® Atom™ Processor from other Processor architecture, 2010.
4. Lori Matassa and Max Domeika, Break Away with Intel® Atom™ Processors,2010, Intel press.

TITLE OF COURSE: BLOCKCHAIN TECHNOLOGY
COURSE CODE: MCP407
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Computer Networks, Data Structure

Introduction:
Cryptography is an integral part of the inner-workings of blockchain technology. Public-key encryption serves as the basis for blockchain wallets and transactions, cryptographic hash functions provide the

trait of immutability, and Merkle trees organize transactions while enabling blockchains to be more efficient.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Learn the methods for evaluating different Cryptosystems
CO2: Learn different functions of Hash Functions, MAC Codes & Digital Signatures and problem solving techniques.
CO3: Learn the concept of Firewalls and Web Security.
CO4: Learn the ideas of Basic Distributed System concepts & Bitcoin.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓	✓		✓	✓
CO2	✓	✓	✓			✓			✓
CO3	✓	✓	✓	✓					✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Contents:
Module-1: Introduction:
Need for Distributed Record Keeping, Modeling faults and adversaries,Byzantine Generals problem,Consensus algorithms and their scalability problems,Why Nakamoto Came up with Blockchain based cryptocurrency? Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.
Module-2: Basic Distributed Computing:
Atomic Broadcast, Consensus, Byzantine Models of fault tolerance
Module-3: Basic Crypto primitives:
 Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems.
Module-4: Blockchain 1.0:
Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use.
Module-5: Blockchain 2.0:
Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts.
Module-6: Blockchain 3.0 :
Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain
Module-7: Privacy, Security issues in Blockchain:
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these

Text Books
1. Draft version of "S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology:

Cryptocurrency and Applications', Oxford University Press, 2019.

References
1. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

TITLE OF COURSE: BLOCK CHAIN BUSINESS APPLICATION & IMPLICATION
COURSE CODE: MCP409
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Computer Networks, Data Structure

Introduction:
This course examines different type of business application through block chain. The Topics to be covered (tentatively) include: opportunities for blockchain, blockchain changes the deep structures and architecture of the firm, application of block chain in civil society, private sector, Trust and Vulnerability in block chain.

Course Outcomes (CO):
In this course we will study the block chain in business application. Students are expected to be capable of understanding the implementation of block chain, their advantages and drawbacks, how to implement them in industry, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to analyses opportunity in blockchain properly.
CO2: Students would be able to implement any problem by writing their own business idea.
CO3: By analyzing the core idea of efficient business proposal in blockchain.
CO4: To become an efficient blockchain business administrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: New Business Models, opportunities for blockchain to disrupt or displace traditional centralized business models. blockchain technology can support "open networked enterprise" business models through the inclusion of native payment systems, reputation systems, un censorable content, trustless transactions, smart contracts, and autonomous agents.
Module-2: Blockchain and the C-Suite, blockchain changes the deep structures and architecture of the firm, it will consequently transform our models of management and the roles of the C-Suite. Navigating the balance between blockchain's hype and its true potential is a key responsibility of an organization's management team, decisions and changes that business leaders can anticipate when considering how the future of blockchain will unfold within their business.
Module-3: Leadership for the Next Era, Blockchain alone is just a tool, fulfill its long-term promise,

humans must lead. Rather than relying on state-based institutions, blockchain must be primarily self-governed through collaborations of civil society, private sector, government, and stakeholders in non-state networks, the idea of blockchain governance networks and explain how they can support blockchain stewardship at three levels: The platform level, the application level, and the ecosystem level. As well, you will learn about the conditions that are necessary for a blockchain-based hub of innovation to succeed.

Module-4: Blueprint for a New Social Contract, digital revolution unfolds, global economy, labor markets, old institutions, and society as a whole. To realize the potential of the blockchain revolution, we need business leaders to come to the table as responsible and active participants in a new social contract for both their own long-term interests as well as in the interest of a healthy society and economy, possible directions for a new social contract—i.e. the agreements, laws, and behaviors that people, companies, civil society, and their governments adhere, catalyze investigation, debate, and action, Trust and Vulnerability Short history of the scaling out of human trust. High and Low trust societies, Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary

Text Books
1 Blockchain Basics: A Non-Technical Introduction in 25 Steps Kindle Edition, by Daniel Drescher

References
1. Bitcoin and Cryptocurrency Technologies, by Arvind Narayanan, Joseph Bonneau, Edward Felten.

TITLE OF COURSE: EMERGING AREAS, THE MERKLE TREE AND CRYPTOCURRENCIES
COURSE CODE: MCP411
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in mathematics and programming languages.
Introduction:
This course examines Merkle Tree. The Topics to be covered (tentatively) include: an introduction to Merkle Tree and Immutability, hash values and hash sequences, hash functions and hash puzzles, basic principal of proof-of-work and proof-of-stake.

Course Outcomes (CO):
In this course we will study the Merkle Tree and Immutability. Students are expected to be capable of understanding the Merkle Tree, their advantages and drawbacks, how to implement them in block chain as crypto currency, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to implement Markel Tree properly.
CO2: Students would be able to implement hash function and solve hash puzzles.
CO3: By analyzing the logic, students would be able to write proper algorithm.
CO4: To become an efficient developer.
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Module-1: Data blocks are assembled as well as how hash values and encryption are used to ensure the proper sequencing and integrity of data blocks that are added to a blockchain. Round Table Discussion - The Merkle Tree and Immutability

Module-2: Hashing and an Introduction to Cryptocurrencies, hash values and hash sequences. Assembling block header hash values for a specified hash puzzle difficulty level. Blockchain Basics, Round Table Discussion - Proof of Work and Proof of Stake

Module-3: Investigated hash functions and hash puzzles, we will focus on proof-of-work, which is an approach to modifying the blockchain that can be difficult and time-consuming to compute. We will also focus on proof-of-stake, an alternative to updating the blockchain in which larger nodes are modified that already represent a large portion of the blockchain.

Module-4: The pros and cons of each approach and prepare to apply the principles of proof-of-work and proof-of-stake Comparing proof-of-work and proof-of-stake, alternative approaches that combine the best features of proof-of-work and proof-of-stake.

Text Books

1. Understanding Bitcoin: Cryptography, Engineering and Economics, By Pedro Franco, Wiley.
2. Cryptocurrency Investing For Dummies 1st Edition, by Kiana Danial, ISBN-13: 978-1119533030, ISBN-10: 1119533031

References

1. The Crypto Book: How to Invest Safely in Bitcoin and Other Cryptocurrencies by Siam Kidd

Professional Elective Courses
AI & Machine **Learning** Track

TITLE OF COURSE: DEEP LEARNING
COURSE CODE: MCP302
L-T-P: 2-0-2
CREDITS: 3

Pre-requisite: Basics of AI and Machine Learning

Introduction:
Deep learning is a branch of machine learning which is completely based on artificial neural networks, as neural network is going to mimic the human brain so deep learning is also a kind of mimic of human brain.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: To have developed an understanding of neural network and deep learning architectures.
CO2: To acquire concepts regarding convolution and related architectures needed to develop computer vision applications.
CO3: To acquire concepts related to sequential data needed to develop text mining applications.
CO4: Students would be able to solve problems using the deep learning functionalities implemented through open-source deep learning frameworks like Tensorflow 2.0 and PyTorch.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓			✓	✓	
CO3	✓	✓	✓				✓	✓	✓
CO4	✓	✓	✓		✓			✓	✓

Course Contents:
Module-1: Fundamentals of Neural Network & Deep Learning:
Challenges in shallow network; Motivation for deep neural network, Different deep neural network architectures – Perceptron, Feedforward network, etc. Forward and backward propagation, Gradient Descent and related problems, Regularization, Batch normalization, Optimization algorithms (Adam's, RMSprop, etc.), Hyperparameters
Module-2: Convolutional Neural Network:
Foundational concepts of CNN, Building a CNN architecture, Popular CNN architectures – LeNet, AlexNet, ResNet, CNN applications

Module-3: Recurrent Neural Network:
Sequence data, Architecture of RNN, Long Short Term Memory (LSTM), Bi-directional LSTM, Gated Recurrent Module (GRU), Applications of RNN

Module-4: Important deep learning frameworks:
Tensorflow 2.0, Keras, PyTorch, Theano, Caffe

Text Books
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, Deep Learning, The MIT Press.
2. Fundamentals of Deep Learning – by Nikhil Buduma (O'Reilly).

References
1. Deep Learning – A practitioner's approach – by Josh Patterson & Adam Gibson (O'Reilly).

TITLE OF COURSE: DEEP LEARNING LAB
COURSE CODE: MCP392
L-T-P: 0-0-2
CREDITS: 1

Pre-requisite: Basics of AI and Machine Learning

Introduction:
Deep learning is a branch of machine learning which is completely based on artificial neural networks, as neural network is going to mimic the human brain so deep learning is also a kind of mimic of human brain.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: To have developed an understanding of neural network and deep learning architectures.
CO2: To acquire concepts regarding convolution and related architectures needed to develop computer vision applications.
CO3: To acquire concepts related to sequential data needed to develop text mining applications.
CO4: Students would be able to solve problems using the deep learning functionalities implemented through open-source deep learning frameworks like Tensor flow 2.0 and PyTorch.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓			✓	
CO2	✓			✓			✓	✓	✓
CO3	✓	✓	✓				✓	✓	✓
CO4	✓	✓	✓		✓				

Course Contents:

Module-1: Fundamentals of Neural Network & Deep Learning:
deep neural network, Different deep neural network architectures – Perceptron, Feed forward network, etc. Forward and backward propagation, Gradient Descent and related problems,
Module-2: Convolutional Neural Network:
Concepts of CNN, Building a CNN architecture, Basics of LeNet, AlexNet, ResNet

Module-3: Recurrent Neural Network:
Architecture of RNN, LSTM, Bi-directional LSTM, Gated Recurrent Unit (GRU)
Module-4: Important deep learning frameworks: Tensorflow 2.0, Keras, PyTorch, Theano, Caffe

Text Books
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, Deep Learning, The MIT Press.
2. Fundamentals of Deep Learning – by Nikhil Buduma (O'Reilly).

References
1. Deep Learning – A practitioner's approach – by Josh Patterson & Adam Gibson (O'Reilly).

TITLE OF COURSE: SOFT COMPUTING
COURSE CODE: MCP404
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of artificial intelligence, data base management system.

Introduction:
This course provides a comprehensive introduction to understand the underlying principles, Techniques and approaches fuzzy logic.

Course Outcomes (CO):
The course presents basics of artificial intelligence programming including: Basics of AI, Data Representation, Control structures, Functions, that aims to:
CO1: Understand fuzzy sets and fuzzy logic systems.
CO2: Be able to know Classical Sets and Fuzzy Sets and Fuzzy relations, Membership functions, Fuzzy to Crisp conversions.
CO3: Understand of Neural Network on Hebbian, competitive, Boltzman.
CO4: Understand Genetic Algorithms in different approach. Also understand Other Soft Computing techniques likes Ant colony optimization (ACO), Particle Swarm Optimization (PSO).

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓								✓
CO2	✓			✓					✓
CO3	✓			✓					✓
CO4	✓			✓					✓

Course Contents:

Module-1: Introduction:

Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm.

Module-2: Fuzzy sets and Fuzzy logic systems:

Classical Sets and Fuzzy Sets and Fuzzy relations: Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations. Membership functions: Features of membership functions, standard forms and boundaries, different fuzzification methods. Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods. Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System-Mamdani Fuzzy Models – Sugeno Fuzzy Models. Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting

Module-3: Neural Network

Introduction to Neural Networks: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron.
Learning Methods: Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Back-propagation and multi layer networks. Competitive learning networks: Kohonen self- organizing networks, Hebbian learning; Hopfield Networks. Neuo-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification

Module-4: Genetic Algorithms:

Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA).Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition

Module 5: Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).

Text Books
1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and GeneticAlgorithms", PHI
3. Principles of Soft Computing , S N Sivanandam, S. Sumathi, John Wiley & Sons
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
5. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI

References
1. Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH,
2. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI
3. A beginners approach to Soft Computing, Samir Roy &UditChakraborty, Pearson

TITLE OF COURSE: MACHINE LEARNING TECHNIQUES
COURSE CODE: MCP406
L-T-P: 3-0-0
CREDITS: 3

Pre-Requisites: Fundamental knowledge of computer application principles and skills, probability and statistics theory, and the theory and application of linear algebra are required.

Introduction:

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer application to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention.

Course Outcomes (CO):
By the end of the course, students should be able to
1. Develop an appreciation for what is involved in learning models from data.
2. Understand a wide variety of learning algorithms.
3. Understand how to evaluate models generated from data.
4. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

CO1: Differentiate various Learning Approaches, and to interpret the Concepts of Supervised Learning.
CO2: Compare the different dimensionality reduction techniques.
CO3: Apply theoretical foundations of Decision Trees to identify best split and Bayesian Classifier to Label data points.
CO4: Illustrate the working of classifier models Like SVM, Neural Networks and Deep Neural Networks Classifier Model for typical Machine Learning Applications.
CO5: Illustrate and apply clustering algorithms and identify its applicability in real life problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓				✓	✓
CO2	✓	✓	✓	✓				✓	✓
CO3	✓	✓	✓	✓		✓		✓	✓
CO4	✓	✓	✓	✓				✓	✓
CO5	✓	✓	✓	✓					

Course Contents:
Module -1: Introductions, Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation
Module -2: Linear regression, Decision trees, overfitting
Module -3: Instance based learning, Feature reduction, Collaborative filtering based recommendation, Probability and Bayes learning
Module -4: Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM
Module -5: Neural network, Perceptron, multilayer network, backpropagation, introduction to deep neural network
Module -6: Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning

Text Books
1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin
References
1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press.

TITLE OF COURSE: NATURAL LANGUAGE PROCESSING

COURSE CODE: MCP408
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in programming languages mathematics etc.

Introduction:
This course introduces the theory and methods of natural language processing (NLP). NLP systems understand and produce human language for applications such as information extraction, machine translation, automatic summarization, question-answering, and interactive dialog systems. The course covers knowledge-based and statistical approaches to language processing for syntax (language structures), semantics (language meaning), and pragmatics/discourse (the interpretation of language in context).

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
CO1: To tag a given text with basic Language features.
CO2: To design an innovative application using NLP components.
CO3: To implement a rule based system to tackle morphology/syntax of a language.
CO4: To design a tag set to be used for statistical processing for real-time applications.
CO5: To compare and contrast the use of different statistical approaches for different types of NLP applications.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓				✓
CO2	✓		✓		✓				✓
CO3	✓	✓	✓	✓	✓				✓
CO4	✓		✓		✓				✓
CO5	✓	✓	✓	✓	✓				✓

Course Contents:
Module-1: INTRODUCTION
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

Module-2: WORD LEVEL ANALYSIS
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

Module-3: SYNTACTIC ANALYSIS
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

Module-4: SEMANTICS AND PRAGMATICS
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional

restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

Module-5: DISCOURSE ANALYSIS AND LEXICAL RESOURCES

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper,-Natural Language Processing with Python, First Edition, OReilly Media, 2009.

References

1. Breck Baldwin, Language processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, Natural Language Processing with Java, OReilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

TITLE OF COURSE: COMPUTER VISION
COURSE CODE: MCP410
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of data structure and algorithm, image processing, programming concepts and linear algebra.

Introduction:

This course examines development of algorithms and techniques to analyze and interpret the visible world around us. The Topics to be covered (tentatively) include:
- Digital Image Formation and low-level processing
- Depth estimation and Multi-camera views
- Feature Extraction
- Image Segmentation
- Pattern Analysis
- Motion Analysis
- Shape from X

Course Outcomes (CO):

CO1: Understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc.

CO2: Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision.

CO3: Applications range from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓					✓
CO2	✓	✓	✓	✓	✓				✓
CO3	✓		✓		✓	✓			✓

Course Contents:

Module 1: Introduction: Introduction to Computer Vision, Case study: Face Recognition.

Module 2: Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Module 3: Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. apparel

Module 4: Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Module 5: Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Module 6: Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Module 7: Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Module 8: Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Text Books

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003

References

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

TITLE OF COURSE: HUMAN COMPUTER INTERACTION
COURSE CODE: MCP412
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic subjects of CSE like Basic Data structures, Algorithms, FLAT, Software Engg, Operating Systems, Databases, OS, Computer Architecture

Introduction:

Human-computer interaction is an emerging field of study at present, due to the proliferation of large number of consumer electronic products. The key issue in this field is to make the products usable to lay-persons. In order to do that, we need to take care of the (creative) design aspects (the look-and-feel of the interface) and also the system design aspect (both software and hardware).

Course Outcomes (CO):

After completion of the course, student will

CO1: understand the engineering life cycles for design of interactive systems,

CO2: understand the computational design framework (as part of the life cycle),

CO3: understand the components of the framework including the computational models of users and systems, and evaluation of such systems (with or without users)

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓						✓
CO2	✓	✓		✓					✓
CO3	✓		✓						✓

Course Contents:

Module 1: Introduction to user-centric design, historical evolution, issues and challenges and current trend, Components of HCI Types of interfaces Design process

Module 2: Engineering user-centric systems – relation with software engineering, iterative life-cycle, prototyping, guidelines, Contextual inquiry Importance of users / talking to users Task analysis

Module 3: Sketching Low & hi fidelity prototyping, mental models, Usability evaluation think aloud, observing users Modelling users, expert evaluations

Module 4: Information visualization, Empirical research – research question formulation, experiment design, data analysis, statistical significance test

Module 5: HCI & mobility New faces of HCI, Refresher for all modules seen in the course, User-centric design evaluation – overview of evaluation techniques, expert evaluation, user evaluation, model-based evaluation with case studies

Text Books

1. Samit Bhattacharya (July, 2019). Human-Computer Interaction: User-Centric Computing for Design, McGraw-Hill India, Print Edition: ISBN-13: 978-93-5316-804-9; ISBN-10: 93-5316-804-X, E-book Edition: ISBN-13: 978-93-5316-805-6; ISBN-10: 93-5316-805-8

2. Alan Dix, Janet E. Finlay, Gregory D. Abowd and Russel Beale. (2003). Human-Computer Interaction (3rd Edition), Pearson.

References

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen and Steven Jacobs. (2009). Designing the User Interfaces: Strategies for Effective Human-Computer Interaction (5th Edison), Pearson

Specialization Elective Course:
Big Data Analytics

TITLE OF COURSE: BIG DATA ANALYTICS
COURSE CODE: BDA301
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

Introduction:

The course enables students to Understand the Big Data Platform and its Use cases, Provide an overview of Apache Hadoop, Provide HDFS Concepts and Interfacing with HDFS, Understand Map Reduce Jobs, Provide hands on Hadoop Eco System, Apply analytics on Structured, Unstructured Data, Exposure to Data Analytics with R.

Course Outcomes (CO):

The students will be able to:
CO1: Identify Big Data and its Business Implications
CO2: List the components of Hadoop and Hadoop Eco-System
CO3: Access and Process Data on Distributed File System
CO4: Manage Job Execution in Hadoop Environment
CO5: Develop Big Data Solutions using Hadoop Eco System

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓		✓		✓				✓
CO3	✓		✓					✓	✓
CO4	✓		✓		✓			✓	✓
CO5	✓		✓						✓

Course Contents:
Module-1: Introduction To Big Data And Hadoop: Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

Module-2: HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Module-3: Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Module-4: Hadoop Eco System Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. HBase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL: Introduction

Module-5: Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Textbooks:
1. Tom White "Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Reference Books:
1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press

TITLE OF COURSE: BIG DATA ANALYTICS LAB
COURSE CODE: BDA391
L-T-P: 0-0-2
CREDITS: 2

Pre-requisite: Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

Introduction:

The course enables students to Understand the Big Data Platform and its Use cases, Provide an overview of Apache Hadoop, Provide HDFS Concepts and Interfacing with HDFS, Understand Map Reduce Jobs, Provide hands on Hadoop Eco System, Apply analytics on Structured, Unstructured Data, Exposure to Data Analytics with R.

Course Outcomes (CO):

The students will be able to:
CO1: Set up single and multi-node Hadoop Clusters
CO2: Apply Map Reduce technique for various algorithms

CO3: Design algorithms that uses Map Reduce to apply on Unstructured and structured data

CO4: Develop Scalable machine learning algorithms for various Big data applications using R
CO5: Represent NoSQL data

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1			✓	✓	✓	✓			✓
CO2	✓		✓		✓	✓			✓
CO3	✓		✓	✓	✓	✓			✓
CO4	✓		✓	✓	✓	✓			✓
CO5			✓		✓				✓

LIST OF EXPERIMENTS

1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
2. MapReduce application for word counting on Hadoop cluster
3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.
4. K-means clustering using map reduce
5. Page Rank Computation
6. Mahout machine learning library to facilitate the knowledge build up in big data analysis.
7. Application of Recommendation Systems using Hadoop/mahout libraries

TITLE OF COURSE: BIG DATA MODELING & MANAGEMENT
COURSE CODE: BDA402
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: Introduction about Big data and Hadoop.

Introduction:
In this course, you will experience various data genres and management tools appropriate for each. You will be able to describe the reasons behind the evolving plethora of new big data platforms from the perspective of big data management systems and analytical tools.

Course Outcomes (CO):
The students will be able to:
CO1: Recognize different data elements in your own work and in everyday life problems.
CO2: Explain why your team needs to design a Big Data Infrastructure Plan and Information System Design.
CO3: Identify the frequent data operations required for various types of data.
CO4: Select a data model to suit the characteristics of your data.
CO5: Apply techniques to handle streaming data.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1	✓	✓				✓			✓
CO2	✓		✓	✓					✓
CO3	✓			✓					✓
CO4	✓			✓	✓				✓
CO5	✓	✓						✓	✓

Course Contents:

Module-1: Introduction to Big Data Modeling and Management, Data Ingestion, Data Storage, Data Quality, Data Operations, Data Scalability and Security, Energy Data Management Challenges at ConEd

Module-2: Big Data Modeling, Introduction to Data Models, Data Model Structures, Data Model Operations, Data Model Constraints, Introduction to CSV Data, What is a Relational Data Model?, What is a Semistructured Data Model?, Exploring the Relational Data Model of CSV Files, Exploring the Semistructured Data Model of JSON data, Exploring the Array Data Model of an Image, Exploring Sensor Data.

Module-3: Vector Space Model, Graph Data Model, Other Data Models, Exploring the Lucene Search Engine's Vector Data Model, Exploring Graph Data Models with Gephi.

Module-4: Data Model vs. Data Format, What is a Data Stream?, Why is Streaming Data different?, Understanding Data Lakes, Exploring Streaming Sensor Data.

Module-5: DBMS-based and non-DBMS-based Approaches to Big Data, From DBMS to BDMS, Redis: An Enhanced Key-Value Store, Aerospike: a New Generation KV Store, Semi structured Data – AsterixDB, Solr: Managing Text, Relational Data – Vertica.

Textbooks:

1. Hands-On Big Data Modeling, By James Lee , Tao Wei & Suresh Kumar Mukhiya
2. Data Management: Databases And Organizations 6th Editionby Richard T. Watson

Reference Books:

1. Big Data Principles and best practices of scalable realtime data systems, Nathan Marz and James Warren

TITLE OF COURSE: BIG DATA INTEGRATION & MODELING
COURSE CODE: BDA403
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Completion of Intro to Big Data is recommended

Introduction:
Nowadays, huge volume of data is collected from many heterogeneous data sources which are generating data in real-time with different qualities — which is called Big Data. The big data integration is very challenging especially after the traditional data integration techniques failed to handle it.

Course Outcomes (CO):
The students will be able to:

CO1: Retrieve data from example database and big data management systems
CO2: Describe the connections between data management operations and the big data processing patterns needed to utilize them in large-scale analytical applications.
CO3: Identify when a big data problem needs data integration
CO4: Execute simple big data integration and processing on Hadoop and Spark platforms

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓						✓	✓
CO4	✓		✓		✓				✓

Course Contents:
Module-1: introduction to big data integration and processing, big data modeling and management, why is big data processing different? What is data retrieval?, querying two relations, subqueries, querying relational data with postgres.
Module-2: Retrieving Big Data: Querying JSON Data with MongoDB, Aggregation Functions, Querying Aerospike, Querying Documents is MongoDB, Exploring Pandas Data Frames.
Module-3: Big Data Integration: Overview of information integration, A Data integration Scenario, Integration for Multichannel Customer Analytics, Big Data Management and Processing Using Splunk and Datameer, why splunk?, Connected Cars with ford's OpenXC and Splunk, Big Data Management and Processing using Datameer, Installing splunk Enterprise on Windows, Installing splunk enterprise on Linux, Exploring Splunk Queries.
Module-4: Processing Big Data: Big Data Processing Pipelines, Some High-Level Processing Operations in Big Data Pipelines, Aggregation Operations in Big Data Pipelines, Typical Analytical Operations in Big Data Pipelines, Overview of Big Data Processing Systems, The Integration and Processing Layer, Introduction to Apache Spark, Getting Started with Spark, WordCount in Spark.
Module-5: Big Data Analytics using Spark: Spark Core: Programming In Spark using RDDs in Pipelines, Spark Core: Transformations, Spark Core: Actions, Spark SQL, Spark Streaming, Spark MLLib, Spark GraphX, Exploring SparkSQL and Spark DataFrames, Analyzing Sensor Data with Spark Streaming.

Textbooks:
1. Data Integration Blueprint And Modeling: Techniques For A Scalable And Sustainable Architecture (Paperback) (Ibm Press) 1st Edition By Anthony David Giordano
2. Managing Data In Motion: Data Integration Best Practice Techniques And Technologies (The Morgan Kaufmann Series On Business Intelligence) 1st Edition By April Reeve

Reference Books:
1. Principles of Data Integration 1st Edition by AnHai Doan, Alon Halevy , Zachary Ives

TITLE OF COURSE: MACHINE LEARNING WITH BIG DATA
COURSE CODE: BDA404
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Completion of Intro to Big Data is recommended

Introduction:

This course provides an overview of machine learning techniques to explore, analyze, and leverage data. You will be introduced to tools and algorithms you can use to create machine learning models that learn from data, and to scale those models up to big data problems.

Course Outcomes (CO):

The students will be able to:
CO1: Design an approach to leverage data using the steps in the machine learning process.
CO2: Apply machine learning techniques to explore and prepare data for modeling.
CO3: Identify the type of machine learning problem to apply the appropriate set of techniques.
CO4: Construct models that learn from data using widely available open source tools.
CO5: Analyze big data problems using scalable machine learning algorithms on Spark.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓		✓				✓
CO2	✓			✓	✓			✓	✓
CO3	✓	✓	✓					✓	✓
CO4	✓	✓	✓		✓				✓
CO5	✓			✓					✓

Course Contents:
Module-1: Introduction to Machine Learning With Big Data, Summary of Big Data Integration and Processing, Machine Learning Overview, Categories Of Machine Learning Techniques, Machine Learning Process, Goals and Activities in the Machine Learning Process, CRISP-DM, Scaling Up Machine Learning Algorithms
Module-2: Data Exploration: Data Terminology, Data Exploration, Data Exploration through Summary Statistics, Data Exploration through Plots, Exploring Data with KNIME Plots, Data Exploration in Spark.
Module-3: Data Preparation: Data Preparation, Data Quality, Addressing Data Quality Issues, Feature Selection, Feature Transformation, Dimensionality Reduction, Handling Missing Values in KNIME, Handling Missing Values in Spark.
Module-4: Classification: introduction to Classification, Building and Applying a Classification Model, Classification Algorithms, k-Nearest Neighbors, Decision Trees, Naïve Bayes, Classification using Decision Tree in KNIME, Classification in Spark.
Module-5: Evaluation of Machine Learning Models: Generalization and Overfitting, Overfitting in Decision Trees, Using a Validation Set, Metrics to Evaluate Model Performance, Confusion Matrix, Evaluation of Decision Tree in KNIME, Evaluation of Decision Tree in Spark.
Module 6: Regression, Cluster Analysis, and Association Analysis: Regression Overview, Linear Regression, Cluster Analysis, k-Means Clustering, Association Analysis, Association Analysis in Detail, Machine Learning With Big Data - Final Remarks, Cluster Analysis in Spark.
Textbooks:

1. Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners Book by Jared Dean
2. Machine Learning Models and Algorithms for Big Data Classification: Thinking with Examples for Effective Learning Book by Shan Suthaharan.

Reference Books:
1. Big Data and Machine Learning in Quantitative Investment Book by Tony Guida
2. Machine Learning For Big Data Analysis, Edited By Siddhartha Bhattacharyya, Hrishikesh Bhaumik, Anirban Mukherjee, Sourav De

TITLE OF COURSE: MANAGING BIG DATA WITH SQL
COURSE CODE: BDA405
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts Data base management system and SQL Query Language.

Introduction:
This course is an introduction to how to use relational databases in business analysis. You will learn how relational databases work, and how to use entity-relationship diagrams to display the structure of the data held within them. This knowledge will help you understand how data needs to be collected in business contexts, and help you identify features you want to consider if you are involved in implementing new data collection efforts.

Course Outcomes (CO):
The students will be able to:
CO1: Understand How Data Needs to Be Collected in Business Contexts.
CO2: Identify Features You Want to Consider If You Are Involved in Implementing New Data Collection Efforts
CO3: Understand How to Execute the Most Useful Query and Table Aggregation Statements For Business Analysts
CO4: Understand Query Practice Using Them with Real Databases.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓			✓		✓			✓
CO2	✓			✓		✓			✓
CO3	✓			✓		✓			✓
CO4	✓	✓	✓			✓		✓	✓

Course Contents:
Module-1: Problems with Having a Lot of Data Used by a Lot of People, How Relational Databases Help Solve Those Problems, Database Design Tools That Will Help You Learn SQL Faster.
Module-2: How Entity-Relationship Diagrams Work, Database Structures Illustrated by Entity-Relationship Diagrams, Relational Schemas, How to Make Entity-Relationship Diagrams using ERDPlus, How to Make Relational Schemas using ERDPlus.
Module-3: Queries to Extract Data from Single Tables: Introduction to Query Syntax, How to Use Jupyter Notebooks, How to Use Your Jupyter Account, How to Use Teradata Viewpoint and SQL Scratchpad.

Module-4: Queries to Summarize Groups of Data from Multiple Tables: What are Joins? Joins with Many to Many Relationships and Duplicates, A Note about Our Join Examples, Retrieve Your Data.

Module-5: Queries to Address More Detailed Business Questions: Design and execute subqueries, Introduce logical conditions into your queries using IF and CASE statements, Implement analyses that accommodate missing data or data mistakes, and Write complex queries that incorporate many tables and clauses.

Textbooks:
1. Sql on big data, technology, architecture, and innovation, authors: pal, sumit.

Reference Books:
1. Oracle database 11g pl/sql programming by mclaughlin, mcgraw hill**,** by mclaughlin.

Specialization Elective Course:
==Data Science==

TITLE OF COURSE: DATA MINING & DATA WARE HOUSING
COURSE CODE: DS301
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts in data base management system, and mathematics.

Introduction:
The recent years have generated explosive expansion of digital data stored in computer databases as well as increased pressure on companies to keep competitive advantage. This has put Data Mining (DM) as a key method for extracting meaningful information from the flood of digital data collected by businesses, government, and scientific agencies.

Course Outcomes (CO):
This course will serve to broaden the student's understanding of the issues and latest developments in the area of data mining. To reach this goal, the following objectives need to be met:
CO1: To understand the basic principles, concepts and applications of data warehousing and data mining
CO2: To introduce the task of data mining as an important phase of knowledge recovery process.
CO3: Ability to do Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment.
CO4: Have a good knowledge of the fundamental concepts that provide the foundation of data mining.
CO5: Design a data warehouse or data mart to present information needed by management in a form that issuable for management client.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓			✓					✓
CO2	✓	✓		✓				✓	✓
CO3	✓	✓	✓		✓			✓	✓
CO4	✓								✓
CO5	✓				✓				✓

Course Contents:
Module 1:
Overview of Data warehousing, Strategic information and the need for Data warehousing, Defining a Data warehouse, Evolution of Data warehousing, Data warehousing and Business Intelligence.
Module 2:

Concepts of Data warehouse architecture – Definition and architecture in the areas of Data acquisition, Data storage, and Information delivery Distinguishing characteristics – Different objectives and scope, Data content, Complex analysis for faster response, Flexible and Dynamic, Metadata-driven etc Architectural Framework – supporting flow of data, and the Management and Control module Technical architecture – Data acquisition, Data storage, and Information delivery.

Module 3:
Distinction between architecture and infrastructure, understanding of how data warehouse infrastructure supports its architecture Components of physical infrastructure, Hardware and Operating systems for data warehouse, Database Software, Collection of Tools, Data warehouse Appliances – evolution and benefits.

Module 4:
Understanding the importance of Metadata, Metadata types by functional areas – Data acquisition, Data storage, and Information delivery, Business Metadata – overview of content and examples, Technical Metadata – overview of content and examples, Metadata Requirements, Sources of Metadata, Metadata management – challenges, Metadata Repository, Metadata, integration and standards.

Module 5:
Data Design – Design decisions, Basics of Dimensional modeling, E-R modeling versus Dimensional modeling, The STAR schema – illustration, Dimension Table, Fact Table, Factless Fact Table, Data granularity, STAR schema keys – Primary, Surrogate, and Foreign, Advantages of the STAR schema, STAR schema examples. Overview of ETL, Requirements of ETL and steps Data extraction – identification of sources and techniques Data transformation – Basic tasks, Transformation types, Data integration and consolidation, Transformation for dimension attributes, Data loading – Techniques and processes, Data refresh versus update, Procedures for Dimension tables, Fact tables : History and incremental loads ETL Tool options.

Module 6:
Overall concept of Online Analytical Processing (OLAP), OLAP definitions and rules, OLAP characteristics Major features and functions of OLAP – General features, Dimensional analysis, Hypercubes, Drill Down and Roll Up, Slice and Dice, Rotation, Uses and Benefits Familiarity with OLAP models – Overview of variations, MOLAP, ROLAP, HOLAP, DOLAP, Database OLAP, Web OLAP. Web-enabled Data Warehouse – adapting data warehouse for the web Web- based information delivery – Browser technology for data warehouse and Security issues OLAP and Web – Enterprise OLAP, Web-OLAP approaches, and OLAP Engine design.

Module 7:
Overview of Data mining – Definition, Knowledge Discovery Process (Relationships, Patterns, Phases of the process), OLAP versus Data mining, Some aspects of Data mining – Association
rules, Outlier analysis, Predictive analytics etc), Concepts of Data mining in a Data warehouse environment, Major Data Mining techniques – Cluster Detection using R Language, Decision Trees, Memory-based Reasoning, Link Analysis, Neural, Networks, Genetic Algorithms etc, Data Mining Applications in industry – Benefits of Data mining using R Language, Discussion on applications in Customer Relationship, Management (CRM), Retail, Telecommunication, Biotechnology, Banking and Finance etc.

Module 8:
Introduction to Big Data Topics, Rise of Big Data, Compare Hadoop vs traditional systems, Limitations and Solutions of existing Data Analytics Architecture, Attributes of Big Data, Types of data, other technologies vs Big Data, Idea of using R Language.

Module-9:
Hadoop Architecture and HDFS Topics - What is Hadoop? Hadoop History, Distributing Processing System, Core Components of Hadoop, HDFS Architecture, Hadoop Master – Slave Architecture, Daemon types - Learn Name node, Data node, Secondary Name node. Hadoop Clusters and the Hadoop Ecosystem: Topics - Hadoop Cluster, Pseudo Distributed mode, Type of clusters, Hadoop Ecosystem, Pig, Hive, Oozie, Flume, SQOOP. Hadoop MapReduce Framework: Topics - Overview of MapReduce

Framework, MapReduce Architecture, Learn about Job tracker and Task tracker, Use cases of MapReduce, Anatomy of MapReduce Program.

Textbooks:
1. Data Mining Technology, Third Edition by Arun K Pujari, Universities Press, India
2. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India
3. Alex Berson, Stephen J. Smith, "Data Warehousing Data Mining & OLAP", Tata McGrow- Hill References

References Books:
1. Data Warehousing, Data Mining, & OLAP – Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill
2. Data warehouse Toolkit by Ralph Kimball, Wiley India
3. Gajendra Sharma,"Data Mining Data Warehousing and OLAP", S.K.KATARIA & SONS.
4. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World", PEARSON

TITLE OF COURSE: DATA SCIENCE WITH PYTHON
COURSE CODE: DS402
L-T-P: 3-0-2
CREDITS: 4

Pre-requisite: This course is intended for learners who have a basic knowledge of programming in any language (Java, C, C++, Pascal, Fortran, Javascript, PHP, python, etc.).

Introduction:
This course will introduce the learner to the basics of the python programming environment, including fundamental python programming techniques such as lambdas, reading and manipulating csv files, and the numpy library. The course will introduce data manipulation and cleaning techniques using the popular python pandas data science library and introduce the abstraction of the Series and DataFrame as the central data structures for data analysis, along with tutorials on how to use functions such as groupby, merge, and pivot tables effectively. By the end of this course, students will be able to take tabular data, clean it, manipulate it, and run basic inferential statistical analyses.

Course Outcomes (CO):
After Completion of this course student able to understand:
CO1: Basic process of data science
CO2: Python and Jupyter notebooks
CO3: An applied understanding of how to manipulate and analyze unsaturated datasets
CO4: Basic statistical analysis and machine learning methods
CO5: How to effectively visualize results.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓				✓				✓
CO2	✓			✓	✓				✓
CO3	✓	✓	✓						✓

	✓	✓	✓		✓				✓
CO4	✓	✓	✓		✓				✓
CO5	✓			✓				✓	✓

Course Contents:

Module 1: Data Science, Jupyter Notebook System, Python Functions, Python Types and Sequences, Python More on Strings

Module 2: Python Demonstration: Reading and Writing CSV files, Python Dates and Times, Advanced Python Objects, map (), Advanced Python Lambda and List Comprehensions, Advanced Python Demonstration: The Numerical Python Library (NumPy).

Module 3: The Series Data Structure, querying a Series, The Data Frame Data Structure, Data Frame Indexing and Loading, querying a Data Frame, Indexing Data frames, Missing Values.

Module 4: Merging Data frames, Pandas Idioms, Group by, Scales, Pivot Tables, Date Functionality.

Module 5: introduced to a variety of statistical techniques such a distributions, sampling and t-tests, Distributions, More Distributions, Hypothesis Testing in Python.

Text Books
1. Learning Python, 5th Edition by Mark Lutz, O'Reilly Media, 2013. ISBN 978-1-4493-5573-9
2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython by Wes McKinny, O'Reilly Media, 2012. ISBN 978-1-4493-1979-3

Reference Books:

1. Clean Code: A Handbook of Agile Software Craftsmanship by Robert C. Martin, Prentice Hall, 2008. ISBN 000-0-1323-5088-2
2. The Linux Command Line: A Complete Introduction by William E. Shotts, Jr., No Starch Press, 2012. ISBN 978-1-5932-7389-7

TITLE OF COURSE: INTRODUCTION TO DATA ANALYSIS
COURSE CODE: DS403
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: This course requires that you are familiar with high-school level linear algebra, and calculus. Knowledge of probability theory, statistics, and programming is desirable.

Introduction:
This course will expose you to the data analytics practices executed in the business world. We will explore such key areas as the analytical process, how data is created, stored, accessed, and how the organization works with data and creates the environment in which analytics can flourish.

Course Outcomes (CO):
After Completion of this course student able to understand:
CO1: Strong foundation in all the areas that support analytics
CO2: Basis for going deeper into advanced investigative and computational methods
CO3: Use a simple but powerful language called SQL to extract analytical data sets

CO4: Machine learning utilization in Data Analysis.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓				✓			✓	✓
CO4	✓	✓	✓		✓			✓	✓

Course Contents:

Module 1: Introduction to Data & Analysis in Real World, Thinking about Analytical Problems, Conceptual Business Models, The Information-Action Value Chain, Real World Events and Characteristics, Data Capture by Source Systems.

Module 2: Introduction - Analytical Technologies, Data Storage and Databases, Big Data & the Cloud, Virtualization, Federation, and In-Memory Computing, the Relational Database, Data Tools Landscape, the Tools of the Data Analyst.

Module 3: 1. Introduction to SQL, Aggregating and Sorting Data in SQL, Extracting Data from Multiple Tables, Stacking Data with UNION Command, Extending SQL Queries Using Operators, Using SQL Subqueries.

Module 4: Introduction to Real World Analytical Orgs, Analytical Organizations – Roles, Analytical Organizations – Structures, Data Governance, Data Privacy, Data Quality.

Module 5: Descriptive Statistics, Inferential Statistics through hypothesis tests Permutation & Randomization Test, Regression & ANOVA, and Machine Learning: Introduction and Concepts, Supervised and Unsupervised Learning Technique.

Textbooks:
1. Montgomery, Douglas C., and George C. Runger., Applied statistics and probability for engineers. John Wiley & Sons, 2010

TITLE OF COURSE: DATA VISUALIZATION
COURSE CODE: DS404
L-T-P: 3-0-0
CREDITS: 3

Pre-requisites: students should have taken a course in algorithms and data structures. While the computer graphics is not required, it is useful background. Familiarity with web technologies and javascript is also useful.

Introduction:

Visualization is increasingly important in this era where the use of data is growing in many different fields. Data visualization techniques allow people to use their perception to better understand this data. The goal of this course is to introduce students to data visualization including both the principles and

techniques. Students will learn the value of visualization, specific techniques in information visualization and scientific visualization, and how understand how to best leverage visualization methods.

Course Outcome:
CO1: Students will be able to prepare data for visualization.
CO2: Students will be able to design visualizations.
CO3: Students will be able to use web technology to create visualizations.
CO4: Understand the type of data impacts the type of visualization.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓								✓
CO2	✓		✓						✓
CO3	✓	✓	✓					✓	✓
CO4	✓			✓					✓

Course Content:
Module 1: The Computer and the Human: Overview of Visualization, 2-D Graphics, SVG-example, 2-D Drawing, 3-D Graphics, Photorealism, Non-Photorealism, The Human, Memory, Reasoning, The Human Retina, Perceiving Two Dimensions, Perceiving Perspective.
Module 2: Visualization of Numerical Data Introduction, Data, Mapping, Charts, Glyphs, Parallel Coordinates, Stacked Graphs, Tufte's Design Rules, Using Color.
Module 3: Visualization of Non-Numerical Data Introduction, Graphs and Networks, Embedding Planar Graphs, Graph Visualization, Tree Maps, Principal Component Analysis, Multidimensional Scaling, Packing.
Module 4: Introduction to Visualization Systems, the Information Visualization Mantra, Database Visualization Part, Visualization System Design

Textbooks:
1. Data Visualization: A Practical Introduction By Kieran Healy
2. Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures By Claus O. Wilke

Reference Books:
1. Data Visualization: A Handbook for Data Driven Design, By Andy Kirk
2. Effective Data Visualization: The Right Chart for the Right Data, Book by Stephanie Evergreen

TITLE OF COURSE: DATA SCIENTIST'S TOOL BOX
COURSE CODE: DS405
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Data Science and Data Visualization Basic Knowledge.
Introduction:
In this course you will get an introduction to the main tools and ideas in the data scientist's toolbox. The course gives an overview of the data, questions, and tools that data analysts and data scientists work

with. There are two components to this course. The first is a conceptual introduction to the ideas behind turning data into actionable knowledge. The second is a practical introduction to the tools that will be used in the program like version control, markdown, git, GitHub, R, and RStudio.

Course Outcome:
CO1: Set up R, R-Studio, Github and other useful tools
CO2: Understand the data, problems, and tools that data analysts use
CO3: Explain essential study design concepts
CO4: Create a Github repository.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓				✓				✓
CO2	✓	✓		✓					✓
CO3	✓		✓					✓	✓
CO4	✓				✓				✓

Course Content:
Module 1: Data Science Fundamentals: Why Automated Videos?, What is Data Science?, What is Data? Getting Help, The Data Science Process.
Module 2: R and RStudio, Installing R, Installing R Studio, RStudio Tour, R Packages, Projects in R.
Module 3: Version Control and GitHub, Version Control, Github and Git, Linking Github and R Studio, Projects under Version Control.
Module 4: R Markdown, Scientific Thinking, and Big Data, R Markdown, Types of Data Science Questions, Experimental Design, Big Data.

Text Books:
1. Data Science Mindset, Methodologies, and Misconceptions By Zacharias Voulgaris
2. Domain-Specific Languages in R, Advanced Statistical Programming By Thomas Mailund

Reference Books:

1. R programming for data science by *roger d. Peng*
2. The analytics lifecycle toolkit a practical guide for an effective analytics capability, by greg nelson

Specialization Elective Course
Cloud Computing

TITLE OF COURSE: INTRODUCTION CLOUD COMPUTING
COURSE CODE: CC301
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of Virtualization utilization in big data handling.

Introduction:

The course enables students to understand the virtualization technology, Applications along with cloud computing concepts and services.

Course Outcomes (CO):

The students will be able to know the basics of virtualization technology, hypervisors and cloud computing concepts
CO1: Understand what Cloud Computing is.
CO2: Understand what Virtualization is.
CO3: Understand Cloud Types and Cloud Service Deployment Models (IaaS*, PaaS*, SaaS*).
CO4: Learn How to Create Virtual Machines (VM) using Hypervisors (type-2).
CO5: Understand Computer Networks and IP Addressing.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓	✓				✓
CO3	✓	✓	✓		✓				✓
CO4	✓	✓	✓		✓				✓
CO5			✓					✓	✓

Course Contents:
Module-1: Overview: introduction to cloud computing, OS and Virtualization, VM, advantage of Virtualization, Virtualization and cloud and its overlapping, service driven model, advantage of cloud computing: marketing point of view, types of services, business value, business impact of cloud, technological value of cloud, end user benefits, change for provider and administrator, pros and cons of cloud model, anatomy of cloud, solution component, service catalog, user self-service portal, service request management, provisioning, optimized infrastructure, chargeback, benefit of cloud, delivery and deployment model, different cloud architecture: public, private and hybrid and its pros and cons, delivery models. Cloud transformation roadmap, history of cloud, Clint-server, cluster, grid models,

cloud vs grid and their relationship, cluster and cloud, utility computing and evolution of cloud computing, cloud computing.

Module-2: Introduction to Virtualization. Overview of Virtualization: Need of Virtualization, traditional IT Infrastructure, shortcoming of physical infrastructure, benefit of Virtualization, comparison of traditional IT infrastructure with virtualized infrastructure.

Module-3: Virtualization: Implementing Virtualization, typical hardware / software server stack and its logical equivalence, pre/post virtualization server stack ,types of virtualization, area and technology based classification, history of virtualization, time sharing system, IBM mainframe and Power virtualization, Extending Virtualization to x86 and its hardware support, impact of Virtualization: cost and manageability impact.

Module-4: Server and Storage Virtualization. Types of Server Virtualization, simulation, Hardware Assisted Virtualization, Hypervisors, Ring levels on x86 processors, types of Hypervisors, IBM Power VM Hypervisors, common consideration in server Virtualization, Desktop Virtualization: Benefits Constraints and Types. Anatomy of server Virtualization, three major layers in Xen server, storage Virtualization overview: benefit and types, features of logical layers, Host level storage Virtualization, host based mirroring, storage level Virtualization, network based storage Virtualization.

Module-5: Network and Application Virtualization. Network Virtualization overview: VPN, VLAN, challenges in using application in traditional install, use and update model, solution for challenges, Architecture, benefits of Application Virtualization.

Module-6: Cloud Implementation, Deployment and Delivery Models. Cloud Deployment models: Public, Private, Hybrid, pros and cons of each architecture, cloud deployment decision factors, Business IT Control, Business critical application, data and transaction security, compliance and audit, balance of CAPEX and OPEX, workload characteristics, workload lifespan preferences, Industry segment- SME and Large enterprises, Data Freedom, software characteristics, time to deploy, Public Cloud: factor matrix, advantage, disadvantage, Public Cloud: Factor Matrix, advantage and disadvantage, Hybrid Cloud: factor matrix, advantage, disadvantage, Overview of Cloud delivery models, infrastructure, IT Layers, IaaS Overview, features, cloud bursting, multi tenancy, resource pooling, PaaS: overview, component, example, SaaS: advantage, example.

Module-7: Case Study on Virtualization and Cloud workloads. Case study overview, customer IT landscape, function of data center, trigger for virtualization, preparation for virtualization, server selection, server sizing, server criticality, provisioning, proximity and locality, transition tool for virtualization, cost savings, cloud workload overview, workload characterization, factor s, suitable workload for cloud, private cloud solution, types of workload, advantage, mission. critical workload, mixed workload, production only workload for hybrid cloud, industry specific workload, non-suitable workload: public, private cloud, possible workload by cloud.

Text Books:

1. Introduction to Virtualization and Cloud Computing (IBM ICE Publication)

Reference Books:

 1. Distributed and Cloud Computing, By Kai Hawang , Geofrey C.Fox, Jack J. Dongarra Pub: Elservier
 2. Cloud Computing, Principal and Paradigms, Edited By Rajkumar Buyya, Jemes Broberg, A. Goscinski, Pub. - Wiley
 3. Kumar Saurabh, "Cloud Computing", Wiley Pub
 4. Krutz , Vines, "Cloud Security " , Wiley Pub
 5. Velte, "Cloud Computing- A Practical Approach", TMH Pub

TITLE OF COURSE: INTRODUCTION TO CLOUD SECURITY
COURSE CODE: CC402
L-T-P: 3-0-0
CREDITS: 3

Pre requisites:

1. Knowledge of a programming language such as Python, Java or C/C++
2. Students are expected to have broad understanding of different aspects of how computer systems work.
3. It is strongly recommended that the student have a working knowledge of computer networks.
4. The students should also feel comfortable with algorithmic concepts and modular arithmetic.

Introduction:
Information is an important strategic and operational corporate asset. These days computers and computer networks, are increasingly being used for storing and retrieving information. Some of these information may be of a sensitive nature. Consequently they need to have adequate security measures that can safeguard sensitive information. In this course, we will begin by investigating some of the security measures that can be employed to safeguard information. For the most part we will look into the theory that goes into designing these measures rather than studying security tools and techniques. This is because there are too many of those tools out there and they are changing frequently. The course examines how system designs, network protocols, and software engineering practices can result in vulnerabilities. The course explores how to better design and implement future systems in order to mitigate vulnerabilities. In addition, the course explores how to detect and mitigate vulnerabilities in existing systems

Course Outcomes (CO):
CO1: Understand the fundamental principles of access control models and techniques, authentication, and secure system design
CO2: Have a strong understanding of different cryptographic protocols and techniques and be able to use them
CO3: Apply methods for authentication, access control, intrusion detection and prevention
CO4: Identify and mitigate software security vulnerabilities in existing systems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓			✓	✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Introduction to Cloud Security. Introduction- Architectural and Technological Influences of Cloud Computing -the Cloud deployment models security concepts- Cloud Computing Roles- threats-risk modeling and security services-Proactive activity monitoring, Incident Response -Monitoring for unauthorized access, malicious traffic, abuse of system privileges, intrusion detection, events and alerts - Auditing – Record generation, Reporting and Management- Tamper-proofing audit logs - Quality of Services - Secure Management -Identity management - Security Information and Event Management.
Module-2: Access control models: Policy, Compliance and Risk Management in Cloud Computing- Discretionary and mandatory access control- Covert channels and Chinese Wall-Clark-Wilson, RBAC, ABAC.
Module-3: Introduction to cryptography, Secret key cryptosystems- Key escrow-Modular Arithmetic and Public key cryptosystems-Public key cryptosystems- Diffie-Hellman, RSA, El-Gammal- Pairing based cryptosystems, IBE and attribute-based encryption.
Module-4: Message digests, Merkle hashes, digital signatures-Identification and authentication, Passwords, Biometrics- One-time passwords and challenge response schemes, Kerberos- SSL, SSH

Module-5: Wireless Security. Wireless Security- Privacy- Cloud Compliance Assessment and Reporting - Case Study- PCI DSS 3.0 Compliant Cloud Tenant- Protecting PHI in Cloud.

Text Books:
1. Charles P. Pfleeger, "Security in Computing", Prentice Hall.
2. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall.

Reference Books:
1. William R. Cheswick and Steven M. Bellovin, "Firewalls and Internet Security: Repelling the Wily Hacker", Addison-Wesley.
2. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network Security: Private Communication in a Public World", Prentice Hall.
3. Marshall D. Adams, Sushil Jajodia and Harold J. Podell, eds., "Information Security: An Integrated Collection of Essays". IEEE Computer Society Press.
4. Edward Amoroso, "Fundamentals of Computer Security Technology", Prentice-Hall.

TITLE OF COURSE: CLOUD ADAPTATION AND MIGRATION
COURSE CODE: CC403
L-T-P: 3-0-0
CREDITS: 3

Pre requisites: For this course it's assumed that you have a working knowledge of Cloud Computing and Cloud principles.

Introduction:

In this course we will study the important terminology and familiar with cloud adaptation, cloud migrations, some of the constraints that cloud avoid cloud migration, legacy hardware and software architecture.

Course Outcomes (CO):
From this course students will be able to learn about intra cloud data adaptation and inter cloud data migration. Students will also get some sense to implement data migration techniques from this course.
CO1: Have a greater visibility of some of the key points of a Cloud Migration.
CO2: Be able to confidently assess the requirements for your migration.
CO3: Get Knowledge about data migration techniques
CO4: Understand about Intra cloud data adaptation.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓	✓	✓	✓					✓
CO3	✓	✓	✓					✓	✓
CO4	✓	✓	✓						✓

Course Contents:

Module-1(Cloud computing definition and use cases): Introduction – Component of CC – Comparing CC with Virtualization, Grids, Utility Computing, client- server model, P-to-P Computing - Key Drivers for Cloud Computing - Cloud computing Service delivery model, Cloud Types – Private, Public and Hybrid. Introduction to cloud computing &it's application. Goal of cloud adaptation and migration. Various use cases of cloud computing.

Module-2 (Adopting the cloud): Instantaneous provisioning of computing resources, tapping into an infinite storage capacity, cost-effective pay-as-you-use billing models. Handling sensitive data, aspects of cloud security, assessing governance solutions. Adoption of Public cloud by SMBs- Public Cloud Adoption phase for SMBs- Vendor liability and Management Adoption process of Public clouds by Enterprises – Managed Private clouds Migrating Application to the cloud – Impact of Shared Resources and Multi-Tenancy on cloud Applications – Phases during Migration an Application to An IaaS Cloud

Module-3: Introduction, definition, cloud adaptation architecture, adaptation techniques, decision engine architecture, adaptation in cloud resource configuration, VM- adaptation

Module-4 (Migration Framework): Re-architecting applications for the cloud, integrating the cloud with existing applications, avoiding vendor lock-in, planning the migration and selecting a vendor.

Module-5 (Migration Planning & Discovery): Identifying and mitigating risk, The 6 R's of cloud migration, asset and application discovery, licensing, data sovereignty, and governance.

Module-6 (Mobile Cloud computing): Introduction, Definition, Architecture, Benefits, challenges in mobile and at cloud shield.

Text Books
1. Cloud Migration from on-premise data center to AWS by Charista Keiko
2. Cloud Computing: Concepts, Technology & Architecture by RichardoPuttini, Thomas Erl, and Zaigham Mahmood

TITLE OF COURSE: CLOUD ARCHITECTURE & DEVELOPMENT MODEL
COURSE CODE: CC404
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of grid computing and cloud computing introduction.

Introduction:
The objective is to study the architecture and deployment models to develop a private cloud using the open standards tools such as open stack. Cloud is the future of computing. It is about outsourcing of IT services and infrastructure to make them accessible remotely via the Internet. Utilizing cloud-computing models boosts not only productivity but also provide a competitive edge to organizations. The growing popularity of cloud computing has given rise to different types of cloud service deployment models and strategies. Therefore, today there exists a variety of enterprise cloud solutions depending on the degree of desired outsourcing needs.

Course Outcomes (CO):
After successful completion of this course, the students will be able to:
CO1: Understand the architecture and deployment model of cloud computing.
CO2: Understand the architecture and components related to open stack.
CO3: Understand other open standards tools for deploying a private cloud
such as Eucalyptus.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓		✓						✓

Course Contents:

Module-1: Definition of cloud computing, Delivery Models, Conceptual reference model, Cloud Computing solution components.

Module-2: Cloud computing Architecture: The conceptual reference model, Service Deployment, Cloud service management, cloud taxonomy, IBM CC RA, Common cloud management platform.

 Case Study:IBM Smart Cloud Entry, VMware vClouddirector.

Module-3: Cloud vendor selection:SLA, Security and privacy, periodic update and maintenance, data location and Jurisdiction, Measurability, Pricing, Interoperability and lock in, Exit process, track record.

Module-4: Open Stack:Definition, Advantages, Releases, Architectural overview, Different components of Open Stack, Open stack- Hypervisors, Network Services, Storage- Block Storage, Object Storage, Choosing Storage Backends , Commodity Storage Backend Technologies: swift, Ceph, Gluster, LVM, ZFS.

Module-5: Advance concepts in Openstack: MultiserverOpenstack, Tenant model architecture, Cloud orchestration using OpenStack using OpenStack Heat and Ubuntu Juju. Eucalyptus: Introduction, Features and Functionality, Architecture, Basic and Advanced Components. Eucalyptus vs Openstack. OpenNebula: Introduction, Features and Functionality, Architecture, Basic and Advanced Components. OpenNebula vs Openstack

Text Books:
1. Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski (2011), Cloud Computing: Principles and paradigms.
2. Rittinghouse, John, W, Cloud computing: Implementation, management and security

 Reference Book:
1. Barrie Sosinsky (2011), Cloud Computing Bible, Wiley.
2. Bumgardner, V. C. (2016). OpenStack in action. Manning Publications Company.

TITLE OF COURSE: AWS FUNDAMENTAL
COURSE CODE: CC405
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts of how the AWS cloud infrastructure is built, walk you through Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Lightsail compute services.

Introduction:

This course gives current or aspiring IT professionals an overview of the features, benefits, and capabilities of Amazon Web Services (AWS). As you proceed through these Module interconnected courses, you will gain a more vivid understanding of core AWS services, key AWS security concepts, strategies for migrating from on-premises to AWS, and basics of building serverless applications with AWS.

Course Outcomes (CO):

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

CO1: Understand the core AWS services

CO2: Understand the key AWS security concepts

CO3: Understand the strategies for migrating from on-premises to AWS.

CO4: Understand basics building serverless applications with AWS.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓				✓
CO2	✓	✓		✓				✓	✓
CO3	✓	✓						✓	✓
CO4	✓	✓	✓						✓

Course Contents:

Module-1: Aws Fundamentals: Going Cloud-Native, Introduced To The Course And Learn About Aws Services, Infrastructure, And Compute Services, Networking And Storage On Aws, Databases On Aws, Monitoring And Scaling.

Module-2: AWS Fundamentals: Addressing Security Risk, basic concepts such as "least privilege" and the "Shared Responsibility Model, network isolation and endpoint security, Detective controls such as Amazon Cloud Trail as well as AWS Security Hub, Amazon Guard Duty and AWS Config, encryption of data at rest, in motion, store data within and between various AWS services, Amazon EC2 and AWS Lambda, AWS Well-Architected Framework.

Module-3: AWS Fundamentals: Migrating to the Cloud, Defining what we mean by Migration, Migration Preparation and Business Planning, Portfolio Discovery and Planning ,Design, Migration and Application Validation ,Operate, Cloud Adoption Framework - Hybrid Environments, Scaling Considerations, High Availability, Considerations with Migrating DB vs Applications, AWS Server Migration Services, VM Import and VM on AWS (Server Migration Service),Introduce AWS Migration Hub, AWS Application Discovery Service, Amazon EFS, Amazon EBS, & Amazon S3,

Module-4: Storage - AWS Snowball & AWS Snowmobile, AWS Storage Gateway Now with AWS DataSync, Storage - AWS DMS Overview, Storage - AWS DMS Core Features, Storage Schema Conversion ,Storage - Amazon Aurora (Serverless), AWS Direct Connect & Amazon Route 53, Automation - AWS API Centricity, AWS System Manager & AWS Cloud Formation, Overview and TSO Logic, Migration Tools - Cloud Endure.

Module-5: AWS Fundamentals: Building Server less Applications, Amazon Lex, Amazon Lex Walkthrough, Introduction to Amazon Cloud Front, AWS Identity Access Management (IAM), And Introduction to Server less Computing with AWS Lambda

Text Books:

1. Amazon web services in action, written by andreas witting and michael wittig

2. Mastering AWS Development, written by Uchit Vyas

Reference Books:
1. Implementing cloud design patterns for aws, written by marcus young.
2. Aws administration – the definitive guide, written by yohan wadia.

Specialization Elective Course:
Blockchain Technolgy

TITLE OF COURSE: BLOCKCHAIN BASICS
COURSE CODE: BC301
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in networking.
Introduction:
This course describe basic blockchain technology in networking system. The Topics to be covered (tentatively) include: an introduction to blockchain, Crypto asset or Digital asset, Ethereum Blockchain, Bitcoin & Blockchain, Decentralized Systems and Ethereum Blockchain.

Course Outcomes (CO):
In this course we will study the basic components of blockchain. Students are expected to be capable of understanding the cryptocurrency, their advantages and drawbacks, how to implement them in blockchain, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any blockchain properly.
CO2: Students would be able to implement any problem by writing their own algorithm in blockchain.
CO3: By analyzing, students would be able to implement public private key combination in security.
CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓				✓	✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Basic introduction about blockchain in digital world, Crypto asset or Digital asset, Self Sovereign Identity, Smart Contract, Decentralized Business Model, Device to device communication in blockchain
Module-2: Network Security, Different type of network attack, Warm hole attack, byzantine attack, network based attack etc, Trust based Secure routing schemes.
Module-3: Bitcoin & Blockchain : Blockchain Structure, Basic Operations, Beyond Bitcoin, Gas , minor's role in blockchain.
Module-4: Ethereum Blockchain : Smart Contracts, Ethereum Structure, Ethereum Operations, Incentive Model in blockchain.
Module-5: Cryptography and cryptocurrency : Algorithms & Techniques Public-Key Cryptography,

Public key and private key combinations in Blockchain security, Hashing, Transaction Integrity, Securing Blockchain.

Module-6: Decentralized Systems : Consensus Protocol, Practitioner's Perspective Decentralized Governance, Robustness, Forks.

Text Books

1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects, by Elad Elrom, ISBN-13: 978-1484248461, ISBN-10: 1484248465

References

1. Blockchain Technology Explained: The Ultimate Beginner's Guide about Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA and Smart Contracts, by Alan T. Norman

TITLE OF COURSE: BLOCKCHAIN COMPONENT & ARCHITECTURE
COURSE CODE: BC402
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in blockchain and networking.

Introduction:

This course described implementation and architecture of blockchain. The Topics to be covered (tentatively) include: an introduction to Blockchain history, Digital Money, Hash, Signature, Blockchains design goals, Blockchain for Government: Digital identity and records.

Course Outcomes (CO):

In this course we will study the basic components of blockchain in digital asset. Students are expected to be capable of understanding the blockchain architecture, their advantages and drawbacks, how to implement them in network, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to design & implement blockchain as a digital asset properly.

CO2: Students would be able to implement different security algorithm in blockchain.

CO3: By analyzing the logic of any algorithm, students would be able to implement Blockchain in Financial Software and Systems.

CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Module-1: Introduction to Blockchain history: Digital Money to Distributed Ledgers Design Primitives: Protocols, Security, Consensus, Permissions, Privacy

Module-2: Blockchain Architecture and Design. Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms

Module-3: Consensus, Requirements for the consensus protocols, Proof of Work (PoW) Scalability aspects of Blockchain consensus protocols

Module-4: Permissioned Blockchains, Design goals, Consensus protocols for Permissioned Blockchains Hyperledger, Decomposing the consensus process Hyperledger fabric components Chaincode Design and Implementation Hyperledger Fabric beyond Chain code fabric SDK and Front End, Hyperledger composer tool

Module-5: Blockchain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance

Use case II: Blockchain in trade supply chain: Provenance of goods, visibility, tradesupply chain finance, invoice management discounting, etc

Module-6: Blockchain for Government: Digital identity, and records and other kinds of record keeping between government entities, public distribution system social welfare systems

Module-7: Blockchain Cryptography Privacy and Security on Blockchain, Blockchain consensus protocols, various recent works on scalability

Module-8: Secure cryptographic protocols on Blockchain Secured, Multi-party Computation, Blockchain, for science: making better use of the data-mining network, Case Studies:
Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more

Text Books
1. Blockchain Technology Explained, by Alan T. Norman

References
1. Blockchain: Ultimate guide to understanding blockchain, bitcoin, cryptocurrencies, smart contracts and the future of money.
2. The Bitcoin Standard: The Decentralized Alternative to Central Banking by Saifedean Ammous

TITLE OF COURSE: TRANSACTION ON BLOCK CHAIN
COURSE CODE: BC403
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in block chain technology.
Introduction:
This course examines basic block chain. The Topics to be covered (tentatively) include: an introduction to Cryptoassets, Smart Contracts, Digital Signatures, and Financial Services etc.

Course Outcomes (CO):
In this course we will study the basic components of crypto asset and transaction of blockchain. Students are expected to be capable of understanding the smart contract, their advantages and drawbacks, how to implement them in blockchain, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement any transaction at blockchain properly.
CO2: Students would be able to implement any problem by writing their own business idea.
CO3: By analyzing the logic of transaction, students would be able to write efficient business proposal in blockchain.
CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Crypto assets, Crypto currencies, Protocol Tokens, Utility Tokens (App Coins),Security Tokens, Natural Asset & Commodity Tokens, Crypto-collectibles, Crypto-fiat Currencies and Stable coins, Practitioner Perspective – Tokenomics, Practitioner Perspective - Cristina Dolan: Crypto assets, Initial Coin Offerings: A New Breed of Meta-Asset, Practitioner Perspective - Rolf Hoefer: ICOs, Recap of Crypto assets Protocol Tokens, Utility Tokens (App Coins), Security Tokens, Natural Asset & Commodity Tokens.
Module-2: Smart Contracts, Practitioner Perspective - Rolf Hoefer: Smart Contracts, Smart Contract Phases, Smart vs. Traditional Contracts, Smart Contracts and Law, Practitioner Perspective - Smart Contracts, Smart Contract Application Areas, Practitioner Perspective - Rob Carter: Smart Contracts, Smart Contract Strategies & Best Practices for the Organization, Smart vs. Traditional Contracts, Smart Contract Application Areas
Module-3: Identity, Introduction to Identity and Identifiers, Five Problems With Identifiers, Distributed, Self-sovereign Identity Systems, Practitioner Perspective - Carlos Augier: Identity,
Blockchain Identity Applications, Practitioner Perspective - Stephen Tse & Li Jiang: Personal Data, Managing Health Data on a Blockchain, Polyalphabetic Ciphers, Symmetric Digital Signatures, RSA, ECC, ECDS
Module-4: Rethinking Finance, Six Inefficiencies in Financial Services, The Golden Eight Part, The Golden Eight Part, Problems With Modern Accounting, The World Wide Ledger, Rethinking Financial Services, The Golden Eight, New Frameworks for Accounting, The Golden Eight

Text Books
1. A Practical Guide to Blockchain and its applications by Parikshit Jain, Publisher: Bloomsbury India

References
1. Blockchain Enabled Applications: Understand the Blockchain Ecosystem and How to Make it Work for You, by Vikram Dhillon & David Metcalf & Max Hooper

TITLE OF COURSE: BLOCK CHAIN OPPORTUNITY ANALYSIS
COURSE CODE: BC404
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in blockchain.
Introduction:
This course examines Blockchain Transformations for Every Industry. The Topics to be covered (tentatively) include: Industry Transformations, Introduction to the Blockchain Case Commons, Problem Solving with Blockchain, Decision Matrix, Statement of Benefit.

Course Outcomes (CO):

In this course we will study the business are of blockchain. Students are expected to be capable of understanding the implementation blockchain in industry, their advantages and drawbacks, how to implement them in network, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to analyses opportModuley in blockchain properly.

CO2: Students would be able to implement any problem by writing their own business idea.

CO3: By analyzing the logic of transaction, students would be able to write efficient business proposal in blockchain.

CO4: To become an efficient blockchain administrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:

Module-1: Blockchain Transformations for Every Industry, Practitioner Perspective: Rob Carter, CIO at FedEx, How to Use the Blockchain Case Commons, Decentralizing the Enterprise, Blockchain & ConsenSys, Transaction Costs and the Structure of the Firm, OpportModuley Search, OpportModuley Contracting, OpportModuley Coordination, OpportModuley, Building Trust, Determining Corporate Boundaries, Hacking Your Future: Boundary Decisions, Decentralizing the Enterprise, Transaction Costs and the Structure of the Firm

Module-2: Industry Transformations, Introduction to the Blockchain Case Commons, Exploratory Market Research, Conducting Preliminary Market Research, How to Perform a Competitive Analysis, Intellectual Property, Payments, Attribution, and Licensing, Distributed Ownership

Module-3: APAC Business Development & Strategic Relations, Use a Decision Matrix, Problems That Blockchain Can and Cannot Solve, Blockchain OpportModuley Brainstorm, Problem Solving With Blockchain, Decision Matrix, Statement of Benefit,

Module-4: Keyless Technologies, Strategic Positioning of Your Organization, Regulatory Principles, Regulation, Regulation vs. Governance, Regulation & Governance, The Blockchain Stack, Multiple Layers of Blockchain Governance, A New Framework for Blockchain Governance, Practitioner Perspective - Rob Carter: Governance, Profile of a Blockchain Hotbed

Text Books

1. Blockchain: Blueprint for a New Economy Kindle Edition, by Melanie Swan

References

1. The Internet of Money Kindle Edition, by Andreas M. Antonopoulos
2. Bitcoin Billionaires: A True Story of Genius, Betrayal, and Redemption, by Ben Mezrich

TITLE OF COURSE: BIT COIN AND CRYPTO CURRENCY
COURSE CODE: BC405
L-T-P: 3-0-0

CREDITS: 3

Pre-requisite: Basic concepts in blockchain architecture.

Introduction:
This course examines bit coin as a crypto currency. The Topics to be covered (tentatively) include: an introduction to crypto currency, Hash Functions, Hash Pointers, Bitcoin Transactions, Bitcoin Scripts, Applications, payment service in bit coin.

Course Outcomes (CO):
In this course we will study the bit coin as a crypto currency. Students are expected to be capable of understanding the crypto currency, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement bit coin as a crypto currency properly.
CO2: Students would be able to implement Ethereum under the hood.
CO3: By analyzing the logic of any hash function, students would be able to implement crypto asset.
CO4: To become an efficient blockchain developer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency, Transacting in Bitcoin, Why Cryptocurrency.
Module-2: Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity, the Block Chain, Incentives and Proof of Work, Putting It All Together, The Digital Signature, A Tamper Proof Ledger, Examples, Distributed Consensus, Proof of Work, Mining and Currency Supply.
Module-3: Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network, Limitations & Improvements, Cryptocurrency as an Asset Class, Risk and Return to Cryptocurrency, Review of Portfolio Theory, Asset Allocation with Cryptocurrency, Mining, Crypto Classifications, The Crypto Vision, Ethereum Overview, Ethereum Under the Hood, The DAO, Private Blockchains.
Module-4: How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets, Building the Blockchain, Crypto Finance, Business Use Cases, Blockchain in Gaming, Investing in Blockchain, Government and Regulation, Media and Advocacy1m, Creating the New Frontier of FinTech.

Text Books
1. Bitcoin and Cryptocurrency Technologies, by Arvind Narayanan, Joseph Bonneau, Edward Felten

References
1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects, by Elad Elrom, ISBN-13: 978-1484248461, ISBN-10:

1484248465

Specialization Elective Course:
Artificial Intelligence & Machine Learning

TITLE OF COURSE: INTRODUCTION TO ARTIFICIAL INTELLIGENCE
COURSE CODE: AIML301
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Knowledge is also assumed of basic concepts on Mathematics, Strong experience of programming languages, writing algorithm for finding patterns and learning.

Introduction:
In this course we will study the basic components of an intelligent system, their functions, mechanisms, policies and techniques used in their implementation and examples.

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: To have developed an understanding of artificial intelligence and knowledge representation.
CO2: To acquire concepts regarding search techniques.
CO3: To acquire concepts related to machine learning and its types.
CO4: Students would be able to solve problems related to supervised and unsupervised learning.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓			✓					✓
CO3	✓	✓	✓					✓	✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1 (Introduction to AI): Definitions, Goals of AI, AI Approaches, AI Techniques, Branches of AI, Applications of AI. Introduction of Intelligent Systems: Agents and Environments, Good Behavior: the concept of Rationality, The Nature of Environments, The structure of Agents, How the components of agent programs work.
Module-2 (Problems Solving, Search and Control Strategies)
Solving Problems by Searching, Study and analysis of various searching algorithms. Implementation of Depth-first search, Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bi-directional search Informed (Heuristic) Search Strategies: Greedy best-first search A* search: Minimizing the total estimated solution cost, Conditions for optimality: Admissibility and

consistency, Optimality of A*, Memory-bounded heuristic search, Heuristic Functions, Generating admissible heuristics from sub problems: Pattern databases, Learning heuristics from experience. Beyond Classical Search: Local Search Algorithms and Optimization Problems: Hillclimbing search Simulated annealing, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Searching with Non-deterministic Actions: AND-OR search trees, Searching with Partial Observations. Adversarial Search and Constraint Satisfaction Problems, Study of min-max algorithm Adversarial Search: Games, Optimal Decisions in Games, The mini-max algorithm, Optimal decisions in multiplayer games, Alpha--Beta Pruning, Move ordering , Imperfect Real-Time Decisions, Evaluation functions, Cutting off search, Forward pruning, Search versus lookup, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Variations on the CSP formalism, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, Alpha-beta pruning and CSP, Implementation aspects of minimax algorithm and CSP.

Module- 3 (Knowledge Representations Issues, Predicate Logic, Rules)

Knowledge representation, KR using predicate logic, KR using rules. Reasoning System - Symbolic, Statistical: Reasoning, Symbolic reasoning, Statistical reasoning.

Module-4 (Quantifying Uncertainty, Learning Systems)

Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees. Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, inducing decision trees from examples.

Module-5 (Expert Systems)

Introduction, Knowledge acquisition, Knowledge base, working memory, Inference engine, Expert system shells, Explanation, Application of expert systems. Fundamentals of Neural Networks: Introduction and research history, Model of artificial neuron, Characteristics of neural networks, learning methods in neural networks, Single layer neural network system, Applications of neural networks. Fundamentals of Genetic Algorithms: Introduction, Encoding, Operators of genetic algorithm, Basic genetic algorithm.

Text Books
1. Rich, Elaine Knight, Kevin, Artificial Intelligence, Tata McGraw Hill.
2. Luger, George F, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education.

References
1. Nilsson, Nils J, Artificial Intelligence, Morgan Kaufmann.
2. Russell, Stuart J. Norvig, Peter, AI: A Modern Approach, Pearson Education.

TITLE OF COURSE: MACHINE LEARNING TECHNIQUES
COURSE CODE: AIML402
L-T-P: 3-0-0
CREDITS: 3

Pre-Requisites: Fundamental knowledge of computer science principles and skills, probability and statistics theory, and the theory and application of linear algebra are required.

Introduction:

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention.

Course Outcomes (CO): By the end of the course, students should be able to
- Develop an appreciation for what is involved in learning models from data.
- Understand a wide variety of learning algorithms.
- Understand how to evaluate models generated from data.
- Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

CO1: Differentiate various Learning Approaches, and to interpret the Concepts of Supervised Learning.
CO2: Compare the different dimensionality reduction techniques.
CO3: Apply theoretical foundations of Decision Trees to identify best split and Bayesian Classifier to Label data points.
CO4: Illustrate the working of classifier models Like SVM, Neural Networks and Deep Neural Networks Classifier Model for typical Machine Learning Applications.
CO5: Illustrate and apply clustering algorithms and identify Its applicability in real life problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓	✓					✓
CO3	✓	✓	✓	✓		✓			✓
CO4	✓	✓	✓	✓					✓
CO5	✓	✓	✓	✓					

Course Contents:
Module-1: Introductions, Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation
Module-2: Linear regression, Decision trees, overfitting
Module-3: Instance based learning, Feature reduction, Collaborative filtering based recommendation, Probability and Bayes learning
Module-4: Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM
Module-5: Neural network, Perceptron, multilayer network, backpropagation, introduction to deep neural network
Module-6: Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning

Text Books
1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin
References
1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press.

TITLE OF COURSE: COMPUTER VISION
COURSE CODE: AIML403
L-T-P: 3-0-0
CREDITS: 3
Pre-Requisites: No prior experience with computer vision is assumed, although previous knowledge of visual computing or signal processing will be helpful. The following skills are necessary for this class: Data structures, Programming concept

Introduction:
This course provides an introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. We'll develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. The focus of the course is to develop the intuitions and mathematics of the methods in lecture, and then to learn about the difference between theory and practice in the projects.

Course Outcomes (CO):
Computer Vision focuses on development of algorithms and techniques to analyze and interpret the visible world around us. This requires understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc. Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision. Applications range from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.
CO1: Appreciate the detailed models of image formation.
CO2: Analyze the techniques for image feature detection and segmentation
CO3: Apply various algorithms for pattern recognition
CO4: Examine various clustering algorithms analysis
CO5: Analyze structural pattern recognition and feature extraction techniques

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓							✓
CO2	✓								✓
CO3		✓	✓	✓					✓
CO4	✓	✓							✓
CO5				✓					✓

Course Contents:
Module-1: Digital Image Formation and low-level processing

Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Module-2: Depth estimation and Multi-camera views

Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. apparel

Module-3: Feature Extraction

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Module-4:Image Segmentation

Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Module-5: Pattern Analysis

Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Module-6: Motion Analysis

Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Module-7: Shape from X

Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Text Books

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

References

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

TITLE OF COURSE: APPLICATION OF MACHINE LEARNING IN INDUSTRIES
COURSE CODE: AIML404
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite:
Basic concept of Artificial Intelligence, Machine Learning

Introduction:
Machine learning (ML) is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical

model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task

Course Outcomes (CO):

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

CO1: Differentiate various Learning Approaches, and to interpret the Concepts of Supervised Learning.

CO2: Compare the different dimensionality reduction techniques.

CO3: Apply theoretical foundations of Decision Trees to identify best split and Bayesian Classifier to Label data points.

CO4: Illustrate the working of classifier models Like SVM, Neural Networks and Deep Neural Networks Classifier Model for typical Machine Learning Applications.

CO5: Illustrate and apply clustering algorithms and identify Its applicability in real life problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓	✓					✓
CO3	✓	✓	✓	✓		✓			✓
CO4	✓	✓	✓	✓					✓
CO5	✓	✓	✓	✓					

Course Contents:

Module-1(Overview of Machine Learning): Process and Techniques, Demonstration of ML concepts with Deep Playground, Data Input and Preprocessing with Tensorflow, Machine Learning Model Building, Prediction with Tensorflow, Monitoring and evaluating models using Tensorboard

Module-2 (Education and training): tutoring systems and personalized learning, how they works

Module-3 (Health and medicine): learning treatment policies in the medical sciences, optimal treatment policies, usage of medical equipment, medication dosing, and two-stage clinical trials

Module-4 (Text, speech, and dialog systems): Different procedure of text, speech processing, How chatbot works etc.

Module-5 (Finance): Machine Learning Examples in Finance for Fraud Detection

Module-6 (Retail): Machine Learning Examples in Retail for Product Recommendations, Improved Customer Service; practically how it is done

Module-7 (Image Classification): How Image Recognition and Classification Works, Different procedure, practical example.

Module-8 (miscellaneous): More applications of Machine Learning (like Travel for Dynamic Pricing)

Text Books

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin

References

1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press.

TITLE OF COURSE: RECOMMENDED SYSTEM
COURSE CODE: AIML405
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basics of Data Structures and Algorithm, Design and Analysis of Algorithm

Introduction:
Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system

Course Outcomes (CO):
To develop state-of-the-art recommender systems that
CO1: automate a variety of choice-making strategies
CO2: goal of providing affordable, personal, and high-quality recommendations

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					✓
CO2	✓	✓	✓	✓					✓

Course Contents:
Module 1:
Neighborhood-Based Collaborative Filtering - Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood-Based Methods, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods, A Regression Modeling View of Neighborhood Methods, Graph Models for Neighborhood-Based Methods.
Model-Based Collaborative Filtering - Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering, Using an Arbitrary Classification Model as a Black-Box, Latent Factor Models, Integrating Factorization and Neighborhood Models.
Module 2:
Content-Based Recommender Systems - Basic Components, Preprocessing and Feature Extraction, Feature Representation and Cleaning, Collecting User Likes and Dislikes, Supervised Feature Selection and Weighting, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations. Knowledge-Based Recommender Systems - Constraint-Based Recommender Systems, Case-Based Recommenders, Persistent Personalization in Knowledge-Based Systems.
Module 3:
Ensemble-Based and Hybrid Recommender Systems - Ensemble Methods from the Classification Perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Augmentation Hybrids, Feature Combination Hybrids, Mixed hybrids. Evaluating Recommender Systems - Evaluation Paradigms, General Goals, Design Issues, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures. Context-Sensitive Recommender Systems - The Multidimensional Approach, Contextual Pre-filtering: A Reduction-Based Approach, Post-Filtering Methods, Contextual Modelling.
Module 4:
Time- and Location-Sensitive Recommender Systems-Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, Structural Recommendations in Networks - Ranking Algorithms, Recommendations by Collective Classification, Recommending Friends: Link Prediction, Social Influence Analysis and Viral Marketing.Social and Trust-Centric Recommender Systems - Multidimensional Models for Social Context, Network-Centric and Trust-Centric Methods, User Interaction in Social Recommenders.
Module 5:

Attack-Resistant Recommender Systems - Understanding the Trade-Offs in Attack Models, Types of Attacks, Detecting Attacks on Recommender Systems, Strategies for Robust Recommender Design.Learning to Rank, Multi-Armed Bandit Algorithms, Group Recommender Systems, Multi-Criteria Recommender Systems, Active Learning in Recommender Systems, Privacy in Recommender Systems, Some Interesting Application Domains

Text Books
1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st Ed.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.

References
1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

TITLE OF COURSE: HUMAN COMPUTER INTERACTION
COURSE CODE: AIML406
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic subjects of CSE like Basic Data structures, Algorithms, FLAT, Software Engg, Operating Systems, Databases, OS, Computer Architecture

Introduction:
Human-computer interaction is an emerging field of study at present, due to the proliferation of large number of consumer electronic products. The key issue in this field is to make the products usable to lay-persons. In order to do that, we need to take care of the (creative) design aspects (the look-and-feel of the interface) and also the system design aspect (both software and hardware). The field is interdisciplinary with inputs required from various other fields. However, the computer science and engineering plays the central role in the design of such systems

Course Outcomes (CO):
After completion of the course, student will
CO1: understand the engineering life cycles for design of interactive systems,
CO2: understand the computational design framework (as part of the life cycle),
CO3: understand the components of the framework including the computational models of users and systems, and evaluation of such systems (with or without users)

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓						✓
CO2	✓	✓		✓					✓
CO3	✓		✓						✓

Course Contents:
Module 1: Introduction to user-centric design, historical evolution, issues and challenges and current trend, Components of HCI Types of interfaces Design process

Module 2: Engineering user-centric systems – relation with software engineering, iterative life-cycle, prototyping, guidelines, Contextual inquiry Importance of users / talking to users Task analysis

Module 3: Sketching Low & hi fidelity prototyping, mental models, Usability evaluation think aloud, observing users Modelling users, expert evaluations

Module 4: Information visualization, Empirical research – research question formulation, experiment design, data analysis, statistical significance test

Module 5: HCI & mobility New faces of HCI, Refresher for all modules seen in the course, User-centric design evaluation – overview of evaluation techniques, expert evaluation, user evaluation, model-based evaluation with case studies

Text Books

1. Samit Bhattacharya (July, 2019). Human-Computer Interaction: User-Centric Computing for Design, McGraw-Hill India, Print Edition: ISBN-13: 978-93-5316-804-9; ISBN-10: 93-5316-804-X, E-book Edition: ISBN-13: 978-93-5316-805-6; ISBN-10: 93-5316-805-8
2. Alan Dix, Janet E. Finlay, Gregory D. Abowd and Russel Beale. (2003). Human-Computer Interaction (3rd Edition), Pearson.

References

5. Ben Shneiderman, Catherine Plaisant, Maxine Cohen and Steven Jacobs. (2009). Designing the User Interfaces: Strategies for Effective Human-Computer Interaction (5th Edison), Pearson

Specialization Elective Course:
Cyber Forensics & Internet Security

TITLE OF COURSE: INTRODUCTION TO CRYPTOGRAPHY
COURSE CODE: IS301
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Networking and security.

Introduction:
This course examines data security in networking. The Topics to be covered (tentatively) include: an introduction to networking by cryptography, Basic symmetric-key encryption, Message integrity, Public key cryptography, Public key cryptography, Protocols.

Course Outcomes (CO):
In this course we will study the basic components of cryptography. Students are expected to be capable of understanding the cryptography, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to design & implement basic concept of cryptography properly.
CO2: Students would be able to implement any problem by writing their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to implement crypto-data set.
CO4: To become an efficient crypto-data programmer.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Basics overview of cryptography, Data security in networking, using cryptography in real world.
Module-2: Basic symmetric-key encryption, One time pad and stream ciphers, perfect secrecy and the one time pad, semantic security and stream ciphers, Block ciphers: Feistel networks and iterated Even-Mansour ciphers
Module-3: Message integrity: definition and applications, Collision resistant hashing, Merkle-Damgard and Davies-Meyer. MACs from collision resistance. Authenticated encryption: security against active attacks.
Module-4: Public key cryptography: Arithmetic modulo primes, Cryptography using arithmetic modulo primes, vanilla key exchange (Diffie-Hellman); the CDH and discrete-log assumptions, Public key

encryption, semantically secure ElGamal encryption, CCA security, RSA and Rabin functions. Encrypt with trapdoor permutations.

Module-5: Digital signatures: definitions and applications. How to sign using RSA. Hash based signatures, certificates, certificate transparency, certificate revocation.

Module-6: Protocols: Identification protocols, Password protocols, salts; one time passwords (S/Key and SecurID), challenge response authentication, Authenticated key exchange and SSL/TLS session setup, Zero knowledge protocols, Cryptography in the age of quantum computers, Grover's algorithm and symmetric crypto, Shor's algorithm and public key crypto, post-quantum crypto: signatures and key exchange

Text Books

1. "Cryptography Kindle Edition" by WAGmob WAGmob; 1.0 edition (2 August 2013)

2. "Serious Cryptography: A Practical Introduction to Modern Encryption" Kindle Edition Jean-Philippe Aumasson

References

1. "The Handbook of Applied Cryptography" by Menezes, van Oorschot, and Vanstone

TITLE OF COURSE: INTRODUCTION TO CYBER SECURITY
COURSE CODE: IS402
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Information and Network Security.

Introduction:
This course examines cyber security. The Topics to be covered (tentatively) include: an introduction to cyber security, type of attack in network, Public Key infrastructure, Password Cracking, E-commerce Security, Server Management and Firewalls.

Course Outcomes (CO):
In this course we will study the basic idea about cyber security. Students are expected to be capable of understanding the cyber-attack, their advantages and drawbacks, how to prevent them, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to know cyber security properly.
CO2: Students would be able to implement digital signature in digital world.
CO3: By analyzing the logic of any networking algorithm, students would be able to implement algo.
CO4: To become an efficient in network security administrator.
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Basics of Communication Systems, Transmission Media, Topology and Types of Networks, TCP/IP Protocol Stacks, Wireless Networks, Information Security Overview: Background and Current Scenario, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography
Module-2: Security Threats and Vulnerabilities, Overview of Security threats, Weak / Strong Passwords and Password Cracking, Insecure Network connections, Malicious Code, Programming Bugs, Cybercrime and Cyber terrorism, Information Warfare and Surveillance.
Module-3: Introduction to Cryptography or Encryption, Digital Signatures, Public Key infrastructure, Applications of Cryptography, Tools and techniques of Cryptography.
Module-4: Security Management, Overview of Security Management, Information Classification Process, Security Policy, Risk Management, Security Procedures and Guidelines, Business Continuity and Disaster Recovery, Ethics and Best Practices.
Module-5: Web Application Tools: Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra.
Module-6: Security Laws and Standards, Security Assurance, Security Laws, IPR, International Standards, Security Audit, SSE-CMM / COBIT etc
Module-7: Introduction to Cyber Crime and law: Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Comp. as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.
Module-8: Server Management and Firewalls, User Management, Overview of Firewalls, Types of Firewalls, DMZ and firewall features, Security for VPN and Next Generation Technologies
VPN Security, Security in Multimedia Networks, Various Computing Platforms: HPC, Cluster and Computing Grids, Virtualization and Cloud Technology and Security
Module-9: System and Application Security, Security Architectures and Models, Designing Secure Operating Systems, Controls to enforce security services, Information Security Models, System Security, Desktop Security, email security: PGP and SMIME, Web Security: web authentication, SSL and SET, Database Security, OS Security Vulnerabilities, updates and patches, OS integrity checks, Anti-virus software, Configuring the OS for security, OS Security Vulnerabilities, updates and patches, Wireless Networks and Security, Components of wireless networks, Security issues in wireless

Text Books
1. Applied Cryptography, Bruce Schneier, 2nd Edition, Wiley & Sons, 1996
2. Firewalls and Internet Security, Repelling the Wily Hacker, William R. Cheswick, and Steven M. Bellovin, Addison-Wesley, 1994

References
1. Handbook of Digital Forensics and Investigations, Eoghan Casey ed., Elsevier Academic Press, ISBN 13: 978-0-12-374267-4
2. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
3. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and S Module Belpure, Publication Wiley.

TITLE OF COURSE: DIGITAL FORENSICS
COURSE CODE: IS403
L-T-P: 3-0-0

CREDITS: 3

Pre-requisite: Basic concepts in network security.

Introduction:
This course examines Computer Forensics. The Topics to be covered (tentatively) include: an introduction to Computer Forensics with basic concepts such as Network Investigations, Malware, Windows Artifacts, Forensic ToolKit, WinHex etc, hidden data, Encryption/Decryption, Steganography.

Course Outcomes (CO):
In this course we will study the basic components of Computer Forensics. Students are expected to be capable of understanding the digital footprint, their advantages and drawbacks, how to implement them in proper security, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to understand hidden data, Encryption/Decryption, Steganography.
CO2: Students would be able to investigative situations and digital crime scene.
CO3: By analyzing the logic use Computer Forensics Tools.
CO4: To become an efficient network admistrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Introduction to Computer Forensics: computer crimes, evidence, extraction, preservation, etc.
Module-2: Overview of hardware and operating systems: structure of storage media/devices; windows/Macintosh/Linux -- registry, boot process, file systems, file metadata.
Module-3: Data recovery: identifying hidden data, Encryption/Decryption, Steganography, recovering deleted files.
Module-4: Digital evidence controls: uncovering attacks that evade detection by Event Viewer, Task Manager, and other Windows GUI tools, data acquisition, disk imaging, recovering swap files, temporary &cache files,
Module-5: forensic, audit/investigative situations and digital crime scene, Criminal Law and Forensics, Network Investigations, Malware, Windows Artifacts, Various (in the past: cell phone forensics; how spinning platter magnetic hard drives work; how flash storage works; how to be an expert witness) investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law.
Module-6: Computer Forensic tools: Evaluating Computer Forensics Tool Needs, Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools, Tool Comparisons, Other Considerations for Tools, Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools, Computer Forensics Hardware Tools,
Forensic Workstations, Using a Write-Blocker. Encase, Helix, FTK, Autopsy, Sleuth kit Forensic Browser, FIRE, Found stone Forensic ToolKit, WinHex, Linux dd and other open source tools.

Module-7: Network Forensic: Collecting and analyzing network-based evidence, reconstructing web browsing, email activity, and windows registry changes, intrusion detection, tracking offenders, etc. Mobile Network Forensic: Introduction, Mobile Network Technology, Investigations, Collecting Evidence, Where to seek Digital Data for further Investigations, Interpretation of Digital Evidence on Mobile Network.

Module-8: Software Reverse Engineering: defend against software targets for viruses, worms and other malware, improving third-party software library, identifying hostile codes-buffer overflow, provision of unexpected inputs, Data Representation, Carving Data etc.

Module-9: Computer crime and Legal issues: Intellectual property, privacy issues, Criminal Justice system for extraction, preservation, and deposition of legal evidence in a court of law.

Text Books
1. "DIGITAL FORENSICS", by Dr.Jeetendra Pande and Dr. Ajay Prasad, Published by: Uttarakhand Open University, Haldwani.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", Fourth Edition, Course Technology. 3. Angus M.Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008.

References
1. Digital Forensics by André Årnes, JOHN WILEY publisher JOHN WILEY, July 2017
2. Computer Forensics: Investigating Network Intrusions and Cyber Crime, EC-Council | Press
3. Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, Syngress imprint of Elsevier.

TITLE OF COURSE: CYBER LAWS & IPR
COURSE CODE: IS404
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Cyber law.

Introduction:
This course examines cyber law & IPR. The Topics to be covered (tentatively) include: an introduction to cyber law, Copyright Protection, Reproducing, Defenses, Ownership and Enforcement of Intellectual Property, Digital Contracts, Digital signature.

Course Outcomes (CO):
In this course we will study the basic components of cyber law & IPR. Students are expected to be capable of understanding the cyber law, their advantages and drawbacks, how to implement them in digital world, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:
CO1: Students would be able to know cyber law.
CO2: Students would be able to implement copyright protection.
CO3: By analyzing the logic of any law, students would be able to use that.
CO4: To become an efficient network administrator and cyber law expert.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓

CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: Intellectual Property: Introduction, Protection of Intellectual Property — Copyright, Related Rights, Patents, Industrial Designs, Trademark, Unfair Competition
Module-2: Information Technology Related Intellectual Property Rights Computer Software and Intellectual Property-Objective, Copyright Protection, Reproducing, Defenses, Patent Protection. Database and Data Protection-Objective, Need for Protection, UK Data Protection Act, 1998, US Safe Harbor Principle, Enforcement. Protection of Semiconductor Chips, Objectives Justification of Protection, Criteria, Subject Matter of Protection, WIPO Treaty, TRIPs, SCPA. Domain Name Protection-Objectives, Domain Name and Intellectual Property, Registration of Domain Names, Disputes under Intellectual Property Rights, Jurisdictional Issues, and International Perspective.
Module-3: Patents (Ownership and Enforcement of Intellectual Property) Patents Objectives, Rights, Assignments, Defences in Case of Infringement Copyright-Objectives, Rights, Transfer of Copyright, Work of Employment Infringement, Defenses for Infringement, Trademarks Objectives, Rights, Protection of good will, Infringement, Passing off, Defenses. Designs Objectives, Rights, Assignments, Infringements, Defenses of Design Infringement.
Module-4: Enforcement of Intellectual Property Rights Civil Remedies, Criminal Remedies, Border Security Measures. Practical Aspects of Licensing Benefits, Determinative Factors, Important Clauses, Licensing Clauses.
Module-5: Cyber Law: Basic Concepts of Technology and Law: Understanding the Technology of Internet, Scope of Cyber Laws, Cyber Jurisprudence Law of Digital Contracts: The Essence of Digital Contracts, The System of Digital Signatures, The Role and Function of Certifying Authorities, The Science of Cryptography Intellectual Property Issues in Cyber Space: Domain Names and Related Issues, Copyright in the Digital Media, Patents in the Cyber World. Rights of Netizens and e-Governance: Privacy and Freedom Issues in the Cyber World, e-Governance, Cyber Crimes and Cyber Laws.
Module-6: Information Technology Act, 2000: Information Technology Act, 2000-1 (Sec. 1 to 13), Information Technology Act, 2000-2 (Sec. 14 to 42 and Certifying authority Rules), Information Technology Act, 2000-3 (Sec. 43 to 45 and Sec. 65 to 78), Information Technology Act, 2000 4 (Sec. 46 to Sec. 64 and CRAT Rules), Information Technology Act, 2000-5 (Sec 79 to 90), Information Technology Act, 2000-6 (Sec. 91-94) Amendments in 2008.

Text Books
1. "IPR and CYBER LAWS" by Adv. (Prof.) Sunil N. Shah,   Himalaya publishing house.
2. IPR & Cyber Laws (April – 2017) Kindle Edition

References
1. CYBER LAW LAW OF INFORMATION TECHNOLOGY AND INTERNET 1st Edition (English, Paperback, Anirudh Rastogi)

TITLE OF COURSE: INTRUSION DETECTION AND PREVENTION SYSTEM
COURSE CODE: IS405
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts in Intrusion Detection and Prevention System.

Introduction:
This course examines basics Intrusion Detection and Prevention System. The Topics to be covered (tentatively) include: an introduction to History of Intrusion detection, Audit, Network IDs protocol, Snort Installation Scenarios.

Course Outcomes (CO):
In this course we will study the fundamental concepts of Network Protocol Analysis and demonstrate the skill to capture and analyze network packets. Use various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems.
CO1: Students would be able to know Intrusion Detection and Prevention System.
CO2: Students would be able to implement any Network IDs protocol by their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to write efficient program.
CO4: To become an efficient network administrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: History of Intrusion detection, Audit, Concept and definition , Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.
Module-2: Intrusion Prevention Systems, Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis
Module-3: Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes.
Module-4: Working with Snort Rules, Rule Headers, Rule Options, the Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with MySQL
Module-5: Using ACID and Snort Snarf with Snort, Agent development for intrusion detection, Architecture models of IDs and IPs.

Text Books
1. Rafeeq Rehman : " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003.

References
1. Christopher Kruegel, Fredrik Valeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005.
2. Carl Endorf, Eugene Schultz and Jim Mellander " Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.
3. Stephen Northcutt, Judy Novak : "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002.

4. T. Fahringer, R. Prodan, "A Text book on Grid Application Development and Computing Environment". 6th Edition, Khanna Publihsers, 2012.

TITLE OF COURSE: ETHICAL HACKING
COURSE CODE: IS406
L-T-P: 3-0-0
CREDITS: 3

Pre-requisite: Basic concepts of Networking.

Introduction:
This course examines Ethical Hacking and security basics. The Topics to be covered (tentatively) include: an introduction to Ethical Hacking, importance of security, Foot-printing & Port Scanning, Hacking Web Services & Session Hijacking, Hacking Wireless Networks.

Course Outcomes (CO):
In this course we will study the basic components of Ethical Hacking. Students are expected to be capable of understanding the digital foot-print, their advantages and drawbacks, how to implement them in python, how their drawbacks can be overcome and what the applications are and where they can be used. To reach this goal, the following objectives need to be met:

CO1: Students would be able to design & implement any digital security properly.
CO2: Students would be able to implement System Hacking their own algorithm.
CO3: By analyzing the logic of any algorithm, students would be able to Hacking Web Services & Session Hijacking.
CO4: To become an efficient network administrator.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				✓
CO2	✓			✓					✓
CO3	✓	✓	✓						✓
CO4	✓	✓	✓		✓				✓

Course Contents:
Module-1: The importance of security, Concept of ethical hacking and essential Terminologies Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking
Module-2: Foot printing & Port Scanning: Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS
Module-3: System Hacking : Aspect of remote password guessing, Role of eavesdropping ,Various methods of password cracking, Keystroke Loggers, Understanding Sniffers ,Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing.
Module-4: Hacking Web Services & Session Hijacking: Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools

Module-5: Hacking Wireless Networks: Introduction to 802.11,Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks.

Text Books
1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010

References
1. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner's Guide (3rd ed.). Packt Publishing, 2011
2. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003
3. Rajat Khare, "Network Seuciryt and Ethical Hacking", Luniver Press, 2006