NEW SCHEME AND SYLLABUS FOR
TWO YEAR POST GRADUATE DEGREE COURSE
MASTER OF COMPUTER APPLICATIONS (M.C.A.)
[W.E.F. 2020-21ADMITTED BATCH]

DEPARTMENT OF INFORMATION TECHNOLOGY AND COMPUTER APPLICATIONS
AU COLLEGE OF ENGINEERING (AUTONOMOUS)
ANDHRA UNIVERSITY
VISAKHAPATNAM-530 003

MASTER OF COMPUTER APPLICATIONS (M.C.A)
COURSE STRUCTURE AND SCHEME OF VALUATION W.E.F. 2020-21

I SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 1.1	Data Structures and Algorithms	4	--	70	30	100	4
MCA 1.2	Probability, Statistics & Queuing Theory	4	--	70	30	100	4
MCA 1.3	Computer Organization	4	--	70	30	100	4
MCA 1.4	Object Oriented Programming With JAVA	4	--	70	30	100	4
MCA 1.5	Operating Systems	4	--	70	30	100	4
MCA 1.6	Data Structures & Programming Lab	--	3	50	50	100	2
MCA 1.7	Computer Organization Lab	--	3	50	50	100	2
Total		20	6	450	250	700	24

II Semester

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 2.1	Web Technologies	4	--	70	30	100	4
MCA 2.2	Data Base Management Systems	4	--	70	30	100	4
MCA 2.3	Artificial Intelligence	4	--	70	30	100	4
MCA 2.4	Business Analytics	4	--	70	30	100	4
MCA 2.5	Elective-I	4	--	70	30	100	4
MCA 2.6	Web Technologies Lab	--	3	50	50	100	2
MCA 2.7	Data Base Management Systems Lab	--	3	50	50	100	2
	Total	20	6	450	250	700	24

Elective I

Computer Graphics/Embedded Systems/Formal Languages and Automata Theory/Management Accountancy

III Semester

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 3.1	Computer Networks	4	--	70	30	100	4
MCA 3.2	Python Programming	4	--	70	30	100	4
MCA 3.3	Software Engineering	4	--	70	30	100	4
MCA 3.4	Data Warehousing & Data Mining	4	--	70	30	100	4
MCA 3.5	Elective-II	4	--	70	30	100	4
MCA 3.6	Network Programming Lab	--	3	50	50	100	2
MCA 3.7	Python Programming Lab	--	3	50	50	100	2
	Total	20	6	450	250	700	24

Elective II

Image Processing/Mobile Computing/ Network Security and Cryptography/E-Commerce

IV Semester

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 4.1	Data Science	4	--	70	30	100	4
MCA 4.2	Elective III	4	--	70	30	100	4
MCA 4.3	Project Work	--	6	50	50	100	14
	Total	8	6	190	110	300	22

Elective III

Internet of Things (IoT) / Machine Learning / Cloud Computing / Distributed Systems

MASTER OF COMPUTER APPLICATIONS – MCA

Program outcomes:

PO1. Identify business problems, formulate them under a mathematical framework and solve using knowledge of computing and decision sciences

PO2. Design and implement components of business systems that are agile and responsive to change through application of software design principles

PO3. Apply data analysis techniques on large sized datasets using contemporary computational tools and interpret the results in specific application domainsand multidisciplinary contexts

PO4. Design sustainable solutions to projects and problems in a professional and ethical manner, giving due importance to social, environmental, regulatory and cultural issues

PO5. Understand client requirements for development of software through effective communication and developing solutions using standard programming languages, tools and frameworks

PO6. Create novel approaches to computing problems, develop innovative methodologies for solving them and explain limitations of the solutions to stakeholders.

PO7. Apply relevant concepts to complex problems using rapidly evolving tools.

PO8. Recognise importance of working effectively in environments with diversity and engage in lifelong learning and skill enhancement.

Program specific outcomes:

PSO1. Create software systems to solve problems in various domains using established as well as emerging technologies.

PSO2. Design and implement algorithms for projects at hand using efficient and reliable storage systems using open source and relevant technologies.

PSO3. Demonstrate working knowledge of system level design, managing databases, identifying security pitfalls, and building scalable software solutions.

4. Develop expertise in industry relevant and contemporary tools and techniques for pursuing successful careers in industry, research and allied areas of computer applications with ethics.

Program educational objectives

PEO1. Effectively interact with project stakeholders to understand the requirements and design, implement, test and maintain scalable software systems.

PEO2. Apply fundamental concepts of computing, statistical analysis and software engineering to model problems in various domains and provide globally feasible applications.

PEO3. Engage in continuous updation of professional skills and emerging technologies for successful career progression in teamwork.

PEO4. Create systems and solutions ethically for handling issues of privacy, security and regulatory compliance.

MCA 1.1	**DATA STRUCTURES AND ALGORITHMS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

* Assess how the choice of data structures and algorithm design methods impacts the performance of programs.
* Choose the appropriate data structure and algorithm design method for a specified application.
* Solve problems using data structures such as linear lists, stacks, queues, binary trees, heaps binary search trees, and graphs and writing programs for these solutions.

Course Outcomes

- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithm.
- Demonstrate different methods for traversing trees.
- Compare alternative implementations of data structures with respect to performance.
- Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.

MCA 1.2	**PROBABILITY, STATISTICS & QUEUING THEORY**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

* to provide foundations of probabilistic and statistical analysis

* to provide an understanding on concepts of probability, random variables, probability distributions, sampling, estimation, hypothesis testing, regression, correlation, multiple regression, hypothesis testing, sample test, queuing methods

* to explore applications of probabilistic and statistical tools to solve real world problems.

Course outcomes

After completion of the course the student should be able to:

- define and explain basic concepts in probability theory and how to translate real-world problems into probability models

- solve standard problems that include random variables, discrete and continuous probability distributions
- perform Test of Hypothesis and construct a confidence interval to estimate population parameters
- compute and interpret the results of Correlation Analysis, Multivariate Regression, Chi-Square test forIndependence and Goodness of Fit
- explain basic concepts in Markov processes, M/M/1 and M/M/C queueing systems.

MCA 1.3	COMPUTER ORGANIZATION	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

* To study about structure and functional components of a computer.

 * Understanding the hierarchical organization of a computer system which consists of instruction set of commands

. * Learn about the architecture of a computer from a programming view.

* To design a balance system that minimizes performance and utilization of all elements.

Course outcomes

After completion of the course the student should be able to:

- describe the internal organization of a computer, CPU, memory unit, input/outputs and the functional units of a processor
- manipulate representations of numbers stored in digital computers
- explain addressing modes, instruction formats and program control statements
- understand the theory and architecture of central processing unit and micro-sequencer.

MCA 1.4	OBJECT ORIENTED PROGRAMMING WITH JAVA	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives:

 * This subject will help to improve the analytical skills of object-oriented programming

 * Overall development of problem solving and critical analysis

* Formal introduction to Java programming language

Course outcomes

- The course aims to make the students learn programming in Java. Java language elements and characteristics, including data types, operators, and control structures are discussed in order to make the students develop Java applications.
- The course also intended for students who would like to learn how to develop internet based applications, graphical user interface (GUI), and graphics in both AWT and SWING.
- Advanced Java topics discussed helps students writing programs for Java database connectivity with JDBC; Manipulating databases with JDBC; Programming for Internet, JavaServer pages.

MCA 1.5	**OPERATING SYSTEMS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives:

* To understand evolution of Operating System.

* To understand operating system as a layer of abstraction above physical hardware that facilitates usage convenience and efficient resource management of computer system resources.

* To learn design and implementation of policies and mechanisms for OS subsystem.

* To investigate case studies to understand the design philosophies / paradigm for popular multiuser or single user operating system.

Course outcomes

After completion of the course the student should be able to:

- describe the basic concepts of operating systems, including structure and components
- explain how memory, I/O devices, files, processes and threads are managed, and evaluate the performance of various scheduling algorithms
- explain the concepts covered in concurrency control, including mutual exclusion and synchronization, deadlock and starvation
- understand key concepts on physical and virtual memory, scheduling, I/O and file systems and massstorage structures.

MCA 1.6	**DATA STRUCTURES AND PROGRAMMING LAB**	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

Course Objectives

* To implement stacks and queues using arrays and linked lists

. * To develop programs for searching and sorting algorithms.

* To write programs using concepts of various trees.

* To implement programs using graphs

Course Outcomes

- Student will be able to write programs to implement stacks and queues.
- Ability to implement various searching and sorting techniques.
- Ability to implement programs using trees and graphs.

MCA 1.7	COMPUTER ORGANIZATION LAB		
Instruction: 3 Periods/week			Credits:2
Internal: 50 Marks	University Exam: 50 Marks		Total: 100 Marks

Course Objectives

* To design and analyse the operational behaviour of IC gates, multiplexers, decoders, flip-flops, counters, shift registers, binary adders and subtractors and ALU.

* To implement assembly language programming using various trainers.

* To make students familiar with Pentium class PC architecture.

Course outcomes

After completion of the course the student should be able to:

- analyze the operational behavior of various digital logic units such as multiplexers, decoders, flip-flops, counters, shift registers, binary adders and subtractors and ALU
- write assembly language code using various trainers
- understand Pentium class PC architecture.

MCA 2.1	WEB TECHNOLOGIES		
Instruction: 3 Periods & 1 Tut/week			Credits:4
Internal: 30 Marks	University Exam: 70 Marks		Total: 100 Marks

Course Objectives:

On completing this course student will be able to

* Understand the principles of Web based application development.

* Design dynamic content in Web Pages using JavaScript.

* Understanding the concepts of java Servlets, java Server Pages and design applications using them.

* Understand the concepts of Component development and design applications by establishing connections to Databases

Course outcomes

After completion of the course the student should be able to:

- understand and be able to analyse any real time web application
- acquire working knowledge to develop web applications using both client side and server sidescripting and retrieving data from databases
- appreciate the importance of MVC architecture pattern in development of web applications

MCA 2.2	**DATA BASE MANAGEMENT SYSTEMS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course Objectives:

* To learn the evolution of DBMS Versus File systems, data models, and layers of abstraction.
* To understand conceptual and physical aspects of database design.
* To learn formal and commercial query language specifications.
* To understand concurrency control, recovery management, and other related issues.

Course outcomes

After completion of the course the student should be able to:

- apply formal database ideas of ER diagrams, functional dependencies and normalization in development of real world database applications
- be familiar with modern database application design tools and interfaces
- understand the notion of concurrency, its importance in transactions and various recovery techniques.

MCA 2.3	**ARTIFICIAL INTELLIGENCE**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course Objectives:

* To learn about AI problem, Production Systems and their characteristics.

* To understand the importance of search and the corresponding search strategies for solving AI problem.

* To introduce to Planning, Natural Language Processing and Expert Systems.

Course outcomes

After completion of the course the student should be able to:

- understand AI problem characteristics and state space approach for solving AI problem.
- The student will have learned several optimal search strategies and the use of heuristics
- understand relational, inferential, inheritable and procedural knowledge and the corresponding knowledge representation approaches acquire AI problem solving approaches to natural language processing, planning and expert systems.

MCA 2.4	BUSINESS ANALYTICS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives:

* To introduce students to problem solving with Business Analytics and the use of spreadsheets for descriptive analytics, data queries and visualization

* To introduce students to statistical sampling, sampling distributions, confidence intervals and statistical inference.

* To familiarize students with various types of regression including simple linear regression and multiple linear regression

Course outcomes

After completion of the course the student should be able to:

- describe data and models used for Business Analytics and apply various descriptive analytic techniques to analyze data
- estimating population parameters, interval estimates, construct confidence intervals and performhypothesis testing
- estimate and interpret the parameters of simple linear regression and multiple linear regression
- apply forecasting models for various time series data including stationary time series, time series with linear trend and time series with seasonality
- implement models on spreadsheets, develop user-friendly applications and build linear poptimization models on spreadsheets.

MCA 2.5	Elective - I COMPUTER GRAPHICS

Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives:
This course focuses on giving introduction about computer graphics, its wide range of application areas. Also gives information about the graphics hardware, working of hardware and software which are needed for producing graphics. It gives information about basic scan conversion algorithms, 2D, 3D transformations and viewing mechanisms, clipping algorithms, color models and Animation techniques.

Course Outcomes

- The students will understand graphics principles and graphics hardware.
- The students can demonstrate geometrical transformations.
- The students can create interactive graphics applications and demonstrate computer graphics animation.

MCA 2.5	Elective-I EMBEDDED SYSTEMS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

* To introduce basics of electronics and reading electronics diagrams

* To introduce students to basics of Arduino programming language and IDE

* Assembly language program using 8051

* Interfacing 8051 Microprocessor

* embedded system design using msp430

Course outcomes

After completion of the course the student should be able to:

- describe embedded system architecture and its typical hardware
- understand tasks and task states, shared data and semaphores, message queues
- test embedded software on host machines using instruction set simulators

MCA 2.5	Elective - I FORMAL LANGUAGES & AUTOMATA THEORY	
Instruction: 3 Periods & 1 Tut/week		Credits:4

Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives:

* To introduce the concepts in automata theory and theory of computation to design grammars and recognizers for different formal languages.

* To employ finite state machines to solve problems in computing.

* To introduce finite state machines, context free grammars and Turing Machines and their properties as the basis for the formal expressivity of computer languages for solving linguistic decision problems.

* To understand the concepts of tractability and decidability, the concepts of NP-completeness and NP-hard problem and also the challenges for Theoretical Computer Science and its contribution to other sciences.

Course outcomes

After completion of the course the student should be able to:

- think analytically for problem-solving situations in related areas of theory in computer science
- describe the language accepted by an automata or generated by a regular expression or a context- free grammar
- understand the functioning of Finite-State Machines, Deterministic Finite-State Automata, Nondeterministic Finite-State Automata and Pushdown Automata and Turing Machines.

MCA 2.5	**Elective - I MANAGEMENT ACCOUNTANCY**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course outcomes

After completion of the course the student should be able to:

- prepare Trading, Profit and Loss Account And Balance Sheet of sole proprietary concerns
- calculate key financial indicators using ratio analysis and prepare Fund Flow Statement
- understand the key concepts in marginal costing and construct Break Even Chart.

MCA 2.6	**WEB TECHNOLOGIES LAB**	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

Course outcomes

After completion of the course the student should be able to:

- design web pages using modern web constructs and client and server side programming.
- enable database connectivity to websites
- apply multimedia effects on web pages design using Flash.

MCA 2.7	DATABASE MANAGEMENT SYSTEMS LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course Objectives

* To introduce to a commercial DBMS such as ORACLE.

* To learn and practice SQL commands for schema creation, data manipulation.

* To learn conceptual and physical database design based on a case study.

* To apply database design stages by studying a case study.

Course Outcomes

- The student is exposed to a commercial RDBMS environment such as ORACLE.
- The student will learn SQL commands for data definition and manipulation.
- The student understands conceptual through physical data base design.
- The student takes up a case study and applies the design steps.

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 3.1	Computer Networks	4	--	70	30	100	4
MCA 3.2	Python Programming	4	--	70	30	100	4
MCA 3.3	Software Engineering	4	--	70	30	100	4
MCA 3.4	Data Warehousing & Data Mining	4	--	70	30	100	4
MCA 3.5	Elective-II	4	--	70	30	100	4
MCA 3.6	Network Programming Lab	--	3	50	50	100	2

MCA 3.7	**Python Programming Lab**	**--**	**3**	**50**	**50**	**100**	**2**
Total		**20**	**6**	**450**	**250**	**700**	**24**

MCA 3.1	**COMPUTER NETWORKS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course Objectives:

1. Building a firm foundation for understanding fundamentals of Computer Networks.
2. Familiarize with the basic terminologies of Computer Networking area.
3. Understand the state of art in Network protocols, Architecture and Applications.
4. Acquire the knowledge of the basic protocols involved in Wired/Wireless communication process.

Course outcomes

After completion of the course the student should be able to:

- understand the design and estimate the requirements for practical setup of a given network scenarioand size
- realize the operation, maintenance and management of the internet by mapping the theoreticalnetworking concepts to the real-time network scenarios
- demonstrate the applications of wireless networks and overview of advanced networking concepts
- identify different networking devices and their usage and functionality.

MCA 3.2	**PYTHON PROGRAMMING**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course Objectives

- To develop skills on procedural oriented and object oriented programming in Python
- To understand and apply different data wrangling techniques using Python.
- To perform data analysis using Python libraries like NumPy, Pandas and exploratory data analysis using Matplotlib

Course Outcomes

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

- acquire programming knowledge on Basics of Python
- acquire programming knowledge on Text and File Handling
- develop Python programs to Mean, Median, Mode, Correlation
- acquire programming knowledge on NumPy, Pandas Library
- acquire programming knowledge on Graph Visualizations in Python and Data Analysis using Python

MCA 3.3	SOFTWARE ENGINEERING	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

1,To provide the idea of decomposing the given problem into Analysis, Desing, Implementation, Testing and Maintenance phases.

2 To provide an idea of using various process models in the software industry according to given circumstances

. 3 To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course outcomes

After completion of the course the student should be able to:

- define a problem and perform Requirements Engineering.
- draw UML diagrams for the requirements gathered
- implement the designed problem in Object Oriented Programming Language and
- test whether all the requirements specified have been achieved or not.

MCA 3.4	DATA WAREHOUSING & DATA MINING	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

• To understand the evolution of data warehousing and data mining systems

• To understand extracting, cleaning and transformation of data into a warehouse.

• To learn the principles of statistics, information theory, machine learning and other areas AI and implementation of data mining techniques.

• To understand pattern mining using classification and clustering methods

Course outcomes

After completion of the course the student should be able to:

- The student understands the differences between OLTP and OLAP.
- The student learns how data cube technology supports summarization and querying high dimensionaldata.
- The student is introduced to similarity, distance, information gain and other performance and error metrics used for evaluation of mining results.
- The student is introduced to various approaches to association rule mining , supervised and unsupervised learning and the corresponding classification and clustering approaches involving decision trees, Bayesian approaches, model based and agglomerative approaches.

MCA 3.5	**Elective-II IMAGE PROCESSING**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

• To explain fundamentals of Image processing concepts.

• To provide mathematical foundation of image enhancement , image compression and image segmentation.

• To explain the students about Morphology and its applications in image processing.

• To explain various methods and techniques for image transformation.

Course outcomes

After completion of the course the student should be able to:

- develop algorithms for fundamental concepts in Image processing.
- perform image enhancement, image compression and image segmentation using various methods.
- implement image transformation techniques

MCA 3.5	**Elective II MOBILE COMPUTING**

Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

- To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
- To explore both theoretical and practical issues of mobile computing.
- To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

Course outcomes

After completion of the course the student should be able to:

- describe the infrastructure, principles, technologies, and applications of mobile computing technologies
- understand wireless LANs, topologies and key concepts in wireless networking
- understand key database issues in mobile computing, adaptive clustering and various data delivery mechanisms such as push-based mechanisms, pull-based mechanisms.

MCA 3.5	**Elective II NETWORK SECURITY AND CRYPTOGRAPHY**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course Objectives

- Introduction of the issues in network security- its need and importance, taxonomy and terminology.
- Discussion of various cryptographic techniques.
- Exploration of different types of security threats and remedies.
- Understanding of Internet security protocols and standards

Course outcomes

After completion of the course the student should be able to:

- understand the importance of network and data security in the Internet and in the distributed environments
- apply various cryptographic techniques in different contexts
- identify the different types of network security issues and their remedies.

MCA 3.5	Elective-II **E-COMMERCE**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

- Introduce students to electronic commerce and its various applications
- Provide knowledge of electronic payment systems and risks involved, electronic data interchange, inter-organizational and intra-organizational commerce
- Introduce students to concepts of information based marketing including online marketing, advertising on internet, consumer search
- Provide knowledge of multimedia concepts including digital video and electronic commerce, video conferencing and video processing.

Course outcomes

After completion of the course the student should be able to:

- be familiar with the key application areas of e-commerce in different domains
- understand the types of Electronic Payment Systems and risks involved in these systems
- understand key concepts in Electronic Data Inter Change and Intra Organizational Commerce including Work Flow Automation and Supply Chain Management
- be familiar with advertising, marketing and multimedia concepts in e-commerce such as information-based marketing, consumer search, information retrieval and filtering.

MCA 3.6	**NETWORK PROGRAMMING LAB**	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

Course objectives:

1. identification of well known ports on a remote system and providing user interface to contact them

2. development of chat application including one-to-one and broadcast

3. development of HTTP server and retrieval of data from remote database by executing SQL queries

4. sending and receiving mails using mail clients including POP and SMTP

5. transfer of files between systems and development of TFTP client

Course outcomes:

After completion of the course the student should be able to:

1. identifying well known ports on a remote system and be able to simulate Telnet

2. develop chat application by opening socket connections

3. develop HTTP server to implement GET, POST, HEAD, DELETE commands and retrieve data from remote database

4. send email using SMTP commands and retrieve and manipulate mail box using POP commands

5. transfer files between two systems without protocols and develop a TFTP client.

MCA 3.7	PYTHON PROGRAMMING LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course Objectives

• familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling

• introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation

• familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and dataframes

• introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others

• implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and crossvalidation.

Course outcomes

After completion of the course the student should be able to:

- implement searching, sorting and handle text and files using Python data structures such as lists anddictionaries
- calculate statistical measures using Python such as measures of central tendency, correlation
- use Python data related libraries such as Numpy and Pandas and create data visualizations
- implement basic machine learning tasks pre-processing data, compressing data, clustering,classification and cross-validation.

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 4.1	Data Science	4	--	70	30	100	4
MCA 4.2	Elective III	4	--	70	30	100	4
MCA 4.3	Project Work	--	6	50	50	100	14
Total		8	6	190	110	300	22

Elective III

Internet of Things (IoT) / Machine Learning / Cloud Computing / Distributed Systems

MCA 4.1	DATA SCIENCE	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

• Provide students with the knowledge and expertise to become a proficient data scientist.

• Demonstrate an understanding of statistics and machine learning concepts that are vital for data science

• Learn to statistically analyze a dataset;

Course outcomes

After completion of the course the student should be able to:

- describe about Data Science and its process
- differentiate between the classification and regression methods
- apply clustering and evaluate the methods
- understand and analyze the text mining and time series forecasting applications.
- assess different feature selection methods and use in applications.

MCA 4.2	Elective-III Internet of Things (IoT)	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

- Vision and Introduction to Internet of Things(IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art - IoT Architecture

. • Understand Real World IoT Design Constraints, Industrial Automation and Commercial.

Course outcomes

After completion of the course the student should be able to:

- describe the framework, architecture of IoT, technology behind IoT and the key components that makeup an IOT system
- understand the design principles for connected devices, for web connection and web communication protocols for connected devices
- collect, store, organize and process data using IoT cloud-based services and appreciate the role ofbig data, cloud computing and data analytics in a typical IoT system
- understand key concepts in sensors, RFIDs, and wireless sensor networks including applications in industrial IoT and automotive IoT,
- understand embedded computing basics, prototyping, designing software for IoT applications and various IoT supported hardware platforms including Raspberry pi, ARM Cortex Processors.

MCA 4.2	**Elective-III MACHINE LEARNING**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

- introduce students to the approaches to machine learning and related algorithms
- familiarize students with ideas of concept learning, version spaces and issues regarding data sources
- understand representation and learning using Decision Trees, Neural Networks, Genetic Algorithms
- introduce students to Bayesian approaches and key concepts of Expectation Maximization
- introduce students to inductive and analytical learning problems and related concepts of inductive bias, using prior knowledge to initialize the hypothesis.

Course outcomes

After completion of the course the student should be able to:

- describe learning tasks and various approaches, algorithms in machine learning

- understand concept learning, version spaces and related concepts of bias-free learning and active queries
- represent and formulate problems in Decision Trees, Neural Networks, Genetic Algorithms
- understand the basics of Bayes theorem and key concepts of Expectation Maximization in Bayesian approaches.

MCA 4.2	Elective-III CLOUD COMPUTING	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

• To understand fundamental concepts in the area of cloud computing

. • To understand the concept of Virtualization and cloud data storage.

• To learn cloud Application Development and cloud Governance.

• To gain competence in Map Reduce and Hadoop Overview.

Course outcomes

After completion of the course the student should be able to:

- describe the benefits and limitations of cloud computing
- identify the architecture and infrastructure of cloud computing including web APIs, cloud storage and deployment methods of cloud computing
- understand the driving forces for Software as a Service
- understand the concepts in development, troubleshooting, management of cloud computing applications describe the best practices in cloud computing and understand how cloud computing might evolve in future.

MCA 4.2	Elective III Distributed Systems	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives: * This course provides an introduction to the fundamentals of distributed computer systems, assuming the availability of facilities for data transmission.

Course outcomes

After completion of the course the student should be able to:

- describe the key principles, architecture and integrity constraints in distributed databases
- transform global queries into fragment queries and understand strategies for optimized access
- understand the management of distributed transactions, concurrency control for distributed transactions, distributed deadlocks, detection and resolution of inconsistency
- describe multi database concurrency control, multi database recovery and database

interoperability

NEW SCHEME AND SYLLABUS FOR
TWO YEAR POST GRADUATE DEGREE COURSE
MASTER OF COMPUTER APPLICATIONS (M.C.A.)
[W.E.F. 2020-21ADMITTED BATCH]

DEPARTMENT OF INFORMATION TECHNOLOGY AND
COMPUTER APPLICATIONS
AU COLLEGE OF ENGINEERING (AUTONOMOUS)
ANDHRA UNIVERSITY
VISAKHAPATNAM-530 003

MASTER OF COMPUTER APPLICATIONS (M.C.A)
COURSE STRUCTURE AND SCHEME OF VALUATION W.E.F. 2020-21

I SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 1.1	Data Structures and Algorithms	4	--	70	30	100	4
MCA 1.2	Probability, Statistics & Queuing Theory	4	--	70	30	100	4
MCA 1.3	Computer Organization	4	--	70	30	100	4
MCA 1.4	Object Oriented Programming With JAVA	4	--	70	30	100	4
MCA 1.5	Operating Systems	4	--	70	30	100	4
MCA 1.6	Data Structures & Programming Lab	--	3	50	50	100	2
MCA 1.7	Computer Organization Lab	--	3	50	50	100	2
Total		20	6	450	250	700	24

MCA 1.1	**DATA STRUCTURES AND ALGORITHMS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course Objectives

1. Assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. Choose the appropriate data structure and algorithm design method for a specified application.
3. Solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps, tournament trees, binary search trees, and graphs and writing programs for these solutions.
4. Solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking, and branch and bound and writing programs for these solutions.

Course Outcomes

1. Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithm.
2. Demonstrate different methods for traversing trees.
3. Compare alternative implementations of data structures with respect to performance.
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.

Syllabus

1. **Introduction to Data Structures and Algorithms**: Review of C Programming, , Abstract Data Types, Meaning and Definition of Data Structures, Efficiency of Algorithms, Asymptotic Notations, Time complexity estimation using O notation, Average, Best case and Worst case complexities, Analysis of recursive algorithms, Arrays Operations, single and Multi-dimensional array Representation in memory
2. **Stacks**: Stack as an Abstract Data Type, Primitive Operations, Implementing Stack Operations using Arrays, Infix, Postfix and Prefix: Definitions, Evaluation and Conversions. **Queues**: Queue as an Abstract Data Type, Operations, Implementation using Arrays, Types of Queues, circular Queue, applications.
3. **Linked List**: singly linked list, Circular Lists: Insertion, Deletion and Concatenation Operations, Doubly Linked Lists, Multiply linked lists, applications, Implementation of Stacks, Queues and priority Queues using Linked Lists, Dynamic Memory Management, applications .
4. **Trees and Binary Trees** - Definitions and Terminology, representation of Trees, Binary Tree Terminology, Representation and Traversal, Threaded Binary Trees and their Traversal, Trees and their Applications; Tree Searching: Insertion and Deletion of a node from a Binary Search Tree, AVL Tree operations, Applications
5. **Searching and Hashing**: Basic Searching, Sequential Searching and its Efficiency, Transpose Sequential search, Binary Search, Interpolation Search, Hash Table structure, Hash Functions, Linear open addressing, chaining, applications
6. **Sorting**: General Background: Efficiency of Sorting, Bubble Sort, Selection Sorting, Insertion sort, Shell Sort and Quick Sort, Heap Sort, Merge Radix Sorts and their Efficiency
7. **Graphs and Their Application**: Definition of Graphs, Representation of Graphs, Transitive closure, Linked Representation of Graphs, Graph Traversal and Spanning Forests, Topological sorting of nodes, Undirected Graphs and their Traversals, Applications of Graphs, Minimal Spanning Trees.

Textbooks

1. Data Structures and Algorithms – Concepts, Techniques and Algorithms by G.A.V.Pai , Tata McGraw Hill Publishing
2. Data Structures Using C by Yaddish Langsam, Moshe J. Augenstein and Aaron M.Tanenbaum, Prentice Hall Of India (Low priced Edition)

Reference Books

1. Data Structures using C by E. Balagurusamy, McGraw Hill Education India Pvt Limited
2. Data Structures, Algorithms and Applications with C++, Sahani Mc-Graw Hill.

MCA 1.2	**PROBABILITY, STATISTICS & QUEUING THEORY**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to provide foundations of probabilistic and statistical analysis
2. to provide an understanding on concepts of probability, random variables, probability distributions, sampling, estimation, hypothesis testing, regression, correlation, multiple regression, hypothesis testing, sample test, queuing methods
3. to explore applications of probabilistic and statistical tools to solve real world problems.

Course outcomes

After completion of the course the student should be able to:

1. define and explain basic concepts in probability theory and how to translate real-world problems into probability models
2. solve standard problems that include random variables, discrete and continuous probability distributions
3. perform Test of Hypothesis and construct a confidence interval to estimate population parameters
4. compute and interpret the results of Correlation Analysis, Multivariate Regression, Chi-Square test for Independence and Goodness of Fit
5. explain basic concepts in Markov processes, M/M/1 and M/M/C queueing systems.

Syllabus

1. **Probability:** Definitions of probability, Addition theorem, Conditional probability, Multiplication theorem, Bayes' Theorem of Probability and Geometric Probability.
2. **Random variables and their properties**: Discrete Random Variable, Continuous Random Variable, Probability Distribution, Joint Probability Distributions their Properties, Transformation Variables, Mathematical Expectations, Probability Generating Functions.
3. **Probability Distributions**: Discrete Distributions : Binomial, Poisson Negative Binominal Distributions And Their Properties; Continuous Distributions : Uniform, Normal, Exponential Distributions And Their Properties.
4. **Multivariate Analysis** : Correlation, Correlation Coefficient, Rank Correlation, Regression Analysis, Multiple Regression, Attributes, Coefficient Of Association, Chi Square Test For Goodness Of Fit, Test For Independence.
5. **Estimation**: Sample, Populations, Statistic, Parameter, Sampling Distribution, Standard Error, Un-biasedness, Efficiency, Maximum Likelihood Estimator, Notion & Interval Estimation.
6. **Testing of Hypothesis**: Formulation of Null hypothesis, critic al region, level of significance, power of the test;
7. **Sample Tests**: Small Sample Tests : Testing equality of .means, testing equality of variances, test of correlation coefficient, test for Regression Coefficient; Large Sample tests: Tests based on normal distribution

8. **Queuing Theory** : Queue description, characteristics of a queuing model, study state solutions of M/M/1: Model, M/M/1 ; N Model, M/M/C: Model, M/M/C: N Model , Case studies

Text Books

1. Probability & Statistics for Engineers and Scientists,Walpole, Myers, Myers, Ye. Pearson Education.
2. Probability, Statistics and Random Processes T.Veerarajan Tata McGraw – Hill

Reference Book

1. Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S. Trivedi, Prentice Hall of India ,1999

MCA 1.3	COMPUTER ORGANIZATION	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives

1. to introduce students to the foundations of computer organization and architecture including register transfer logic and arithmetic operations
2. to explore the different types of addressing modes and memory organization
3. to expose students to the basic architecture and functionality of processing, memory and I/O organization in a computer system.
4. to introduce students to the design and implementation of simple CPU and micro-sequencer.

Course outcomes

After completion of the course the student should be able to:

1. describe the internal organization of a computer, CPU, memory unit, input/outputs and the functional units of a processor
2. manipulate representations of numbers stored in digital computers
3. explain addressing modes, instruction formats and program control statements
4. understand the theory and architecture of central processing unit and micro-sequencer.

Syllabus

1. **Introduction to Computer Organization**, CPU Organization, Memory subsystem Organization, and Interfacing, I/O Subsystem Organization and Interfacing, a relative Simple Computer, An8085 Based Computer
2. **Computer arithmetic & Digital Logic Fundamentals**: Unsigned, Notation, Signed Notation, Binary Code Decimal, Specialized Arithmetic Hardware, Floating Point Numbers, The IEEE 754 Floating Point Standard; Boolean Algebra, Basic functions, Mapping Boolean Functions, Combinatorial Logic, Combinational Circuits, Sequential circuits.
3. **Register Transfer Languages**: Micro Operations and Register Transfer Language, RTL Specification, Digital systems, More Complex Digital Systems, VHDL-VHSIC Hardware Description Language
4. **Instruction Set architecture**: Levels of Programming Languages,< Assembly Language Instructions, Instruction Set Architecture Design, A Relatively Sample Instruction Set Architecture, 8085 Microprocessor Instruction Set Architecture.

5. **CPU Design**: Specifying a CPU, Design & Implementation of a Very Simple CPU, Short comings of the simple CPUs, Internal Architecture of the 8085 microprocessor.
6. **Microprocessor Control Unit Design**: Basic Micro-sequencer Design, Design and Implementation of very simple Micro-sequencer, Reducing the number of Micro Instructions, Micro-prgrammed controls Hardware Control, A(Mostly) Micro-coded CPU, The Pentium Microprocessor.

7. **Memory & I/O Organization**: Hierarchical Memory systems, Cache Memory Systems, Virtual Memory., Memory Management in a Pentium/Windows Personal computer, Input/output Organization, Organization of Asynchronous Data Transfers, Programmed I/O, Interrupts, Directory Memory Acess,I/OProcessors, Serial Communications, Serial Communication Standards.

Text Book

1. Computer Systems Organization & Architecture, John D. Carpinelli, Addison Wesley Longman, Inc ./ Pearson Education , 1993

Reference Books

1. Computer System Architecture, M. Morris Mano, Third Edition, Pearson Education, 2007
2. Computer Architecture and organization: Design Principles and Applications, B. Govindarajalu, TMH Publishing Company Ltd., 2004
3. Fundamentals of Computer organization and Design, Sivarama P. Dandamudi Springer International Edition, 2004

MCA 1.4	OBJECT ORIENTED PROGRAMMING WITH JAVA	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

1. To understand Object Oriented Programming concepts, class hierarchy, characteristics of Java, inheritance and polymorphism and become familiar with the relationship between classes and objects in a Java program.
2. Learn programming based on JAVA 7 and above.
3. To write efficient and effective applications in Java, Java's event handling model, graphical user interface (GUI), swing component set, understand the relationship between the AWT and Swing.
4. Have a better understanding of Java's event model and design, build simple Graphical User Interfaces (GUI)s, Networking, Java Database Connectivity with JDBC™, Servlets, JavaServer Pages (JSP).

Course outcomes

1. The course aims to make the students learn programming in Java. Java language elements and characteristics, including data types, operators, and control structures are discussed in order to make the students develop Java applications.
2. The course also intended for students who would like to learn how to develop internet based applications, graphical user interface (GUI), and graphics in both AWT and SWING.
3. Advanced Java topics discussed helps students writing programs for Java database connectivity with JDBC; Manipulating databases with JDBC; Programming for Internet, JavaServer pages.

Syllabus

1. Introduction to Computers, Programming, and Java; Elementary Programming; Selections; Mathematical Functions, Characters, and Strings; Loops;
2. Methods; Single-Dimensional Arrays; Multidimensional Arrays; Objects and Classes; Object-Oriented Thinking;
3. Inheritances and Polymorphism; Exception Handling and Text I/O; Abstract Classes and Interfaces.
4. JavaFX Basics; Event-Driven Programming and Animations;
5. JavaFX UI Controls and Multimedia; Multithreading and Parallel Programming;
6. Networking; Java Database Programming ;
7. Servlets; JavaServer Pages.

Text Book

1. Introduction to Java Programming Comprehensive version, Y. Daniel Liang, Tenth Edition, Pearson Education, Inc.

Reference Books

1. Object Oriented Programming Through Java, P. Radha Krishna, CRC Press.
2. Java And Object Oriented Programming Paradigm, Debasish Jana, PHI Learning Pvt. Ltd.

MCA 1.5	OPERATING SYSTEMS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives

1. to provide overview of types of operating systems, operating system calls and services
2. to introduce the notion of a process and various stages of processes, including scheduling, creation, and termination
3. to explore inter-process communication using shared memory and message passing and to introduce the critical-section problem
4. to introduce CPU scheduling and various CPU-scheduling algorithms
5. to develop a description of deadlocks and different methods for preventing or avoiding deadlocks
6. to explore various techniques of allocating memory to processes, how paging works, the concepts of virtual memory, demand paging and page-replacement algorithms
7. to describe the details of implementing local file systems and directory structures and to introduce the characteristics of mass-storage devices, disk scheduling.

Course outcomes

After completion of the course the student should be able to:

1. describe the basic concepts of operating systems, including structure and components
2. explain how memory, I/O devices, files, processes and threads are managed, and evaluate the performance of various scheduling algorithms
3. explain the concepts covered in concurrency control, including mutual exclusion and synchronization, deadlock and starvation
4. understand key concepts on physical and virtual memory, scheduling, I/O and file systems and mass storage structures.

Syllabus

1. **Introduction to Operating Systems**: Over view of Operating Systems, Types Of Operating Systems, Operating System Structures, Operating-System Services, System Calls, Virtual Machines, Operating System Design and Implementation.
2. **Process Management**: Process Concepts, Operations On Processes, Cooperating Processes, Threads, Inter Process Communication, Process Scheduling, Scheduling Algorithms, Multiple -Processor Scheduling. Thread Scheduling.
3. **Process Synchronization**: The Critical Section Problem, Semaphores, And Classical Problems Of Synchronization, Critical Regions, Monitors, Synchronization examples
4. **Deadlocks**: principles of Deadlocks,-System Model, Deadlocks Characterization, Methods For Handling Deadlocks, Deadlock- Prevention, Avoidance, Detection,& Recovery from Deadlocks
5. **Memory Management**: Logical Versus Physical Address, Swapping, contiguous memory allocation, paging, structure of the page table , segmentation, , Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing

6. **File System Implementation**: Concept of a file, Access Methods, Directory Structure, Protection, File System Structure, Allocation Methods, Free Space Management, Directory Management, Device Drivers
7. **Mass-storage structure**: overview of Mass-storage structure, Disk structure, disk attachment, disk scheduling, swap-space management.

Text Book

1. Operating Systems, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Wiley John Publ., Seventh Edition.

Reference Books

1. Operating Systems, William Stallings 5th Edition - PHI
2. Operating Systems: A Design-Oriented Approach', Charles Crowley, 'Tata Hill Co.,1998 edition.
3. Modern Operating Systems, Andrew S.Tanenbaum, , 2nd edition, 1995, PHI.
4. Operating Systems - A concept based approach, Dhamdhere, 2nd Edition, TMH, 2006.
5. Understanding the Linux Kernel, Daniel P Bovet and Marco Cesati, 3rd Edition,' Reilly, 2005.

MCA 1.6	**DATA STRUCTURES AND PROGRAMMING LAB**	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

Course Objectives

1. To implement stacks and queues using arrays and linked lists.
2. To develop programs for searching and sorting algorithms.
3. To write programs using concepts of various trees.
4. To implement programs using graphs.

Course Outcomes

1. Student will be able to write programs to implement stacks and queues.
2. Ability to implement various searching and sorting techniques.
3. Ability to implement programs using trees and graphs.

List of Programs

1. Write a program for sorting a list using Bubble sort and then apply binary search.
2. Write a program to implement the operations on stacks.
3. Write a program to implement the operations on circular queues.
4. Write a program for evaluating a given postfix expression using stack.
5. Write a program for converting a given infix expression to postfix form using stack.
6. Write a program for implementing the operations of a priority queue using dynamic allocation.
7. Write a program for the representation of polynomials using circular linked list and for the addition of two such polynomials
8. Write a program for quick sort
9. Write a program for Merge sort.
10. Write a program for Heap sort
11. Write a program to create a binary search tree and for implementing the in order, preorder, post order traversal using recursion
12. a)Write a program for finding the transitive closure of a digraph

    b)Write a program for finding the shortest path from a given source to any vertex in a digraph using Dijkstra’s algorithm.

MCA 1.7	COMPUTER ORGANIZATION LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course objectives

1. to design and analyze the operational behavior of IC gates, multiplexers, decoders, flip-flops, counters, shift registers, binary adders and subtractors and ALU
2. to implement assembly language programming using various trainers
3. to make students familiar with Pentium class PC architecture

Course outcomes

After completion of the course the student should be able to:

1. analyze the operational behavior of various digital logic units such as multiplexers, decoders, flip-flops, counters, shift registers, binary adders and subtractors and ALU
2. write assembly language code using various trainers
3. understand Pentium class PC architecture.

I - Cycle: Digital Logic Design Experiments

1. TTL Characteristics and TTL IC Gates
2. Multiplexers & Decoders
3. Flip-Flops
4. Counters
5. Shift Registers
6. Binary Adders & Subtractors
7. A L U

II - CYCLE: 8085 Assembly Language Programming

1. 8085 Assembly Language Programming according to theory course microprocessors-I using the following trainers:

   Keyboard Monitor of 8085µP Trainer

   Serial Monitor of 8085µP Trainer with Terminal

   8085 Line Assembler of 8085µP Trainer with PC as Terminal

   8085 Cross Assembler using In-Circuit Emulator (ICE) with 8085µP Trainer and PC as Terminal

   Graded Problems are to be used according to the syllabus of COMPUTER ORGANIZATION

2. PENTIUM CLASS PC ARCHITECTURE FAMILIARIZATION HARDWARE & SOFTWARE PARTS DEMONSTRATION

II Semester

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 2.1	Web Technologies	4	--	70	30	100	4
MCA 2.2	Data Base Management Systems	4	--	70	30	100	4
MCA 2.3	Artificial Intelligence	4	--	70	30	100	4
MCA 2.4	Business Analytics	4	--	70	30	100	4
MCA 2.5	Elective-I	4	--	70	30	100	4
MCA 2.6	Web Technologies Lab	--	3	50	50	100	2
MCA 2.7	Data Base Management Systems Lab	--	3	50	50	100	2
Total		20	6	450	250	700	24

Elective I

Computer Graphics/Embedded Systems/Formal Languages and Automata Theory/Management Accountancy

MCA 2.1	WEB TECHNOLOGIES	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives

1. to familiarize students with the formats and languages used in modern web-pages including HTML, CSS, XML, Javascript, DOM
2. to establish database connectivity using JDBC and implement embedded SQL
3. to introduce students to the concepts of servlet, JSP, client request handling and response and MVC architecture.

Course outcomes

After completion of the course the student should be able to:

1. understand and be able to analyse any real time web application
2. acquire working knowledge to develop web applications using both client side and server side scripting and retrieving data from databases
3. appreciate the importance of MVC architecture pattern in development of web applications.

Syllabus

1. Introduction to HTML , Core Elements , Links and Addressing, Images , Text , Colors and Background, Lists, Tables and Layouts , Frames, Forms , Cascading Style Sheets.
2. Introduction to Java Scripts, Elements of Objects in Java Script, Dynamic HTML with Java Script
3. Document type definition, XML Syntax, XML Schemas, Document Object model, Presenting XML, Using XML Processors
4. JDBC OBJECTS- JDBC Driver Types, JDBC Packages, Database Connection, Statement Objects, Result Set.
5. JDBC and Embedded SQL - Tables, Inserting Data into Tables , Selecting Data from a Table, Meta Data ,Updating Table , Deleting data from Table , Joining Table , Calculating Data, Grouping and Ordering Data , Sub quires ,View.
6. Introduction to Servlet, Servlet Life Cycles, Servlet Basics, Tomcat Web Server, Configuring Apache Tomcat, Handling Client Request and Response, Handling Cookies, Session Tracking
7. Introduction to JSP, Benefits of JSP, Basic Syntax, Invoking Java code with JSP Scripting Elements, JSP Page Directive, Including Files in JSP Pages,
8. Introduction to Java Beans, Using JAVA Bean Components in JSP Documents, MVC Architecture.

Text Books

1. Web Programming, building internet applications, 2nd Ed., Chris Bates, Wiley Dreamtech
2. The complete Reference HTML and DHTML, Thomas A. Powey
3. The complete Reference J2ME, James Keogh
4. Core Servlets and Java Server Pages, Marty Hall Larry Brown, Second Edition

Reference Books

1. Internet , World Wide Web , How to program, Dietel , Nieto, PHI/PEA
2. Web Technologies, Godbole, Kahate, 2nd Ed., TMH

MCA 2.2	**DATA BASE MANAGEMENT SYSTEMS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to introduce students to the database concepts of relational model, relational algebra, SQL and various database design architectures
2. to understand conceptual database design, ER diagrams, functional dependencies and standard database design practices such as normalization
3. to familiarize students with database application design tools including embedded SQL, JDBC, cursors and stored procedures
4. to understand transaction management, concurrency control and recovery systems.

Course outcomes

After completion of the course the student should be able to:

1. apply formal database ideas of ER diagrams, functional dependencies and normalization in development of real world database applications
2. be familiar with modern database application design tools and interfaces
3. understand the notion of concurrency, its importance in transactions and various recovery techniques.

Syllabus

1. **Database Systems**: Introduction to the Database Systems, Concepts of Relational Models and Relational Algebra. SQL: Introduction to SQL Queries, Integrity Constraints, Joins, Views, Intermediate and Advanced SQL features and Triggers.
2. **Database Design**: Overview of the Design process, E-R Models, Functional dependencies and other kinds of dependencies, Normal forms, Normalization and Schema Refinement.
3. **Database Application Design and Development**: User Interfaces and Tools, Embedded SQL, Dynamic SQL, Cursors and Stored procedures, JDBC, Security and Authorization in SQL, Internet Applications.
4. **Query Evaluation**: Overview, Query processing, Query optimization, Performance Tuning.
5. **Database System Architectures**: Centralized and Client-Server Architecture, Server system Architecture, Parallel and Distributed database, Object based databases and XML. Advanced data types in databases. Cloud based data storage systems.
6. **Transaction Management**: Overview of Transaction Management, Transactions, Concurrency control, Recovery systems, Advanced Transaction Processing.
7. **Case Studies**: Postgre SQL, Oracle, IBM DB2 Universal Database, Microsoft SQL Server.

Text Book

1. Database System Concepts, Avi Silberschatz , Henry F. Korth , S. Sudarshan McGraw- Hill, Sixth Edition, ISBN 0-07-352332-1.

Reference Book

1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke,McGraw-Hill.

MCA 2.3	ARTIFICIAL INTELLIGENCE	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives

1. to introduce students to the key concepts in AI, standard AI problems and techniques
2. to formulate AI problems as state space search and understand the standard search techniques including BFS, DFS, heuristic search techniques, hill climbing, Best-First Search, A* Algorithm, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis
3. to understand how knowledge is represented in computers, the various structured representations and symbolic logic
4. explore the key ideas in Expert Systems and Natural Language Processing.

Course outcomes

After completion of the course the student should be able to:

1. understand AI problem characteristics and state space approach for solving AI problem. The student will have learned several optimal search strategies and the use of heuristics
2. understand relational, inferential, inheritable and procedural knowledge and the corresponding knowledge representation approaches
3. acquire AI problem solving approaches to natural language processing, planning and expert systems.

Syllabus

1. **Introduction to Artificial Intelligence**: Artificial Intelligence, AI Problems, AI Techniques, The Level of the Model, Criteria For Success. Defining the Problem as a State Space Search, Problem Characteristics , Production Systems, , Production System Characteristics
2. **Search**: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis.
3. **Knowledge Representation**: Procedural Vs Declarative Knowledge, Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation, Logic Programming Forward Vs Backward Reasoning,
4. **Symbolic Logic**: Propositional Logic, First Order Predicate Logic: Representing Instance and is- a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification &Resolution, Representation Using Rules, Natural Deduction.
5. **Structured Representations of Knowledge**: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs, Scripts, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms.
6. **Reasoning under Uncertainty**: Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic & Fuzzy Systems.

7. **Experts Systems**: Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells
8. **Natural Language Processing**: Role of Knowledge in Language Understanding, Approaches Natural Language Understanding, Steps in The Natural Language Processing, Syntactic Processing and Augmented Transition Nets, Semantic Analysis, NLP Understanding Systems; Planning, Components of a Planning System, Goal Stack Planning, Hierarchical Planning, Reactive Systems.

Text Book

1. Artificial Intelligence, Elaine Rich, McGraw-Hill Publications

Reference Books

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI
2. Artificial Intelligence, George F Luger, Pearson Education Publications
3. Artificial Intelligence, Robert Schalkoff, Mcgraw-Hill Publications

MCA 2.4	**BUSINESS ANALYTICS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to introduce students to problem solving with Business Analytics and the use of spreadsheets for descriptive analytics, data queries and visualization
2. to introduce students to statistical sampling, sampling distributions, confidence intervals and statistical inference
3. to familiarize students with various types of regression including simple linear regression and multiple linear regression
4. to introduce students to key concepts in statistical forecasting models for time series data
5. to familiarize students with predictive decision modeling, model analysis and developing spreadsheet applications including building linear optimization models on spreadsheets.

Course outcomes

After completion of the course the student should be able to:

1. describe data and models used for Business Analytics and apply various descriptive analytic techniques to analyze data
2. estimating population parameters, interval estimates, construct confidence intervals and perform hypothesis testing
3. estimate and interpret the parameters of simple linear regression and multiple linear regression
4. apply forecasting models for various time series data including stationary time series, time series with linear trend and time series with seasonality
5. implement models on spreadsheets, develop user-friendly applications and build linear poptimization models on spreadsheets.

Syllabus

1. **Foundations of Business Analytics**: Evolution of Business Analytics, Scope, data and models for Business Analytics, problem solving with Business Analytics, Analytics on spreadsheets, Excel functions for Database queries, Add-ons for Business Analytics. **Descriptive Analytics**: Data visualization, creating charts in MS Excel, Data Queries, Tables, sorting and filtering, Data summarization with statistics, Data exploration using Pivot tables
2. **Statistical Sampling:** methods, estimating population parameters, sampling error, sampling distributions, interval estimates, confidence intervals, using confidence intervals for decision making, prediction intervals

   Statistical Inference: Hypothesis testing, one-sample Hypothesis testing, two-tailed test of Hypothesis for mean, two-sample Hypothesis testing, Analysis of variance, chi-square test for independence
3. **Trendliness and Regression:** Modelling Relationships and trends in data, Simple linear regression, least squares regression, regression on analysis of variance, testing hypothesis for regression coefficients, Confidence intervals for regression coefficients, Residual analysis and regression

assumptions, Multiple linear regression, building regression models, regression with categorical independent variables with two or more levels, regression with nonlinear terms, advanced techniques for regression modelling

4. **Forecasting Techniques:** Qualitative and judgemental forecasting, statistical forecasting models, forecasting models for stationery time series, forecasting models for time series with linear trend, forecasting models for time series with seasonality, selecting appropriate time-series-based forecasting models, regression forecasting with casual variables, practice of forecasting
5. **Spreadsheet modeling and Analysis:** Strategies for predictive decision modelling, Implementing models on spreadsheet, spreadsheet applications in Business analytics, Model assumptions, complexity and realism, developing user-friendly applications, analyzing uncertainty and model assumptions, model analysis using analytics solver platform
6. **Linear Optimization & Applications:** Building Linear Optimization Models on spreadsheets, solving Linear Optimization models, Graphical interpretation of linear optimization, Using optimization models of prediction and insight, Types of constraints in optimization models, process selection models, Blending Models, Portfolio Investment models

Text Book

1. “Business Analytics: Methods, Models, and Decisions” James R. Evans, Pearson Publications, Second edition

Reference Book

1. “Business Analytics: The Science of Data-Driven Decision Making”, U.Dinesh Kumar, Wiley Publications

<table>
<tr><td><b>MCA 2.5</b></td><td colspan="2"><b>Elective - I COMPUTER GRAPHICS</b></td></tr>
<tr><td colspan="2"><b>Instruction: 3 Periods & 1 Tut/week</b></td><td><b>Credits:4</b></td></tr>
<tr><td><b>Internal: 30 Marks</b></td><td><b>University Exam: 70 Marks</b></td><td><b>Total: 100 Marks</b></td></tr>
</table>

Course Objectives

1. Provides a comprehensive introduction to computer graphics with a foundation in Graphics Applications.
2. A thorough introduction to computer graphics techniques.
3. To give the basics of Geometric Transformations and projections.
4. To introduce three dimensional concepts and object representations with color models and basics of computer animation.

Course Outcomes

1. The students will understand graphics principles and graphics hardware.
2. The students can demonstrate geometrical transformations.
3. The students can create interactive graphics applications and demonstrate computer graphics animation.

Syllabus

1. **Introduction:** Computer Graphics and their applications: Computer Aided Design, Computer Art, Entertainment, Education and Training, Graphical User Interfaces; Overview of Graphics systems: Video Display Devices, Raster Scan Systems, Random Scan Systems, Graphics Monitors And Workstations, Input Devices, Hard Copy Devices, Interactive Input Methods, Windows and Icons, Virtual Reality Environments, Graphics Software
2. **Output primitives:** Points and Lines, **,** Line and Curve Attributes, Color and Gray scale levels, Antialiasing, Loading the Frame buffer, Line function, Line Drawing Algorithms, Circle Generating Algorithms, Ellipse Generating Algorithms, Pixel Addressing, Area Fill Attributes, Filled Area Primitives, Filled Area Functions, Cell Array, Character Generation, Character Attributes, Bundled Attributes, Curve Functions, Parallel Curve Algorithms.
3. **Two Dimensional Transformations:** Basic 2D Transformations, Matrix Representations, Homogeneous Coordinates, Composite Transformations, Other Transformations, Transformations between Coordinate Systems, AffineTransformations.
4. **Three Dimensional Transformations & Projections:** Translation, Rotation, Scaling, Other Transformations, Composite Transformations, 3D Transformation Functions, Modeling and Coordinate Transformations, Need for projections, Parallel & Perspective projections, General Projection Transformations.
5. **Viewing Pipeline and Clipping operations :** Viewing Pipeline ,Viewing Coordinates & Reference frames, Window-to-Viewport Coordinate Transformation, Two Dimensional Viewing Functions, , Three Dimensional Viewing, View Volumes, Clipping and its Operations, Types of clipping operations- Point Clipping, Line Clipping, Polygon Clipping,, Curve Clipping,, Text and Exterior Clipping.
6. **Three Dimensional Concepts and Object representations:** 3D display methods, 3D Graphics, Polygon Surfaces, Curved Lines and Surfaces, Quadratic Surfaces, Super Quadrics, Blobby Objects, SplineRepresentations, Cubic Spline methods, Bézier Curves and Surfaces, B-Spline Curves and Surfaces.

7. **Color Models and Basics of Computer Animation:** Intuitive color concepts, Basics of RGB Color model, YIQ Color Model, CMY & HSV Color models. Design of animation Sequences, Raster Animations, Key Frame systems: Morphing, A Simple program on Animation.

Text Book

1. Computer Graphics, Donald Hearn & M. Pauline Baker, Pearson Education, NewDelhi.

Reference Books

1. Procedural Elements for Computer Graphics, David F.Rogers, Tata Mc Graw Hill Book Company, NewDelhi, 2003.
2. Computer Graphics: Principles & PracticeinC, J.D.Foley, S.KFeiner, AVanDam F.H John Pearson Education, 2004.
3. Computer Graphics using Open GL, Franscis S Hill Jr, Pearson Education, 2004.
4. Computer Vision and Image Processing: A Practical Approach using CVIP tools, S.E. Umbaugh, Prentice Hall, 1998.

MCA 2.5	Elective-I **EMBEDDED SYSTEMS**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to make students familiar with embedded system architecture, Microprocessor Architecture, Round–Robin Architecture and typical hardware of an embedded system
2. to understand the concept of shared data and semaphores, message queues and RTOS design
3. to understand how to get the embedded software into target system and testing on host machine.

Course outcomes

After completion of the course the student should be able to:

1. describe embedded system architecture and its typical hardware
2. understand tasks and task states, shared data and semaphores, message queues
3. test embedded software on host machines using instruction set simulators

Syllabus

1. **Examples of Embedded Systems** – Typical Hardware – Memory – Microprocessors – Busses – Direct Memory Access – Introduction to 8051 Microcontroller – Architecture-Instruction set – Programming
2. **Microprocessor Architecture** – Interrupt Basics – The Shared-Data problem – Interrupt Latency.
3. **Round–Robin Architecture** - Round–Robin with Interrupts Architecture - Function-Queue-Scheduling Architecture – Real-Time Operating Systems Architecture – Selection of Architecture.
4. **Tasks and Task States** – Tasks and Data – Semaphores and Shared Data – Semaphore Problems – Semaphore variants.
5. **Message Queues** – Mailboxes – Pipes – Timer Functions – Events – Memory Management – Interrupt Routines in RTOS Environment.
6. **RTOS design** – Principles – Encapsulation Semaphores and Queues – Hard Real- Time Scheduling Considerations – Saving Memory Space – Saving Power.
7. **Host and Target Machines** – Linker/Locator for Embedded Software- Getting Embedded Software into the Target System.
8. **Testing on your Host Machine** – Instruction Set Simulators – Laboratory Tools used for Debugging.

Text Book

1. The 8051 Microcontroller Architecture, Programming & Applications, Kenneth J. Ayala, Penram International.
2. An Embedded Software Primer, David E. Simon, Pearson Education , 2005.

Reference Book

1. Embedded Systems: Architecture , Programming and Design, Raj Kamal, Tata McGraw-Hill Education, 2008

MCA 2.5	**Elective - I FORMAL LANGUAGES & AUTOMATA THEORY**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to introduce students to the concepts in automata theory and theory of computation to design grammars and recognizers for different formal languages
2. to employ finite state machines to solve problems in computing
3. to introduce context free grammars and Turing Machines and their properties as the basis for the formal expressivity of computer languages
4. to understand the concepts of tractability and decidability, the concepts of NP-completeness and NP-hard problems.

Course outcomes

After completion of the course the student should be able to:

1. think analytically for problem-solving situations in related areas of theory in computer science
2. describe the language accepted by an automata or generated by a regular expression or a context-free grammar
3. understand the functioning of Finite-State Machines, Deterministic Finite-State Automata, Nondeterministic Finite-State Automata and Pushdown Automata and Turing Machines.

Syllabus

1. **Finite Automata and Regular Expressions**: Basic Concepts of Finite State Systems, Deterministic and Non-Deterministic Finite Automata, Finite Automata with є-moves, Regular Expressions, Mealy and Moore Machines, Two-Way Finite Automate, Applications of FSM.
2. **Regular sets & Regular Grammars**: Basic Definitions of Formal Languages and Grammars, Regular Sets and Regular Grammars, Closure Properties of Regular Sets, Pumping Lemma for Regular Sets, Decision Algorithm for Regular Sets, Myhill-Nerode Theorem, Minimization of Finite Automata.
3. **Context Free Grammars and Languages**: Context Free Grammars and Languages, Derivation Trees, Simplification of Context Free Grammars, Normal Forms, Pumping Lemma for CFL, Closure properties of CFL's, Decision Algorithm for CFL.
4. **Push down Automata**: Informal Description, Definitions, Push-Down Automata and Context free Languages, Parsing and Push-Down Automata.
5. **Turing Machines**: The Definition of Turing Machine, Design and Techniques for Construction of Turing Machines, Combining Turing Machines.
6. **Universal Turing Machines and Undecidability** : Universal Turing Machines. The Halting Problem, Variants of Turing Machines, Restricted Turing Machines , Decidable & Undecidable Problems - Post Correspondence Problem.
7. **Chomsky Hierarchy of Languages:** Regular Grammars, Unrestricted Grammars, Context Sensitive languages, Relationship between Classes of Languages.

Text Book

1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman , Pearson Education Asia.

Reference Books

1. Introduction to languages and theory of computation – John C. Martin (MGH)
2. Theory of Computation, KLP Mishra and N. Chandra Sekhar, IV th Edition, PHI
3. Introduction to Theory of Computation – Michael Sipser (Thomson Nrools/Cole)

MCA 2.5	**Elective - I MANAGEMENT ACCOUNTANCY**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to introduce students to fundamental concepts in accounting, double entry book keeping and the basic books of accounts
2. to analyze financial statements by using ratio analysis and Fund Flow Statement
3. to explore the basic principles of budgetary control, marginal costing and break-even analysis
4. to familiarize students with computerized accounting systems

Course outcomes

After completion of the course the student should be able to:

1. prepare Trading, Profit And Loss Account And Balance Sheet of sole proprietary concerns
2. calculate key financial indicators using ratio analysis and prepare Fund Flow Statement
3. understand the key concepts in marginal costing and construct Break Even Chart.

Syllabus

1. **Principles Of Accounting** : Nature And Scope Of Accounting, Double Entry System Of Accounting, Introduction To Basic Books Of Accounts Of Sole Proprietary Concern, Closing Of Books Of Accounts And Preparation Of Trial Balance.
2. **Final Accounts** : Trading, Profit And Loss Accounts And Balance Sheet Of Sole Proprietary Concern With Normal Closing Entries. (With numerical problems)
3. **Ratio Analysis**: Meaning, Advantages, Limitations, Types of Ratio and Their Usefulness. (Theory only) Fund Flow Statement: Meaning Of The Term Fund, Flow Of Fund, Working Capital Cycle, Preparation and Inter-preparation Of Statement.
4. **Costing**: Nature, Importance And Basic Principles. Budget and Budgetary Control: Nature And Scope, Importance Method Of Finalization And Master Budget, Functional Budgets.
5. **Marginal Costing** : Nature, Scope, Importance, Construction Of Break Even Chart, Limitations And Uses Of Break Even Chart, Practical Applications Of Marginal Costing.(with numerical problems)
6. **Introduction To Computerized Accounting System**: Coding Logic And Codes Required, Master Files, Transaction Files, Introduction To Documents Used For Data Collection, Processing Of Different Files And Outputs Obtained.

Text Books

1. Introduction to Accountancy. T.S.Grewal.
2. Management Accountancy, S .P.Jain.

Reference Book

1. Introduction To Accounting, G.Agarwal

MCA 2.6	WEB TECHNOLOGIES LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course objectives

1. to introduce students to design of web pages learn and practice client and server side programming
2. to understand database connectivity and implement web enabling of databases
3. to apply multimedia effects on web pages.

Course outcomes

After completion of the course the student should be able to:

1. design web pages using modern web constructs and client and server side programming.
2. enable database connectivity to websites
3. apply multimedia effects on web pages design using Flash.

List of programs

1. Design of the Web pages using various features of HTML and DHTML
2. Client server programming using Servlets, ASP and JSP on the server side and java script on the client side
3. Web enabling of databases
4. Multimedia effects on web pages design using Flash.
5. Case Study: Design & Development of Websites with Database Connectivity and Multimedia Effects

Reference Books

1. Internet and Web Technologies by Raj Kamal, Tata McGraw-Hill
2. Programming the World Wide Web by Robert W. Sebesta, Pearson Education.

MCA 2.7	DATABASE MANAGEMENT SYSTEMS LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course Objectives

1. To introduce to a commercial DBMS such as ORACLE.
2. To learn and practice SQL commands for schema creation, data manipulation.
3. To learn conceptual and physical database design based on a case study.
4. To apply database design stages by studying a case study.

Course Outcomes

1. The student is exposed to a commercial RDBMS environment such as ORACLE.
2. The student will learn SQL commands for data definition and manipulation.
3. The student understands conceptual through physical data base design.
4. The student takes up a case study and applies the design steps.

Features of a commercial RDBMS package such as ORACLE/DB2, MS Access, MYSQL & Structured Query Language (SQL) used with the RDBMS.

I Laboratory Exercises should include

1. Defining Schemas for Applications,
2. Creation of Database,
3. Writing SQL Queries,
4. Retrieve Information from Database,
5. Creating Views
6. Creating Triggers
7. Normalization up to Third Normal Form
8. Use of Host Languages,
9. Interface with Embedded SQL,
10. Use of Forms
11. Report Writing

II Some sample applications are given below

1. Accounting Package for Shops,
2. Database Manager for Magazine Agency or Newspaper Agency,
3. Ticket Booking for Performances,
4. Preparing Greeting Cards & Birthday Cards

5. Personal Accounts - Insurance, Loans, Mortgage Payments, Etc.,
6. Doctor's Diary & Billing System
7. Personal Bank Account
8. Class Marks Management
9. Hostel Accounting
10. Video Tape Library,
11. History of Cricket Scores,
12. Cable TV Transmission Program Manager,
13. Personal Library.
14. Sailors Database
15. Suppliers and Parts Database

III Semester

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 3.1	Computer Networks	4	--	70	30	100	4
MCA 3.2	Python Programming	4	--	70	30	100	4
MCA 3.3	Software Engineering	4	--	70	30	100	4
MCA 3.4	Data Warehousing & Data Mining	4	--	70	30	100	4
MCA 3.5	Elective-II	4	--	70	30	100	4
MCA 3.6	Network Programming Lab	--	3	50	50	100	2
MCA 3.7	Python Programming Lab	--	3	50	50	100	2
Total		20	6	450	250	700	24

Elective II

Image Processing/Mobile Computing/ Network Security and Cryptography/E-Commerce

MCA 3.1	COMPUTER NETWORKS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives

1. to introduce to the students the basic requirements of network hardware, software and its architecture.
2. to familiarize the students with layered architecture of the network software and hierarchal nature of the network physical infrastructure
3. to study various network interconnecting devices and other associated network hardware
4. to introduce advanced networking concepts, wireless and wireless sensor networks.

Course outcomes

After completion of the course the student should be able to:

1. understand the design and estimate the requirements for practical setup of a given network scenario and size
2. realize the operation, maintenance and management of the internet by mapping the theoretical networking concepts to the real-time network scenarios
3. demonstrate the applications of wireless networks and overview of advanced networking concepts
4. identify different networking devices and their usage and functionality.

Syllabus

1. Introduction to Computer Networks: Introduction, Network Hardware, Network Software, Reference Models, Data Communication Services & Network Examples, Internet Based Applications.
2. Data Communications: Transmission Media, Wireless Transmission, Multiplexing, Switching, Transmission in ISDN, Broad Band ISDN , ATM Networks,
3. Data Link Control, Error Detection & Correction, Sliding Window Protocols, LANs & MANs: IEEE Standards for LANs & MANs-IEEE Standards 802.2, 802.3, 802.4, 802.5, 802.6, High Speed LANs.
4. Design Issues in Networks: Routing Algorithms, Congestion Control Algorithms, Net work Layer in the Internet, IP Protocol, IP Address, Subnets, and Internetworking.
5. Internet Transport Protocols: TRANSPORT Service, Elements of Transport Protocols, TCP and UDP Protocols, Quality of Service Model, Best Effort Model, Network Performance Issues.
6. Over View of DNS, SNMP, Electronic Mail, FTP, TFTP, BOOTP, HTTP Protocols, World Wide Web, Firewalls.
7. Network Devices: Over View of Repeaters, Bridges, Routers, Gateways, Multiprotocol Routers, Brouters, Hubs, Switches, Modems, Channel Service Unit CSU, Data Service Units DSU, NIC, Wireless Access Points, Transceivers, Firewalls, Proxies.
8. Overview of Cellular Networks, Ad-hoc Networks, Mobile Ad-hoc Networks, Sensor Networks.

Text Book

1. Computer Networks, Andrews S Tanenbaum,, Edition 5, PHI, ISBN:-81-203-1165-5

Reference Books

1. Data Communications and Networking , Behrouz A Forouzan , Tata McGraw- Hill Co Ltd , Second Edition, ISBN: 0-07-049935-7
2. Computer networks, Mayank Dave, CENGAGE.
3. Computer networks, A system Approach, 5th ed, Larry L Peterson and Bruce S Davie, Elsevier.
4. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education.
5. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson.

MCA 3.2	PYTHON PROGRAMMING	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives

1. To develop skills on procedural oriented and object oriented programming in Python.
2. To understand and apply different data wrangling techniques using Python.
3. To perform data analysis using python libraries like NumPy, Pandas and exploratory data analysis using Matplotlib

Course Outcomes

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

1. acquire programming knowledge on Basics of Python
2. acquire programming knowledge on Text and File Handling
3. develop Python programs to Mean, Median, Mode, Correlation
4. acquire programming knowledge on NumPy, Pandas Library
5. acquire programming knowledge on Graph Visualizations in Python and Data Analysis using Python

Syllabus

1. **Introduction to Python: Rapid Introduction to Procedular Programming, Data Types**: Identifiers and Keywords, Integral Types, Floating Point Types

   Strings: Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods, String formatting with str.format

   Collections Data Types: Tuples, Lists, Sets, dictionaries, Iterating and copying collections

2. **Python Control Structures, Functions and OOP:Control Structures and Functions**: Conditional Branching, Looping, Exception Handling, Custom Fuctions

   Python Library Modules: random, math, time, os, shutil, sys, glob, re, statistics,creating a custom module

   Object Oriented Programming: Object Oriented Concepts and Terminology, Custom Classes, Attributes and Methods, Inheritance and Polymorphism, Using Properties to Control Attribute Access

   File Handling: Writing and Reading Binary Data, Writing and Parsing Text Files

3. **NumPy Arrays and Vectorized Computation**: NumPy arrays, Array creation, Indexing and slicing, Fancy indexing, Numerical operations on arrays, Array functions, Data processing using arrays, Loading and saving data, Saving an array, Loading an array, Linear algebra with NumPy, NumPy random numbers

4. **Data Analysis with Pandas**: An overview of the Pandas package, The Pandas data structure-Series, The DataFrame, The Essential Basic Functionality: Reindexing and altering labels , Head and tail, Binary operations, Functional statistics , Function application Sorting, Indexing and selecting data, Computational tools, Working with Missing Data, Advanced Uses of Pandas for Data Analysis - Hierarchical indexing, The Panel data

5. **Data Analysis Application Examples**: Data munging,Cleaning data, Filtering, Merging data, Reshaping data, Data aggregation, Grouping data
6. **Data Visualization**: The matplotlib API primer-Line properties, Figures and subplots, Exploring plot types-Scatter plots, Bar plots, Histogram plots, Legends and annotations, Plotting functions with Pandas

Text Books

1. Programming in Python 3: A Complete Introduction to Python Language, Mark Summerfield, Second Edition, Addison-Wesley Publications
2. Python: End-to-End Data Analysis Learning Path, Module 1: Getting Started with Python Data Analysis , Phuong VothiHong , Martin Czygan, , Packt Publishing Ltd

Reference Books

1. Learning Python, 5th Edition, Mark Lutz, Orielly Publications
2. Python for Data Analysis, Wes McKinney, Orielly Publications
3. How to Think Like a Computer Scientist: Learning with Python 3 Documentation 3rd Edition, Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers
4. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
5. Python Cookbook – Recipes for Mastering Python 3,3rdEdition, David Beazley, Brian K. Jones, Oreilly

MCA 3.3	SOFTWARE ENGINEERING	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives

1. to explain the importance of OOSE in Software development.
2. to explain the importance of Requirements Engineering.
3. to explain the role of UML and Testing in Software Development.
4. to explain the entire Software Development Process with aid of case studies.

Course outcomes

After completion of the course the student should be able to:

1. define a problem and perform Requirements Engineering.
2. draw UML diagrams for the requirements gathered
3. implement the designed problem in Object Oriented Programming Language and
4. test whether all the requirements specified have been achieved or not.

Syllabus

1. **Introduction to Software Engineering:** Nature Of The Software, Types Of Software , Software Engineering Projects, Software Engineering Activities, Software Quality, Introduction To Object Orientation, Concepts Of Data Abstraction, Inheritance & Polymorphism, Software Process Models-Waterfall Model, The Opportunistic Model , The Phased Released Model, The Spiral Model, Evolutionary Model, The Concurrent Engineering Model
2. **Requirements Engineering:** Domain Analysis, Problem Definition And Scope, Requirements Definition, Types Of Requirements, Techniques For Gathering And Analyzing Requirements, Requirement Documents, Reviewing, Managing Change In Requirements.
3. **Unified Modeling Language & Use Case Modeling:** Introduction To UML, Modeling Concepts, Types Of UML Diagrams With Examples; User-Centred Design, Characteristics Of Users, Developing Use Case Models Of Systems, Use Case Diagram, Use Case Descriptions, The Basics Of User Interface Design, Usability Principles, User Interfaces.
4. **Class Design and Class Diagrams**: Essentials Of UML Class Diagrams, Associations And Multiplicity, Other Relationships, Generalization, Instance Diagrams, Advanced Features Of Class Diagrams, Interaction And Behavioural Diagrams: Interaction Diagrams, State Diagrams, Activity Diagrams, Component And Deployment Diagrams.
5. **Software Design And Architecture**: The Process Of Design, Principles Leading To Good Design, Techniques For Making Good Design Decisions, Writing A Good Design Document., Pattern Introduction, Design Patterns: The Abstraction-Occurrence Pattern, General Hierarchical Pattern, The Play-Role Pattern, The Singleton Pattern, The Observer Pattern, The Delegation Pattern, The Adaptor Pattern, The Façade Pattern, The Immutable Pattern, The Read-Only Interface Pattern And The Proxy Pattern; Software Architecture Contents Of An Architecture Model, Architectural Patterns: The Multilayer, Client-Server, Broker, Transaction Processing, Pipe & Filter And MVC Architectural Patterns

6. **Software Testing**: Overview Of Testing, Testing Concepts, Testing Activities, Testing Strategies, Unit Testing, Integration Testing, Function Testing, Structural Testing, Class Based Testing Strategies, Use Case/Scenario Based Testing, Regression Testing, Performance Testing, System Testing, Acceptance Testing, Installation Testing, OO Test Design Issues, Test Case Design, Quality Assurance, Root Cause Analysis, Post-Mortem Analysis.
7. **Software Project Management**: Introduction To Software Project Management, Activities Of Software Project Management, Structure Of Project Plan, Software Engineering Teams, Software Cost Estimation, Project Scheduling, Tracking And Monitoring.

Text Book

1. Object-Oriented Software Engineering Practical software development using UML and Java by Timothy C. Lethbridge & Robert, Langaniere Mcgraw-Hill

Reference Books

1. Object-Oriented Software Engineering: Using UML, Patterns and Java, Bernd Bruegge and Allen H. Dutoit, 2nd Edition, Pearson Education Asia.
2. Software Engineering: A Practitioner's Approach, Roger S Pressman.
3. A Practical Guide to Testing Object-Oriented Software, John D. McGregor; David A. Sykes, Addison-Wesley Professional.

MCA 3.4	**DATA WAREHOUSING & DATA MINING**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. To understand the evolution of data warehousing and data mining systems
2. To understand extracting, cleaning and transformation of data into a warehouse.
3. To learn the principles of statistics, information theory, machine learning and other areas AI and implementation of data mining techniques.
4. To understand pattern mining using classification and clustering methods.

Course outcomes

After completion of the course the student should be able to:

1. The student understands the differences between OLTP and OLAP.
2. The student learns how data cube technology supports summarization and querying high dimensional data.
3. The student is introduced to similarity, distance, information gain and other performance and error metrics used for evaluation of mining results.
4. The student is introduced to various approaches to association rule mining , supervised and unsupervised learning and the corresponding classification and clustering approaches involving decision trees, Bayesian approaches, model based and agglomerative approaches.

Syllabus

1. **Introduction to Data Mining**: Motivation and importance, What is Data Mining, Relational Databases, Data Warehouses, Transactional Databases, Advanced Database Systems and Advanced Database Applications, Data Mining Functionalities, Interestingness of a pattern Classification of Data Mining Systems, Major issues in Data Mining.
2. **Data Warehouse and OLAP Technology for Data Mining**: Data Warehouse, Multi- Dimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Development of Data Cube Technology, Data Warehousing to Data Mining
3. **Data Preprocessing**: Pre-process the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation
4. **Data Mining Primitives, Languages and system Architectures,Data Mining Primitives**: What defines a Data Mining Task?, A Data Mining query language, Designing Graphical Use Interfaces Based on a Data Mining Query language,Architectures of Data Mining Systems
5. **Concept Description**: Characterization and comparison ,Concept Description?, Data Generalization and summarization-based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between different Classes, Mining Descriptive Statistical Measures in large Databases

6. **Mining Association rule** in large Databases, Association Rule Mining, Mining Single- Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint-Based Association Mining
7. **Classification and prediction**, Concepts and Issues regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back-propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods like k-Nearest Neighbor Classifiers, Case- Based Reasoning, Generic Algorithms, Rough Set Approach, Fuzzy Set Approaches, Prediction, Classifier Accuracy
8. **Cluster Analysis**: Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods.

Text Book

1. Data Mining Concepts and Techniques, Jiawei Han and Kamber, Morgan Kaufman Publications

Reference Books

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

MCA 3.5	**Elective-II IMAGE PROCESSING**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to explain fundamentals of image processing concepts
2. to provide mathematical foundation of image enhancement, image compression and image segmentation.
3. to explain about morphology and its applications in image processing.
4. to explain various methods and techniques for image transformation.

Course outcomes

After completion of the course the student should be able to:

1. develop algorithms for fundamental concepts in Image processing.
2. perform image enhancement , image compression and image segmentation using various methods.
3. implement image transformation techniques

Syllabus

1. **Fundamentals of Image Processing**: Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels, distance measures, connectivity , Image Geometry, Photographic film. Histogram: Definition, decision of contrast basing on histogram, operatio ns basing on histograms like image stretching, image sliding, Image classification. Definition and Algorithm of Histogram equalization.
2. **Image Transforms**: A detail discussion on Fourier Transform, DFT,FFT, properties, WALSH Transform , WFT, HADAMARD Transform, DCT.
3. **Image Enhancement**: (by SPATIAL Domain Methods)Arithmetic and logical operations, pixel or point operations, size operations, Smoothing filters-Mean, Median, Mode filters – Comparative study, Edge enhancement filters – Directorial filters, Sobel, Laplacian, Robert, KIRSCH Homogeneity & DIFF Filters, prewitt filter, Contrast Based edge enhancement techniques. – Comparative study, Low Pass filters, High Pass filters, sharpening filters. – Comparative Study, Comparative study of all filters, Color image processing.
4. **Image enhancement**: (By FREQUENCY Domain Methods) -esign of Low pass, High pass, EDGE Enhancement, smoothening filters in Frequency Domain. Butter worth filter, Homomorphic filters in Frequency Domain Advantages of filters in frequency domain, comparative study of filters in frequency domain and spatial domain.
5. **Image compression**: Definition: A brief discussion on – Run length encoding, contour coding, Huffman code, compression due to change in domain, compression due to quantization Compression at the time of image transmission. Brief discussion on:- Image Compression standards.
6. **Image Segmentation**: Definition, characteristics of segmentation.

7. Detection of Discontinuities, Thresholding Pixel based segmentation method. Region based segmentation methods – segmentation by pixel aggregation, segmentation by sub region aggregation, histogram based segmentation, spilt and merge technique. Use of motion in segmentation (spatial domain technique only)
8. **Morphology**: Dilation, Erosion, Opening, closing, Hit-and-Miss transform, Boundary extraction, Region filling, connected components, thinning, Thickening, skeletons , Pruning Extensions to Gray – Scale Images Application of Morphology in I.P.

Text Book

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods Addision Wesley

Reference Books

1. Fundamentals of Electronic Image Processing by Arthyr –R – Weeks, Jr.(PHI)
2. Image processing, Analysis, and Machine vision by Milan Sonka vaclan Halavac Roger Boyle, Vikas Publishing House.

MCA 3.5	**Elective II MOBILE COMPUTING**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. to introduce students to infrastructure, principles, technologies, and applications of mobile computing and wireless IP
2. to familiarize students with wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices
3. understand the data issues in mobile computing including data replication and data dissemination.

Course outcomes

After completion of the course the student should be able to:

1. describe the infrastructure, principles, technologies, and applications of mobile computing technologies
2. understand wireless LANs, topologies and key concepts in wireless networking
3. understand key database issues in mobile computing, adaptive clustering and various data delivery mechanisms such as push-based mechanisms, pull-based mechanisms.

Syllabus

1. **Introduction to Mobile Communications and Computing**: Introduction to cellular concept, Frequency Reuse, Handoff, GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services, Introduction to mobile computing, novel applications, limitations, and architecture.
2. **Wireless LANs:** Introduction, Advantages and Disadvantages of WLANs, WLAN Topologies, Introduction to Wireless Local Area Network standard IEEE 802.11, Comparison of IEEE 802.11a, b, g and n standards, Wireless PANs, Hiper LAN, Wireless Local Loop
3. **Wireless Networking:** Introduction, Various generations of wireless networks, Fixed network transmission hierarchy, Differences in wireless and fixed telephone networks, Traffic routing in wireless networks, WAN link connection technologies, X.25 protocol, Frame Relay, ATM, Virtual private networks, Wireless data services, Common channel signaling, Various networks for connecting to the internet.
4. **Database Issues:** Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations.
5. **Data Dissemination:** Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.
6. **Mobile IP and Wireless Application Protocol:** Introduction to Mobile IP, Introduction to Wireless Application Protocol, Application layer.

Text Books

1. Gottapu Sasibhushana Rao, “Mobile Cellular Communication”, Pearson Education, First Edition, 2013.
2. Stojmenovic and Cacute, “Handbook of Wireless Networks and Mobile Computing”, Wiley, 2002.

MCA 3.5	Elective II **NETWORK SECURITY AND CRYPTOGRAPHY**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. introduce students to key concepts in confidentiality and data integrity and issues involved in network security
2. to familiarize students with various cryptographic techniques
3. introduce students to number theory and algorithms in Public Key Cryptography
4. explore different types of security threats in IP, web, systems, electronic mail and their remedies.

Course outcomes

After completion of the course the student should be able to:

1. understand the importance of network and data security in the Internet and in the distributed environments
2. apply various cryptographic techniques in different contexts
3. identify the different types of network security issues and their remedies.

Syllabus

1. **Introduction**: Confidentiality -- Data Integrity -- Authentication -- Non-Repudiation-- Overview of Issues involved.
2. **Classical Encryption Techniques**: Monoalphabetic, Substitution Methods, Polyalphabetic Substation Methods -- Permutation Methods -- Cryptanalysis of these Methods.
3. **Modern Encryption Techniques**: Simplified DES -- DES -- Triple DES -- Block Cipher , Design Principles -- Block Cipher Modes of Operation. IDEA -- Security Issues Involved with these methods.
4. **Confidentiality Using Conventional Encryption**: Placement of Encryption -- Traffic Confidentiality -- Key Distribution -- Random Number , Generation.
5. **Introduction to Number Theory**: (Basics Pertaining to Security Related Algorithms).
6. **Public Key Cryptography**: Principles -- RSA Algorithm. Message Authentication and Hash Functions -- Hash an MAC Algorithms. Digi Signatures and Authentication Protocols -- Authentication Applications
7. Basic Overview of :Electronic Mail Security -- IP Security -- WEB Security
8. **System Security** : Intruders, Viruses and Worms – Firewalls.

Text Book

1. Cryptography and Network Security, William Stallings. (Second Edition) Pearson Education Asia

Reference Books

1. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes-Ousley, Keith Strassberg Tata Mcgraw-Hill
2. Handbook of Applied Cryptography.

MCA 3.5	**Elective-II** **E-COMMERCE**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. introduce students to various application of e-commerce in commerce, organizational and consumer domains
2. familiarize students with types of Electronic Payment Systems, their design principles and the risks in these systems
3. introduce the key concepts of Electronic Data Inter Change and Intra Organizational Commerce
4. explore the advertising, marketing and multimedia concepts in e-commerce.

Course outcomes

After completion of the course the student should be able to:

1. be familiar with the key application areas of e-commerce in different domains
2. understand the types of Electronic Payment Systems and risks involved in these systems
3. understand key concepts in Electronic Data Inter Change and Intra Organizational Commerce including Work Flow Automation and Supply Chain Management
4. be familiar with advertising, marketing and multimedia concepts in e-commerce such as information based marketing, consumer search, information retrieval and filtering.

Syllabus

1. Introduction: Electronic Commerce-Frame Work, Anatomy of E-Commerce Applications, E-Commerce Consumer Applications, E-Commerce Organization Applications. Consumer Oriented Electronic Commerce - Mercantile Process Models.
2. Electronic Payment Systems – Types of Electronic Payment Systems, Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment Systems, Designing Electronic Payment Systems
3. Electronic Data Inter Change, Inter Organizational Commerce - EDI, EDI Implementation, Value Added Networks.
4. Intra Organizational Commerce, Macro Forces And Internal Commerce, Work Flow Automation and Coordination, Customization And Internal Commerce, Supply Chain Management.
5. Business Cases for Document Library, Digital Document Types, Corporate Data Ware-Houses.
6. Advertising And Marketing: Information Based Marketing, Advertising On Internet, Online Marketing Process, Market Research. Consumer Search and Resource Discovery, Information Search and Retrieval, Commerce Catalogues, Information Filtering.
7. Multimedia-Key Multimedia Concepts, Digital Video and Electronic Commerce, Desktop Video Processing, Desktop Video Conferencing.

Text Book

1. Frontiers of Electronic Commerce, Kalakata and Whinston, Pearson.

Reference Books

1. E-Commerce fundamentals and Applications, Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, John Wiley.
2. E-Commerce, S.Jaiswal, Galgotia.
3. E-Commerce, Efrain Turbon, Jae Lee, David King, H.Michael Chang.
4. E-Commerce - Business, Technology and Society, Kenneth C.Taudon, Carol Guyerico Traver.

MCA 3.6	NETWORK PROGRAMMING LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course objectives

1. identification of well known ports on a remote system and providing user interface to contact them
2. development of chat application including one-to-one and broadcast
3. development of HTTP server and retrieval of data from remote database by executing SQL queries
4. sending and receiving mails using mail clients including POP and SMTP
5. transfer of files between systems and development of TFTP client

Course outcomes

After completion of the course the student should be able to:

1. identifying well known ports on a remote system and be able to simulate Telnet
2. develop chat application by opening socket connections
3. develop HTTP server to implement GET, POST, HEAD, DELETE commands and retrieve data from remote database
4. send email using SMTP commands and retrieve and manipulate mail box using POP commands
5. transfer files between two systems without protocols and develop a TFTP client.

List of programs

1. Identifying well known ports on a Remote System :By trying to listen to the various well known ports by opening client connections. If the exception does not occur then the remote port is active else the remote port is inactive.
2. Writing a Chat application :
   i. One-One: By opening socket connection and displaying what is written by one party to the other.
   ii. Many-Many (Broad cast): Each client opens a socket connection to the chat server and writes to the socket. Whatever is written by one party can be seen by all other parties.
3. Data retrieval from a Remote database: At the remote database a server listens for client connections. This server accepts SQL queries from the client, executes it on the database and sends the response to the client.
4. Mail Client:
   i. POP Client : Gives the server name , user name and password retrieve the mails and allow manipulation of mail box using POP commands.
   ii. SMTP Client : Gives the server name, send e-mail to the recipient using SMTP commands

5. Simulation of Telnet: Provide a user interface to contact well-known ports, so that client- server interaction can be seen by the user.
6. Simple file transfer between two systems (without protocols): By opening socket connection to our server on one system and sending a file from one system to another.
7. TFTP- Client:To develop a TFTP client for file transfer. (Unix Network programming- Stevens.)
8. HTTP-Server: Develop a HTTP server to implement the following commands. GET, POST, HEAD, DELETE. The server must handle multiple clients.

Reference Books

1. Java Network Programming, Harol, Orielly Publications
2. An Introduction to Computer Networking, Kenneth C. Mansfield Jr and James L. Antonakos, Pearson Education Asia

MCA 3.7	**PYTHON PROGRAMMING LAB**	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

Course objectives

1. familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling
2. introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation
3. familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and dataframes
4. introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others
5. implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and cross-validation.

Course outcomes

After completion of the course the student should be able to:

1. implement searching, sorting and handle text and files using Python data structures such as lists and dictionaries
2. calculate statistical measures using Python such as measures of central tendency, correlation
3. use Python data related libraries such as Numpy and Pandas and create data visualizations
4. implement basic machine learning tasks pre-processing data, compressing data, clustering, classification and cross-validation.

Syllabus

1. Python Programs on lists & Dictionaries
2. Python Programs on Searching and sorting
3. Python Programs on Text Handling
4. Python Programs on File Handling
5. Python Programs for calculating Mean, Mode, Median, Variance, Standard Deviation
6. Python Programs for Karl Pearson Coefficient of Correlation, Rank Correlation
7. Python Programs on NumPy Arrays, Linear algebra with NumPy
8. Python Programs for creation and manipulation of DataFrames using Pandas Library
9. Write a Python program for the following.
    - Simple Line Plots,
    - Adjusting the Plot: Line Colors and Styles, Axes Limits, Labeling Plots,
    - Simple Scatter Plots,

- Histograms,
- Customizing Plot Legends,
- Choosing Elements for the Legend,
- Boxplot
- Multiple Legends,
- Customizing Colorbars,
- Multiple Subplots,
- Text and Annotation,
- Customizing Ticks

10. Python Programs for Data preprocessing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features
11. Python Program for Compressing data via dimensionality reduction: PCA
12. Python Programs for Data Clustering
13. Python Programs for Classification
14. Python Programs for Model Evaluation: K-fold cross validation

Reference Books

1. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
2. Chris Albon, “Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning”, O’REILLY Publisher,2018
3. Mark Summerfield, Programming in Python 3--A Complete Introduction to the Python Language, Second Edition, Additson Wesley
4. Phuong Vo.T.H , Martin Czygan, Getting Started with Python Data Analysis, Packt Publishing Ltd
5. Armando Fandango, Python Data Analysis, Packt Publishing Ltd
6. Magnus Vilhelm Persson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing Ltd
7. Sebastian Raschka& Vahid Mirjalili, “Python Machine Learning”, Packt Publisher, 2017

IV Semester

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 4.1	Data Science	4	--	70	30	100	4
MCA 4.2	Elective III	4	--	70	30	100	4
MCA 4.3	Project Work	--	6	50	50	100	14
Total		8	6	190	110	300	22

Elective III

Internet of Things (IoT) / Machine Learning / Cloud Computing / Distributed Systems

MCA 4.1	**DATA SCIENCE**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. introduce students to the process involved in data science projects
2. familiarize students with basics of preparation, exploration and visualization of data
3. introduce students to modeling methods such as clustering, classification, regression and model evaluation
4. introduce students to recommendation engines and various methods in time series forecasting
5. familiarize students with basics of anomaly detection and feature selection.

Course outcomes

After completion of the course the student should be able to:

1. describe about Data Science and its process
2. differentiate between the classification and regression methods
3. apply clustering and evaluate the methods
4. understand and analyze the text mining and time series forecasting applications.
5. assess different feature selection methods and use in applications.

Syllabus

1. **Introduction:** Data Science, Data Science Process: Process, Data, Data Preparation, Modeling. **Data Exploration:** Objectives, Types of data, Descriptive Statistics, Data Visualization, Roadmaps for data Exploration
2. **Classification Methods:** K-Nearest Neighbors, Decision Trees, Rule Induction, Naive Bayesian, Ensemble Learners **Regression Methods:** Linear Regression, Logistic Regression
3. **Clustering**: k-means, DBSCAN, Self-Organizing Maps **Model Evaluation**: Confusion Matrix, ROC and AUC, Lift Curves, Implementation
4. **Recommendation Engines:** Concepts, Collaborative Filtering, Content Based Filtering, Hybrid Recommendation **Time Series Forecasting:** Decomposition, Smoothing, Regression and Machine Learning Methods, Performance Evaluation
5. **Anomaly Detection:** Concepts, Distance and Density based Outlier Detection, Local Outlier Factor **Feature Selection:** Classifying Feature Selection Methods, PCA, and Information Theory based Filtering; Chi-Square based Filtering, Wrapper type feature selection.

Text Book

1. Vijay Kotu, BalaDeshpande, Data Science Concepts and Practice, Second Edition, Morgan Kaufmann Publishers, An imprint of Elsevier, 2019

References

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly 2014
2. Joel Grus, Data Science from scratch, Second Edition, O'Reilly 2019.

MCA 4.2	Elective-III **Internet of Things (IoT)**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. provide students a conceptual framework and architectural view of IoT
2. introduce students to design principles for connected devices and for web connection
3. familiarize students with acquiring, organizing and processing of data and analytics using cloud platform and IoT cloud-based services
4. introduce students to key concepts in sensors, RFIDs, and wireless sensor networks
5. introduce students to prototyping embedded devices for IoT and various IoT supported hardware platforms.

Course outcomes

After completion of the course the student should be able to:

1. describe the framework, architecture of IoT, technology behind IoT and the key components that makeup an IOT system
2. understand the design principles for connected devices, for web connection and web communication protocols for connected devices
3. collect, store, organize and process data using IoT cloud-based services and appreciate the role of big data, cloud computing and data analytics in a typical IoT system
4. understand key concepts in sensors, RFIDs, and wireless sensor networks including applications in industrial IoT and automotive IoT,
5. understand embedded computing basics, prototyping, designing software for IoT applications and various IoT supported hardware platforms including Raspberry pi, ARM Cortex Processors.

Syllabus

1. Internet of Things - An Overview: Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT.
2. Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway
3. Design Principles for Web connection: Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Devices Network using Gateway, SOAP, REST, HTTP RESTful and Web Socket's
4. Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise Systems, Analytics, Knowledge Acquiring, Managing and Storing Processes; Data Collection, Storage and Computing Using a Cloud Platform; Cloud Computing Paradigm for Data Collection, Storage and Computing, everything as a Service and Cloud Service Models, IoT Cloud-Based Services Using the Xively.

5. Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks: Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology.

6. Prototyping the Embedded Devices for IoT and M2M: Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet; Prototyping and Designing the Software for IoT Applications; Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs Key Concepts.

7. Overview of IoT supported Hardware platforms: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo IoT Case Studies; Design Layers, Design Complexity and Designing Using Cloud PaaS; IoT/IIot Applications in the Premises, Supply-Chain and Customer Monitoring.

Text Books

1. Internet of Things by Raj Kamal, McGrahill Publications 2017.

2. Internet of Things Principles and Paradigms by Rajkumar Buyya and Amir Vahid Dastjerdi, Morgan Kaufmann, 2016

MCA 4.2	**Elective-III MACHINE LEARNING**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. introduce students to the approaches to machine learning and related algorithms
2. familiarize students with ideas of concept learning, version spaces and issues regarding data sources
3. understand representation and learning using Decision Trees, Neural Networks, Genetic Algorithms
4. introduce students to Bayesian approaches and key concepts of Expectation Maximization
5. introduce students to inductive and analytical learning problems and related concepts of inductive bias, using prior knowledge to initialize the hypothesis.

Course outcomes

After completion of the course the student should be able to:

1. describe learning tasks and various approaches, algorithms in machine learning
2. understand concept learning, version spaces and related concepts of bias-free learning and active queries
3. represent and formulate problems in Decision Trees, Neural Networks, Genetic Algorithms
4. understand the basics of Bayes theorem and key concepts of Expectation Maximization in Bayesian approaches.

Syllabus

1. **Introduction:** Introduction to Machine Learning, learning task- illustration, Approaches to Machine Learning, Machine Learning algorithms- Theory, Experiment in biology and Psychology.
2. **Concept Learning**: Introduction, Concept Learning Task- Notation, Concept Learning Search, Version spaces, Candidate Elimination Algorithm, Inductive Bias, Biased hypothesis Space, Unbiased Learner, Bias-free Learning, Active queries, Mistake bound/PAC model – basic results. Overview of issues regarding data sources, success criteria
3. **Decision Tree Learning**: Decision Tree Representation, Basic decision Tree Learning, Inductive bias in Decision tree Learning, Issues in Decision Tree Learning, Minimum Description Length Principle, Occam's razor, Learning with active queries
4. **Neural Network Learning:** Neural Network Representation, Problems for Neural Network Learning, Perceptions and gradient descent, Multi Layer Network and Back propagation Algorithm, Illustrative Example of Back Propagation Algorithm- Face Recognition, Advanced Topics in ANN.
5. **Bayesian Approaches**: Basics of Bayes Theorem and Concept Learning, Expectation Maximization, Minimum Description Length Principle, Navie Bayes Classifier, Bayesian Belief Networks, EM Algorithm, K-Means Algorithm, Hidden Markov Models Instance-Based Techniques; Lazy vs. eager generalization, k nearest neighbor, Locally Weight Representation, Case-based Reasoning

6. **Analytical Learning**: Inductive and Analytical Learning problems, Learning with perfect Domain Theory, Explanation Based Learning, Inductive Bias in EBL, Search Control Knowledge with EBL, Inductive- Analytical Approaches to Learning, Using prior Knowledge for Initialize the Hypothesis, and Altering Search objective, FOCL Algorithm.
7. **Genetic Algorithms**: Representation of Hypothesis as GA,, Genetic Operators, Fitness function and Selection, Hypothesis Space search, Genetic Programming, Models of Evolution and Learning, Parallelizing GA, Different search methods for induction.

Text Books

1. Machine Learning, Tom Mitchell , McGraw Hill,1997
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani & Jerome Friedman, Springer Verlag, 2001

Reference Books

1. Pattern Classification, Richard 0. Duda, Peter E. Hart and David G. Stork, John Wiley & Sons Inc.,2001
2. Neural Networks for Pattern Recognition, Chris Bishop, Oxford University Press, 1995

MCA 4.2	Elective-III CLOUD COMPUTING	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course objectives

1. introduce students to the benefits, limitations, security concerns and regulatory issues in cloud computing
2. familiarize students with the hardware and infrastructure in cloud computing
3. provide the driving forces for Software as a Service, mobile device integration, local clouds and thin clients
4. introduce students to migrating to the cloud and best practices for migration.

Course outcomes

After completion of the course the student should be able to:

1. describe the benefits and limitations of cloud computing
2. identify the architecture and infrastructure of cloud computing including web APIs, cloud storage and deployment methods of cloud computing
3. understand the driving forces for Software as a Service
4. understand the concepts in development, troubleshooting, management of cloud computing applications
5. describe the best practices in cloud computing and understand how cloud computing might evolve in future.

Syllabus

1. Cloud Computing Basics - Cloud Computing Overview, Applications, Intranets and the Cloud, First Movers in the Cloud. The Business Case for Going to the Cloud - Cloud Computing Services, Business Applications, Deleting Your Datacenter, Salesforce.com, Thomson Reuters.
2. Organization and Cloud Computing - When You Can Use Cloud Computing, Benefits, Limitations, Security Concerns, Regulatory Issues, Cloud Computing with the Titans - Google, EMC, NetApp, Microsoft, Amazon, Salesforce.com, IBM Partnerships.
3. Hardware and Infrastructure - Clients, Security, Network, Services. Accessing the Cloud - Platforms, Web Applications, Web APIs, Web Browsers. Cloud Storage - Overview, Cloud Storage Providers, Standards - Application, Client, Infrastructure, Service.
4. Software as a Service - Overview, Driving Forces, Company Offerings, Industries Software plus Services - Overview, Mobile Device Integration, Providers, Microsoft Online.
5. Developing Applications - Google, Microsoft, Intuit QuickBase, Cast Iron Cloud, Bungee Connect, Development, Troubleshooting, Application Management.

6. Local Clouds and Thin Clients - Virtualization in Your Organization, Server Solutions, Thin Clients, Case Study: McNeilus Steel.
7. Migrating to the Cloud - Cloud Services for Individuals, Cloud Services Aimed at the Mid- Market, Enterprise-Class Cloud Offerings, Migration, Best Practices and the Future of Cloud Computing - Analyze Your Service, Best Practices, How Cloud Computing Might Evolve.

Text Book

1. Cloud Computing-A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGrawHill.

MCA 4.2	Elective III **Distributed Systems**	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course objectives

1. introduce students to the principles, architecture of distributed databases
2. understand the concepts of global queries, fragment queries and equivalence transformations
3. familiarize students with concepts of atomicity, concurrency control for distributed transactions and distributed deadlocks
4. introduce students to multidatabase concurrency control and multidatabase recovery.

Course outcomes

After completion of the course the student should be able to:

1. describe the key principles, architecture and integrity constraints in distributed databases
2. transform global queries into fragment queries and understand strategies for optimized access
3. understand the management of distributed transactions, concurrency control for distributed transactions, distributed deadlocks, detection and resolution of inconsistency
4. describe multidatabase concurrency control, multidatabase recovery and database interoperability

Syllabus

1. Features of Distributed versus Centralized Databases, Principles Of Distributed Databases, Levels Of Distribution Transparency, Reference Architecture for Distributed Databases , Types of Data Fragmentation, Integrity Constraints in Distributed Databases.
2. Translation of Global Queries to Fragment Queries, Equivalence Trans-formations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.
3. Optimization of Access Strategies, A Framework for Query Optimization, Join Queries, General Queries.
4. The Management of Distributed Transactions, A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions.
5. Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.
6. Reliability, Basic Concepts, Nonblocking Commitment Protocols, Re-liability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection
7. Architectural Issues, Alternative Client/Server Architectures, Cache Consistency Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution , Transaction Management, Transaction Management in Object DBMSs , Transactions as Objects.

8. Database Integration, Scheme Translation, Scheme Integration, Query Processing Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues. Transaction Management Transaction and Computation Model Multidatabase Concurrency Control, Multidatabase Recovery, Object Orientation And Interoperability Object Management Architecture CORBA and Database Interoperability Distributed Component Model COM/OLE and Database Interoperability, PUSH-Based Technologies.

Text Books

1. Distributed Database Principles and Systems, Stefano Ceri, Giuseppe Pelagatti, McGraw-Hill
2. Principles of Distributed Database Systems, M.Tamer Ozsu, Patrick Valduriez - Pearson Education.
3. Distributed Database Principles and Systems, Stefano Ceri, Giuseppe Pelagatti, McGraw-Hill.

Reference Book

1. Principles of Distributed Database Systems, M.Tamer Ozsu, Patrick Valduriez - Pearson Education.

IV Semester Project Guidelines

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 4.3	Project Work	--	--	50	50	100	14

1. Three Stages In Project adjudication:
   Stage I: Presentation of Concept Note & Problem Approval by Guide
   Stage II; Progress Approval by System Demonstration with results Internal -50 Marks
   Stage III: Final Presentation with Documentation & External Viva-Voce - 50 Marks
2. Candidates can do their thesis work within the department or in association with any industry/research organization. In case of thesis done in association with an industry/research organization, one advisor (Guide) should be from the department and one advisor(CO-Guide) should be from the industry/research organization.
3. A publication of a paper on the thesis work in a National/International Conference proceedings with presentation certificate or a paper on the thesis work be communicated to a National/International Journal & accepted for publication for the submission of thesis at the end of 4th semester is desirable.
4. The external examiner shall be nominated by the Chairman, Board of Examiners in ITCA as per the norms of the University.

Code	Name of the subject			Max. Marks		Total	Credits
		Theory (Hrs)	Lab (Hrs)	Ext.	Int.		
Total (Complete Course)		68	24	1540	860	2400	94