Indira Gandhi Delhi Technical University for Women

(Established by Govt. of Delhi vide Act 09 of 2012)

Kashmere Gate, Delhi–110006

Scheme of Examination

&

Detailed Syllabus

(w.e.f. Academic Year 2020-2021 onwards)

for

Master of Computer Applications

Department of Information Technology

PROGRAMME OUTCOMES

Post Graduates of Master of Computer Application will be able to:

PO1. Apply knowledge of Computing fundamentals, Computing specialization, Mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.

PO2. Design and develop applications to analyze and solve all computer science related problems.

PO3. Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.

PO4. Analyze and review literatures to invoke the research skills to design, interpret and make inferences from the resulting data.

PO5. Integrate and apply efficiently the contemporary IT tools to all computer applications.

PO6. Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

PO7. Involve in perennial learning for a continued career development and progress as a computer professional.

PO8. Function effectively both as a team leader and team member on multi-disciplinary projects to demonstrate computing and management skills.

PO9. Communicate effectively and present technical information in oral and written reports.

PO10. Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

PO11. Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

PO12. Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

PROGRAMME SPECIFIC OUTCOMES

PSO1. Design, develop and implement interdisciplinary application software projects to meet the demands of industry requirements using modern tools and technologies.

PSO2. To prepare graduates who will perform both as an individual and in a team through good analytical, design and implementation skills.

PSO3. To prepare graduates who will be lifelong learners through continuous professional development.

FIRST SEMESTER

S. No.	Course Code	Course	L-T-P	Credits	Course Category
1	MCA-101	Programming with Python	3-0-2	4	DCC
2	MCA-103	Database Management Systems	3-0-2	4	DCC
3	MCA-105	Data and File Structures	3-0-2	4	DCC
4	MCA-107	Operating Systems	3-0-2	4	DCC
5	HMC-101	Professional Skills	3-0-0	3	HMC
6	MCA-109	IT Workshop – I	1-0-2	2	DCC
7.	BCS - 110	Programming in C language	Noncredit courses are mandatory to pass for students with B.Sc./ B.Com./ B.A. degree (Non-Computer Science/Non-IT) with Mathematics at 10+2 Level or at Graduation Level		Bridge course (Courses are from the CSE Deptt. of the University, syllabi are already approved)
8.	BCS - 203	Discrete Structures			
Total				21	

SECOND SEMESTER

S. No.	Code	Subject	L-T-P	Credits	Category
1	MCA-102	Object Oriented Programming using Java	3-0-2	4	DCC
2	MCA-104	Machine Learning	3-0-2	4	DCC
3	MCA-106	Software Engineering	3-0-2	4	DCC
4	MCA 108	Data Communication and Computer Networks	3-0-2	4	DCC
5	MCA-110	IT Workshop –II	1-0-2	2	DCC
6	HMC-102	Human Values and Professional Ethics	3-0-0	3	HMC
7	GEC-102	Generic Open Elective	0-2-0 0-0-4 2-0-0	2	GEC
Total				23	

THIRD SEMESTER

S. No.	Code	Subject	L-T-P	Credits	Category
1	MCA-201	Design and Analysis of Algorithms	3-0-2	4	DCC
2	MCA-203	Big Data and NoSQL	3-0-2	4	DCC
3	MCA-205	Software Testing and Quality Assurance	3-0-2	4	DCC
4	MCA-2xx	Departmental Elective-1	3-0-2 3-1-0	4	DEC
5	MCA-2xx	Departmental Elective-2	3-0-2 3-1-0	4	DEC
6	MCA-253	Industrial Training/Internship	-	1	DCC
7	HMC-203	Financial Reporting and Analysis	3-0-0	3	HMC
Total				24	

FOURTH SEMESTER

S.No.	Code	Subject	L-T-P	Credits	Category
1	HMC-202	Disaster Management	1-0-2	2	HMC
2	GEC-202	Generic Open Elective	0-2-0 0-0-4 2-0-0	2	GEC
3	MCA-202	Major Project	-	18	DCC
Total				22	

List of Departmental Elective Courses: The list of departmental electives is tentative. Before the commencement of the academic semester, any elective along with their L-T-P structure can be added or dropped from the respective elective basket depending upon the academic requirement or current industry trend.

Category	Course Code	Subjects	L-T-P
Departmental Elective Course (DEC)	MCA-207	Cyber Security	3-0-2
	MCA-209	Cryptography and Network Security	3-0-2
	MCA-211	Requirements Engineering	3-1-0
	MCA-213	Cloud Computing and IoT	3-0-2
	MCA-215	Blockchain Technologies	3-0-2
	MCA-217	Privacy and Security in Online Social Networks	3-0-2
	MCA-219	Mobile Computing	3-0-2
	MCA-221	Soft Computing	3-0-2
	MCA-223	Web-based Programming	3-0-2
	MCA-225	Front End Design Techniques	3-0-2
	MCA-227	Software Project Management	3-0-2
	MCA-229	Agile Methodology and DevOps	3-1-0
	MCA-231	Digital Image Processing and Computer Vision	3-0-2
	MCA-233	Computer Graphics and Animation	3-0-2
	MCA- 235	Conceptual Modelling	3-0-2
	MCA- 237	Natural Language Processing	3-0-2
	MCA- 239	Wireless networks	3-0-2

Programming with Python

Course Code: MCA-101 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 1

Introduction: Python is a versatile programming language, suitable for projects ranging from small scripts to large systems. It is widely used in many scientific areas for data exploration. This course will be useful for both text and data processing.

Course Objectives:

- To know the basics of algorithmic problem solving for reading and writing Python programs.
- To develop Python programs with conditions and loops.
- To use Python data structures –- lists, tuples dictionaries.
- To define Python functions and call them.
- To do input/output with files in Python

Prerequisite: Basics of Programming and logic design.

Course Outcomes: After completion of the subject, students will be able to:

CO1: Understand the fundamental Python syntax and semantics and be fluent in Python control flow statements.

CO2: Apply the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, and sets.

CO3: Implement Object-Oriented Programming concepts such as encapsulation, inheritance, and polymorphism as used in Python.

CO4: Create projects with a graphical user interface to solve real-time problems.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT-I	**10 hours**
The Structuring Programming Principle, Program Structuring, Stepwise refinement, Introduction to Python programming language, The concept of data types, variables, assignments, immutable variables, numerical types, arithmetic operators, Data and Expressions, Literals, Variables and Identifiers, Understanding error messages, Conditions, Boolean Logic, Logical Operators, ranges, Control statements: if-else, loops (for, while);	
UNIT-II	**10 hours**
Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab separated); String manipulations: subscript operator, indexing, slicing a string, Lists, Tuples, and Dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries; Function, Execution of A Function, Keyword and Default Arguments, Scope Rules.	
UNIT-III	**10 hours**
Exception, Testing and Debugging: Handling if exceptions to handle the code cracks, handling and helping file operations, coding with the exceptional handling and testing Anonymous method, Properties, Indexers, Exception Handling	
UNIT-IV	**10 hours**
Simple programs using the built-in functions of packages like matplotlib, numpy, pandas etc., Graphical user interfaces; Tkinter introduction, Tkinter and Python Programming, event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.	
Text Books	
1. C. Dierbach, "Introduction to Computer Science Using Python: A Computational Problem-Solving Focus", Wiley, 1st Edition, 2015/Latest Edition.	
2. Y.Kanetkar, "Let Us Python", BPB Publishers, 1st Edition, 2019/Latest Edition.	
Reference Books	
1. A.B. Downey, "Think Python: How to Think Like a Computer Scientist", O'Reilly, 2nd Edition, 2016/Latest Edition.	
2. M.C. Brown, "Python: The Complete Reference", McGraw-Hill, 4th Edition, 2018/Latest Edition.	

Database Management Systems

Course Code: MCA-103 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 1

Introduction: Database Management System (DBMS) is used for creating and managing the databases. The main aim of a DBMS is to supply a way to store-up and retrieve the desired database information as per the application requirement, which is both convenient and efficient.

Course Objectives:

- To introduce the concepts of database management systems
- To design of relational databases by applying normalization techniques to normalize the database
- Strong practice in SQL programming through a variety of database problems.
- Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access

Prerequisite: Basic concepts of set theory, Linear algebra and Information Technology.

Course Outcomes: After completion of the course, the students will be able:

CO1: To have a high-level understanding of major DBMS components and their functions.

CO2: To model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.

CO3: To develop structured query language (SQL) queries to create, read, update, and delete relational database data.

CO4: To understand the concept of Transaction, concurrency and Query processing.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT I	10 Hours
Introduction: Database system concepts and its architecture, Data models schema and instances, Data independence and database language and interface, Data definition languages, DML. Overall database structure. **Data modeling using Entity Relationship Model:** ER model concept, notation for ER diagrams mapping constraints, Keys, Concept of super key, candidate key, primary key generalizations, Aggregation, reducing ER diagrams to tables, extended ER model. **Relational Data Model and Language:** Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key.	
UNIT II	**12 Hours**
Relational algebra, relational calculus, SQL Queries, SQL Functions, Nested Queries, Joins, Advanced Queries, Views, Indexing, Sequence, Grant and Revoke, Materialized View, Introduction to PL/SQL	
UNIT III	**10 Hours**
Data Base Design: Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal form, join dependencies and fifth normal form. Inclusion dependencies, lossless join decompositions, normalization using FD, MVD and JDs, Denormalization.	
UNIT IV	**10 Hours**
Transaction processing concepts: Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view the serializable schedule, recovery from transaction failures, deadlock handling. **Concurrency Control Techniques:** Locking Techniques for concurrency control, time stamping protocols, and concurrency control in Distributed systems. Multiple granularities and multi-version schemes.	
Text Books	
1	E.Ramez ,N. Shamkant, "Fundamentals of Database System", Pearson, 7th Edition,2017/Latest Edition.
2	A.Silberschatz, H.F. Korth, S.Sudarshan,"Database System Concepts", McGraw Hill, 7th Edition,2019/Latest Edition.
Reference Books/Materials	
1	Ceri, Pelagatti, "Distributed Databases: Principles & Systems", McGraw-Hill, 2017/Latest Edition.
2	Conolly , Begg, "Database Management Systems", Pearson Education Asia, 5th Edition, 2010/Latest Edition.

Data and File Structures

Course Code: MCA-105 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 1

Introduction: This course covers the design, analysis, and implementation of data structures and algorithms to solve engineering problems using an object-oriented programming language. Topics include elementary data structures, (including arrays, stacks, queues, and lists), advanced data structures (including trees and graphs), the algorithms used to manipulate these structures, and their application to solving practical engineering problems.

Course Objectives:

- To learn efficient storage mechanisms of data for easy access.
- To design and implement various basic and advanced data structures.
- To introduce various techniques for representation of the data in the real world.
- To develop applications using data structures.

Prerequisite: Standard programming language C/C++/Python, and knowledge of basic mathematics.

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

CO1: Understand the basics of data structures to represent data items in the real world.

CO2: Analyse the time and space complexities of Algorithms.

CO3: Implement and know the application of sorting and pattern-matching algorithms.

CO4: Create programs using a variety of data structures such as stacks, queues, hash tables, binary trees, search trees, heaps, graphs, and B-trees.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT-I	11 Hours
Introduction: Abstract Data Type, Elementary Data Organization, Measuring efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations. Arrays: Single and Multidimensional Arrays, **Representation of Arrays:** Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices. **Linked lists:** Array and Dynamic Implementation of Single Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition. **Stacks:** Stack operations: Push & Pop, Array and Linked list implementation of Stack, Applications: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion.	
UNIT-II	**11 Hours**
Queues: Operations: Create, Add, Delete, full and empty queues, Array and linked implementation of queues, Dequeue, Circular queues and Priority Queue. Hashing: Hash Function, Hash Table, Collision Resolution Strategies. **Trees:** Basic terminology, Binary Trees, Array and linked list implementation, Types of Binary Tree, Extended Binary Trees, Algebraic Expressions, Tree Traversal algorithms: Inorder, Preorder and Postorder, Threaded Binary trees, Search, Addition and deletion of an element in a binary tree, AVL Trees, Heaps, B Trees, Trees and their applications, Evaluating an expression tree.	
UNIT-III	**10 Hours**
Searching: Sequential search, Binary Search. Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, Heap Sort, Radix Sort, Bucket Sort, Shell Sort, Graphs: Representation (Matrix and Linked), Traversals, Shortest path, Topological sort. Dijkstra's Algorithm, Floyd Warshall's Algorithm, Minimum Spanning Tree Algorithms (Kruskal's Algorithm, Prim's Algorithm).	
UNIT-IV	**10 Hours**
Files: Creation and Processing of files, File handling using command line arguments, File opening, closing, modes, formatted inputs, output to file, reading/writing of files, accessing records randomly, updating files. Operations on files, Library functions, File Indexing (primary, secondary, clustered, unclustered, dense, sparse), File streams, Hierarchy of file stream classes, Error handling during file operations.	
Text Books	
1. Aaron Tanenbaum, "Data Structures Using C",Pearson Education India, 2nd edition, 2016/Latest Edition.	
2. Ellis Horowitz and Sartaj Sahni, "Fundamentals of data structures", Silicon Pr, 2nd Edition, 2017/Latest Edition.	
Reference Books/Materials	
1. Seymour Lipschutz, "Data Structures", Cengage Learning, 2nd Edition, 2015/Latest Edition.	
2. Donald Knuth, "The Art of Computer Programming",Addison-Wesley,3rd Edition, 2015/Latest Edition.	
3. https://nptel.ac.in/courses/106/106/106106145/	

Operating Systems

Course Code: MCA-107 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 1

Introduction: This course will aim at introducing classical internal algorithms and structures of modern operating systems including CPU scheduling, memory management, and device management. Topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity will be covered.

Course Objectives:

- To learn the fundamentals of Operating Systems.
- To learn the mechanisms of OS to handle processes and threads and their communication.
- To learn the mechanisms involved in memory management in contemporary OS.
- To gain knowledge on OS architecture, mutual exclusion algorithms, deadlock detection algorithms etc.
- To know the components and management aspects of concurrency management

Prerequisite: Basics of Information Technology and Programming Concepts.

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

CO1: To understand various types of OS, basic concepts, various functions of different OS, process management & CPU scheduling.

CO2: To compare and contrast various memory management schemes like paging, segmentation and to apply different deadlock handling algorithms.

CO3: To implement different disk scheduling algorithms, to apply and use various process synchronization techniques and device management strategies.

CO4: To understand management of I/O and different file handling & directory implementation schemes in OS.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT-I	10 Hours
Introduction: Introduction to Operating System, Types of O.S: Simple Batch, Multi-programmed Batched, Time-Sharing, Personal-computer, Parallel, Distributed, Real-Time, Mobile **Operating-System Structures:** Layered Architecture, System Calls, System Programs, System Structure, Virtual Machine **Processes:** Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Inter-process Communication, Threads, Multithreaded Programming. **CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling	
UNIT-II	**11 Hours**
Process Synchronization: Background, Critical-Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions, Monitors. **Memory Management:** Background, Logical versus Physical Address space, Swapping, Contiguous allocation, Fragmentation, Paging, Segmentation, Segmentation with Paging. **Virtual Memory:** Demand Paging, Page Replacement, Page-replacement Algorithms, Performance of Demand Paging, Allocation of Frames, thrashing. **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock	
UNIT-III	**11 Hours**
Device Management: Techniques for Device Management, Dedicated Devices, Shared Devices, Virtual Devices **Secondary-Storage Structure**: Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, Disk Reliability, Stable-Storage Implementation.	
UNIT-IV	**11 Hours**
Information Management: Introduction, Simple File System, General Model of a File System, Symbolic File System, Basic File System, Access Control Verification, Logical File System, Physical File System **File-System Interface**: File Concept, Access Methods, Directory Structure, Protection, and Consistency Semantics. File-System Implementation: File-System Structure, Allocation Methods, Free-Space Management, Directory Implementation, Efficiency and Performance, Recovery.	

Text Books

1. Silberschatz , Galvin, “Operating System Concepts”, John Wiley, 9th Edition, 2016/Latest Edition.
2. Madnick E. and Donovan J., “Operating Systems”, McGraw Hill, 2017.
3. Tannenbaum, “Operating Systems”, PHI, 5th Ed.

Professional Skills

Course Code: HMC-101 **Contact Hours:** L-3 T-0 P-0 **Course Category:** HMC	**Credits:** 3 **Semester:** 1

Introduction: This course aims to enhance the students' professional communication skills by providing adequate exposure in verbal and nonverbal skills and related sub skills. The course is designed to provide awareness of appropriate communication strategies with social, organizational and cultural awareness. The course empowers students in day-to-day professional soft skills like listening skills, presentation skills, and group discussion etc.

Course Objectives:

- To know the process of professional communication and its various components.
- To improve language skills i.e. Listening Skills, Speaking Skills, Reading Skills and Writing Skills (LSRW).
- To create literary sensibility and enhance comprehension skills.
- To develop confidence for communicating in English language.

Prerequisite: None

Course Outcomes: After completion of the course, the students should be able to:

CO1: Understand the importance of flawless communication in a professional environment.

CO2: Enrich knowledge and improve skills required for the corporate world.

CO3: Evaluate theoretical frameworks and concepts for the study of communication.

CO4: Develop ethical professional habits.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT-I	10 Hours
Self-analysis through SWOT, Johari window, Personality Development, Intra personal communication vs. Interpersonal Communication and Relationships, Leadership Skills, Team Building, Public speaking, Individual Communication, Self-advertising, Overstating and understating, Time Management.	
UNIT-II	**12 Hours**
Communication Boosters: Body language, Voice, Posture and gesture, Eye contact, Dress codes, Verbal crutches, Pronunciation, Contextualization: creating and understanding contexts, Aura words. **Interview:** Types of Interviews, preparing for the Interviews, Attending the Interview, Interview Process, Employers Expectations, General Etiquette.	
UNIT-III	**10 Hours**
Group Discussions: Guidelines, Expressions, Evaluation. Video conferencing, Telephone skills, Teleconferencing, Participation in meetings: chairing sessions. Presentation Skills, Types of presentation, Capturing Data, Guidelines to make an effective presentation, Body Language, Voice Modulation, Integrating voice & picture, Audience Awareness, Presentation Plan, Visual Aids, Forms of Layout, Styles of Presentation, Management presentations.	
UNIT-IV	**10 Hours**
Letter writing: Types of Letters, Business letters, E-mail, Fax, Pro-forma culture, Drafting the Applications, Format, Style, Effectiveness, study of sample letters, Elements of structure, Preparing a CV Resume, Statement of Purpose, Paragraph Writing, Greeting, Memos, Reports, Minutes, Business correspondence.	

Text Books	
1.	Rajendra Pal, J S Korlahhi,Essentials of Business Communication, Sultan Chand & Sons, 2017/Latest Edition.
2.	Andre J. Rutherford, Basic Communication Skills for Technology, Pearson Education Asia, 2014/Latest Edition.
3.	K R Lakshiminarayana: English for Technical Communication, Scitech Publications, 2nd Edition, 2015/Latest Edition.
Reference Books	
1.	RK Madhukar. Business Communication, Vikas Publishing House Pvt. Ltd, 3rd Edition, 2018/Latest Edition.
2.	Puchta and JeffStranks , Englishin Mind,Herbert University Press,2ndEdition, 2010/Latest Edition.
3.	Suresh K, P. Srihari, J Savithri, Communication Skills and Soft Skills: An Integrated Approach ,Pearson Education, 1st Edition, 2010/Latest Edition..

IT Workshop-I

Course Code: MCA-109 **Contact Hours:** L-1 T-0 P-2 **Course Category:** DCC	**Credits:** 2 **Semester:** 1

Introduction: IT Workshop is a practical course where students will learn programming with R. R is capable of handling mathematical and statistical manipulations. It has its own programming language as well as built-in functions to perform any specialized task.

Course Objectives:

- To introduce students to the statistical package R for data analysis.
- To use R to perform descriptive statistics including graphics, perform basic inferential statistical analyses including regression analysis, read and write data files,
- To perform basic data manipulations (eg, creating new variables, merging data sets), write and use R script files, use R packages, write and use R functions, and perform basic programming in R.

Pre-Requisites: Fundamentals of Mathematics background.

Course Outcomes:

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

CO1: Perform simple calculations, make simple plots and perform multiple operations in sequence, or at once

CO2: Troubleshoot errors

CO3: Perform exploratory data analysis, data modeling and interpretation of results

CO4: Format “clean” data and clean up “dirty” data

Pedagogy: The teaching-learning of the course would be organized mainly through lectures, and practical sessions in lab. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	11 Hours
An overview of R language: Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments. Getting R and Running R, R Packages Expressions, Objects, Symbols, Functions, Special Values	
UNIT II	**11 Hours**
Constants, Numeric vectors, Character Vectors, Operators. R Syntax, Data Structure in R (Matrices, Arrays, Factors, Data frames), Attributes, Symbols and Environment, Functions, Loading, Saving, and Editing Data in R, Combining Datasets, Transformations, Binning Data	
UNIT III	**10 Hours**
Subsets, Summarizing Functions, Data Cleaning. Analyzing Data, Probability Distribution, Continuous Data, Discrete Data, T-test Design, Anova Test Design, Introduction to Regression, Linear model, Smoothening	
UNIT IV	**10 Hours**
Graphics and Plots: Scatter Plots, Bar Charts, Pie Charts, Three-dimensional Data, Plotting Distribution, Customizing Charts, Basic Graphic Functions, Common Arguments for Chart Functions.	

Text Books:	
1	Long, James D., and Paul Teetor. R Cookbook: Proven Recipes for Data Analysis, Statistics, and Graphics. O' Reilly Media, 2019/Latest Edition.
2	Christian Heumann, Michael Schomaker and Shalabh, Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R, Springer, 2016/Latest Edition.
3	Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, The R Software-Fundamentals of Programming and Statistical Analysis, Springer 2013/Latest Edition.
Reference Books:	
1	Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, A Beginner's Guide to R (Use R), Springer 2009/Latest Edition.
2	Hadley Wickham, ggplot2 Elegant Graphics for Data Analysis, Springer 2016/Latest Edition.

Programming in C Language	
Course Code: BCS-110 **Contact Hours:** L-3 T-0 P-2 **Course Category:** Bridge	**Credits:** 4 Semester: 1

Introduction: This course briefs about basic introduction to computers and its corresponding concepts in benefit of students coming from non-computer background. Apart from this, programming concepts are also discussed in this course using the C programming language.

Course Objectives:

- To provide an understanding of basic computer architecture including Number System. Discussion of computer history and overview of operating systems.
- To impart adequate knowledge on the need and concept of algorithms and programming.
- Develop, execute and document computerized solutions for various problems using the features of C language.
- To enable effective usage of arrays, structures, functions, pointers and to implement the concepts of file organization.

Prerequisite: Basics of Information Technology and concepts of Programming language.

Course Outcomes: After studying this course students will be able to:

CO1: Explain the fundamentals of computers and programming.

CO2: Apply problem solving skills in programming.

CO3: Learn logic development.

CO4: Develop and run computer programs in C language

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT I: Introduction to Computer system and Basics Programming fundamentals	**12 hours**
Introduction to computer systems, ALU, registers, memory. Concepts of the finite storage, bits bytes, kilo, mega and gigabytes. Idea of program execution at micro level. **Introduction to system software**: operating systems, compilers, assemblers, interpreter and multi-user environments. Concept of flow chart and algorithms, algorithms to programs. Logic development for solving problems, development of flowchart and algorithms	
UNIT II : Programming using C	**12 hours**
Concept of variables, program statements and function calls from the library (Printf for example), C data types: int, char, float etc., C expressions, arithmetic operation, relational and logic operations, C assignment statements, extension of assignment of the operations. C primitive input output using getchar and putchar, exposure to scanf and printf functions, C Statements, conditional executing using if, else , switch case, goto and break statements.	
UNIT III : Concept of Sub-programming	**09 hours**
Concept of loops in C using for, while and do-while. **Arrays:** single and two--dimensional arrays, initializers, array parameters, example of iterative programs using arrays and use in matrix computations. Functions, parameters and return values, standard library functions.	
UNIT IV : Pointers, Strings and Structure	**09 hours**
Pointers, relationship between arrays and pointers, Call by reference. Array of pointers, passing arrays as arguments. Character strings: processing strings using loops, and string library functions Structure and Unions: structure concepts, structures as parameters, arrays of structures.	

Text Books

1. K.R. Venugopal,S.R Prasa, "Mastering C", McGraw Hill Education,2nd Edition, 2017/Latest Edition.
2. Y. Kanetkar, "Let Us C", BPB Publications, 13th Edition, 2013/Latest Edition.
3. V Rajaraman, "Fundamentals of Computers", PHI Learning, 6th Edition, 2014/Latest Edition.

Reference Books

1. E Balagurusamy, "Programming in ANSI C",McGraw Hill Education (India)Private Limited, 6th Edition, 2012/Latest Edition.
2. B W Kernighan, D. Ritchie, "The C Programming Language", Pearson Education India, 2nd Edition, 2015/Latest Edition.
3. H. Schildt, "The Complete Reference C", McGraw Hill, 4th Edition, 2017/Latest Edition.

Discrete Structures

Course Code: BCS-203 **Contact Hours:** L-3 T-0 P-2 **Course Category:** Bridge	**Credits:** 4 **Semester:** 1

Introduction: The discrete structures subject introduces Propositional logic, Sets, Relations, and Functions, Algebraic structures, Graphs and Trees required for building mathematical foundation of computer science.

Course Objectives:

- To introduce and understand the fundamental notions in discrete mathematics
- To understand basic concept of an algorithm and its application in combinatorial mathematics
- To introduce the basic properties of graphs and trees and model simple applications.
- To Learn concepts of discrete mathematics

Prerequisite: Basics of Set Theory, Number System

Course Outcomes: After studying this course students will be able to:

CO1: Distinguish between the notion of discrete and continuous mathematical structures.

CO2: Become Familiar with application of induction and other proof techniques towards problem solving.

CO3: Understand concepts of discrete structures.

CO4: Learn use of discrete structures in program development

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT I:	10 hours
Propositional logic: Syntax, semantics, valid, satisfiable and unsatisfiable formulas, Mathematical reasoning, propositions, negation disjunction and conjunction, implication and equivalence, truth tables, predicates quantifiers, natural deduction, rules of Inference. **Methods of proofs:** Forward proof, proof by contradiction, contrapositive proofs, proof of necessity and sufficiency.	
UNIT II :	**10 hours**
Sets, relations and functions: Operations on sets, relations, binary relations, partial ordering relations, equivalence relations and partitions, Partial orderings,Posets, Linear and well-ordered sets, principles of mathematical induction. Functions, mappings, injection and surjections, composition of functions, inverse functions, special functions; Peono postulates; pigeonhole principle; recursive function theory. **Size of a set:** Finite and infinite sets, countable and uncountable sets, Cantor's diagonal argument and the power set theorem, Schröder-Bernstein theorem.	
UNIT III :	**12 hours**
Algebraic structures and Morphisms: Algebraic structures with one binary operation - semigroups, monoids and groups, subgroups and their properties, congruence relation and quotient structures. Free and cyclic monoids and groups, permutation groups, substructures, normal subgroups. Algebraic structures with two binary operations - rings, integral domains and fields. Boolean algebra and Boolean ring	
UNIT IV :	**10 hours**
Graphs and trees: Terminology, Graphs and their basic properties - degree, path, cycle, subgraphs, isomorphism, Eulerian and Hamiltonian walks, Graph coloring, planar graphs, directed graphs, Trees terminology,tree traversals, spanning trees.	
Text Books	
1. K. H. Rosen, "Handbook of Discrete and Combinatorial Mathematics", CRC Press, 2nd Edition, 2000/Latest Edition.	
2. C.L.Liu, D.P Mohapatra, "Elements of Discrete Mathematics: A Computer Oriented Approach",McGraw-Hill, 4th Edition, 2017/Latest Edition.	
3. B.Kolman, R.C.Busby,S.C. Ross, "Discrete Mathematical Structures", Pearson, 6th Edition, 2017/Latest Edition.	
Reference Books	
1. R.P. Grimaldi, "Discrete and Combinatorial Mathematics," Pearson Education Asia, 5th Edition, 2006/Latest Edition.	
2. N.L. Biggs, "Discrete Mathematics", Oxford University Press. 2nd Edition, 2002/ Latest Edition.	
3. J.P. Tremblay, R. Manohar, "Discrete mathematical structures with applications to Computer Science", McGraw-Hill, 1st Edition,2017/Latest Edition.	

Object Oriented Programming using Java	
Course Code: MCA-102 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 2

Introduction: Java Programming is one of the most widely used programming languages among developers and is preferred over other languages. This course introduces students to object-oriented concepts and its implementation in Java Language. The objective is to provide students with the use of the Java programming language for writing complex and stand-alone applications at the Intermediate level.

Course Objectives:

- To understand object-oriented programming concepts, and apply them in solving problems.
- To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes
- To introduce the implementation of packages and interfaces
- To introduce the concepts of exception handling and multithreading.
- To introduce the design of a Graphical User Interface using applets and swing controls.

Prerequisite: Basic background in some Programming language

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

CO1: Understand syntax of java programming language and their use to understand basic concepts of Object-Oriented Programming.

CO2: Implement reusable java programs using the concepts of inheritance, polymorphism, and packages.

C03: Understand interface, Multithreading and Exception handling to improve effective programming skills

CO4: Implement GUI based programme with event handling.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT I	10 hours
An Overview of Java, Data types, Variables and Arrays, operators, expressions, control statements. Object-oriented thinking- A way of viewing world – Agents and Communities, messages and methods, Responsibilities, Classes and Instances, Class Hierarchies- Inheritance, Method binding, Overriding and Exceptions, Summary of Object-Oriented concepts. Java buzzwords, Introducing classes, Methods and Classes, String handling.	
UNIT II	**10 hours**
Inheritance– Inheritance concept, Inheritance basics, Member access, Constructors, Creating Multilevel hierarchy, super uses, using final with inheritance, Polymorphism-ad hoc polymorphism, pure polymorphism, method overriding, abstract classes, Object class, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Packages- Defining a Package, CLASSPATH, Access protection, importing packages.	
UNIT III	**10 hours**
Interfaces- defining an interface, implementing interfaces, Nested interfaces, applying interfaces, variables in interfaces and extending interfaces. Stream based I/O(java.io) – The Stream classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, auto boxing, generics. Exception handling – Fundamentals of exception handling, Exception types, Termination or resumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception subclasses.	
UNIT IV	**10 hours**
Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication. Event and GUI programming : Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing.	
Text Books	
1. H. Schildt, "Java: The Complete Reference", McGraw-Hill Education, 11th Edition, 2019/Latest Edition.	
2. T. Budd, "Understanding Object-Oriented Programming with Java", Pearson Education, 1999/Latest Edition	
3. Horstmann & Cornell, "Core Java Volume-I Fundamentals", Pearson Education, 8th Edition,2020/Latest Edition.	
Reference Books	
1. D.Liang, "Introduction to Java Programming (Comprehensive Version)", Pearson, 11th Edition, 2018/Latest Edition.	
2. S. Malhotra, S. Chaudhary, "Programming in Java", Oxford University Press, 1st Edition, 2018/Latest Edition.	

Machine Learning

Course Code: MCA-104 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 2

Introduction: Machine learning is the science of getting computers to act without being explicitly programmed. Many researchers also think it is the best way to make progress towards human-level AI. This course provides a broad introduction to various machine learning algorithms.

Course Objectives:

- To provide an introduction to the basic principles, techniques, and applications of Machine Learning.
- To explain the strengths and weaknesses of different machine learning algorithms (relative to the characteristics of the application domain)
- To be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed.

Prerequisite: Knowledge of Programming, Discrete Mathematics (Set Theory, Graph Theory, Logic), Basic Probability Theory and Statistics, and Data Structures and Algorithms.

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Understand machine learning algorithms and their use in data-driven knowledge discovery and program synthesis.

CO2: Identify, formulate, and solve machine learning problems that arise in practical applications

CO3: Apply and evaluate the current state of the art in machine learning for real-time problems.

CO4: Create projects for real-time problems in different domains using machine learning algorithms.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT-I	11 Hours
Introduction to Machine Learning, Well Posed Problems, Machine Learning Process, Designing a Learning System, Types of Machine Learning, Application of Machine Learning, Prospective and Issues In Machine Learning. Features, Feature Vectors, Feature Selection and Visualization, Testing ML Algorithms, (Overfitting, Training, Testing and Validation Sets, Confusion Matrix, Accuracy Metrics, ROC Curve, Unbalanced Datasets, Measurement Precision. The Curse Of Dimensionality, Dimensionality Reduction, Principle Component Analysis, Linear Discriminant Analysis (LDA), Factor Analysis, Independent Components Analysis (ICA).	
UNIT-II	**11 Hours**
Linear and Logistic Regression, Naïve Bayes' Classifier, Neural Networks, Perceptron, Multi-Layer Perceptron, Forward and Back-error propagation, Radial Basis Functions and Splines. Probabilistic Learning, Gaussian Mixture Models, Nearest Neighbour Methods. Support Vector Machines- Optimal Separation, Kernels, SVM Algorithm and Extension. Learning With Decision Tree, ID3, CART, Ensembling Learning, Boosting, Bagging,Random Forest. Different Ways To Combine Classifiers.	
UNIT-III	**10 Hours**
Unsupervised Learning, Clustering, Mixture Models, K-Means Clustering, Hierarchical Clustering, Distributional Clustering, Self-Organising Map (SOM). Evaluation Parameters For Unsupervised Learning.Reinforcement Learning: State And Action Spaces, Action, Policy, Markov Decision Processes	
UNIT-IV	**10 Hours**
Markov Chain Monte Carlo (MCMC) Methods, Graphical Models, Bayesian Networks, Hidden Markov Models (HMMS), Tracking Methods. Case Study on Machine Learning Algorithms.	

Text Books	
1	Chapman & Hall, Machine Learning: An Algorithmic Perspective, CRCF Press, Second Edition, 2015 / Latest Edition.
2	Christopher Edition, Bishop, Pattern Recognition and Machine Learning, Springer,2nd Edition, 2010/ Latest Edition.
3	Tom Mitchell, Machine Learning, McGraw Hill, 2017/ Latest Edition.
Reference Books	
1	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, McGraw Hill Education,2nd Edition, 2008/ Latest Edition.
2	Han, Jiawei, Jian Pei, and Micheline Kamber, Data Mining: Concepts and Techniques, Elsevier, 3rd Edition, 2011/ Latest Edition.

Software Engineering

Course Code: MCA-106 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 2

Introduction:

This course introduces students to the different software development lifecycle (SDLC) phases used in developing, delivering, and maintaining software products. Students will also acquire basic software development skills and understand common terminology used in the software engineering profession. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of software development projects.

Course Objectives:

- To introduce the concepts of software engineering, software processes and its models.
- To understand the software requirements analysis, transform the requirements using DFD, create software requirement specification document and validation of the software requirements.
- To understand fundamental of software design, software quality and software maintenance.
- To understand the project planning process, size and cost estimation techniques for development of software.

Prerequisite: Basic knowledge of Programming Languages

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

CO1: Understand the concepts of Software engineering, Software process and its models.

CO2: Evaluate the Software Requirements Specification, Interpret and Create Software Requirements Specification Document.

CO3: Apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices, evaluate the quality and maintenance of the software through software testing.

CO4: Create the software project plan for size and cost estimation including risk analysis.

Pedagogy: This course is structured around continuous progress. It will include a combination of lectures, and group activities focused on experiential learning, in-class discussions, regular assessments and case studies. The topics will be presented to students using real-world scenarios and problem-solving activities.

UNIT-I	10 Hours
Introduction of Software (SW), Type of Software, SW Components: Process, People, Project, Product, Software crisis, Software Process Models: Details of People involved in each Process, SDLC methods/models: Build & Fix, Waterfall, Prototype (Evolutionary & Throw-away), Iterative, Incremental iterative, Spiral, RAD, Agile methodology.	
UNIT-II	**11 Hours**
Requirement Analysis & Specifications: Requirement Analysis, Requirement Specification, Approaches to Requirement analysis, Specifying Behavioural & Non-Behavioural Requirements, SRS Components & various Users of SRS. Introduction of Requirement Specification: Dataflow (DF) Diagram, Data dictionaries, Entity-Relationship (ER) diagram, Object Diagram etc., Requirement Validation.	
UNIT-III	**11 Hours**
Software Design and Testing: Design Architecture and Patterns, Modularity, Function oriented design, Object Oriented Design, Software Testing: Software Testing Strategy and Techniques, Functional testing, Structural testing, Debugging and testing tools, SW/HW reliability, Reliability concepts and models, Reliability allocation, Software Maintenance: Introduction to SW Maintenance and types, SW Maintenance models: Re-engineering & Forward Engineering.	
UNIT-IV	**10 Hours**
Software Project Planning: Role of Software Project Planning, Estimation method, Estimation of Effort & Schedule, Software Metrics: Introduction to Size metrics, Data structure metrics, information flow metrics, entropy-based measures, metric analysis. Basic COCOMO, Intermediate COCOMO, Detailed COCOMO, Quality Planning, Planning Parameter, Quality Defect Removal Cycle, Role of Risk Analysis.	

Text Books	
1	K.K.Aggarwal, Y.Singh, "Software Engineering",New Age International Ltd,3rd Edition, 2008/ Latest Edition.
2	P. Jalote, "An Integrated ApproachtoSoftware Engineering", Narosa Publishing, 3rd Edition, 2005/ Latest Edition.
Reference Books	
1	R.S. Pressman,"Software Engineering – A Practitioner's Approach" ,McGraw Hill, 8th Edition, 2014 / Latest Edition.
2	I. Sommerville, "Software Engineering,"Pearson, 10th Edition, 2017/ Latest Edition.

Data Communication and Computer Networks

Course Code: MCA-108 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 2

Introduction: Data communications refers to the transmission of digital data between two or more computers, whereas, a computer network or data network is a telecommunication network that allows computers to exchange data. The physical connection between networked computing devices is established using either wired or wireless media. The best-known computer network is the Internet.

Course Objectives:

- Students should understand the layered structure of networking devices.
- They should be familiar with a few networking protocols.
- Study the different types of networks and topologies of networks.

Prerequisite: Basics of IT, Concepts of data structure and programming language

Course Outcomes: Upon successful completion of this course, students will be able:

CO1: Describe the fundamental concepts and layered architecture of computer networking.

CO2: Explain the basic concepts of link layer properties to detect error and develop the solution for error control and flow control. Design, calculate, and apply subnet masks and addresses to fulfill networking requirements. Also, compare various routing protocols.

CO3: Comprehend the duties of transport layer and congestion control techniques.

CO4: Illustrate the features and operations of various application layer protocols such as DNS, HTTP, FTP, e-mail protocols and other applications; and focus on network security issues to secure communication towards society.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT-I	10 Hours
Introduction: Goals and Applications of Networks, Layering Concept, OSI Reference Model, TCP/IP Protocol Suite, Networks Topology, Physical Layer: Signals, Digital Transmission – Analog to Digital & Digital to Digital, Analog Transmission – Digital to Analog & Analog to Analog, Multiplexing – FDM & TDM, Media – Guided and Unguided, switching – Packet based & Circuit based, Shannon Capacity; Network Topologies, Connecting Devices.	
UNIT -II	**10 Hours**
Data Link Layer: Addressing, Error Detection & Correction, Checksum & CRC; Medium Access – ALOHA, CSMA, CSMA/CD & CA; Protocols – Ethernet, ARP & RARP; Switching Techniques. Network Layer: Need for internetworking, IP Addressing, Subnetting, Super-netting, Basic Routing (or Forwarding) Mechanism; IPv4 frame format and functions; Key features of IPv6, ICMP, IGMP, Routing protocols – RIP, OSPF & BGP and algorithms – Distance Vector and Link State. Linux Network Commands: arp, route, ifconfig, netstat, traceroute, ping.	
UNIT-III	**10 Hours**
Transport Layer: Port Addresses; ARQ - Simple, Stop and Wait, Go Back-N, Selective Repeat; UDP – Services & Applications; TCP – header format, connection setup & termination, state transition diagram, flow control, error control, Congestion Control: causes for congestion, effects of congestion, various open-loop and close-loop congestion control techniques: The leaky bucket algorithm, The token bucket algorithm	
UNIT -IV	**10 Hours**
Application Layer: Web & HTTP, FTP, Email, Telnet, DNS, RPC. Network Security Basic Concepts: Cryptographic Protocols, PGP, IPSEC, SSL, SSH, Firewalls, IDS, IPS. Advanced Protocols: SNMP, RTP, SIP, BitTorrent.	

Text Books	
1.	A. S. Tanenbaum and D.J. Wetherall, Computer Networks, Pearson, 5th Edition, 2013/ Latest Edition.
2.	B. Forouzan, Data Communications and Networking, Mcgraw Hill, 5th Edition, 2017/ Latest Edition.
References Books	
1.	L. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach", Elsevier, 5th Edition, 2011/ Latest Edition.
2.	W. Stallings, "Data and Computer Communications", Pearson, 5th Edition, 2014/ Latest Edition.
3.	V. Pallapamanvi, "Data Communications and Computer Networks", Prentice Hall, 2nd Edition, 2014/ Latest Edition.
4.	K. James, "Computer Networking: A Top-down Approach", Pearson, 6th Edition, 2017/ Latest Edition.

IT Workshop - II	
Course Code: MCA 110 **Contact Hours:** L-1 T-0 P-2 **Course Category:** DCC	**Credits:** 2 **Semester:** 2

Introduction: With the emergence of Web 2.0 in the field of Information Technology, it is important to stay abreast with the latest web and cloud technologies. Therefore, it is important to apprise students with some of the technologies so that they can apply in solving problems through a computational approach.

Course Objectives:

- To acquaint students with contemporary and futuristic trends by motivating examples / use cases.
- To explain complex ideas through lucid / abstract introductions.
- To facilitate experimentation of ideas through case studies / mini projects.

Prerequisite: Working knowledge of any programming language.

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

CO1: Understand the concept of JAVA SCRIPT and PHP

CO2: Understand the concept of cloud technology and its application

CO3: Develop and deploy website/mobile app/GUI app

CO4: Formulate technical documents and give oral presentations related to work completed.

Pedagogy: The course would be organized through assignments and mini-project that involve usage of basic and advanced concepts of web and cloud technologies. Emphasis will be on developing applications by writing programs.

UNIT I	**10 hours**
Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Simple AJAX applications.	
UNIT II	**10 hours**
PHP - Variables, DataTypes, Conditions, Loops, Session Handling, Form Handling, File Handling, Databases - SQL and mongoDB. ,	
UNIT III	**10 hours**
Cloud Technologies: Introduction to Cloud Computing. Any one Cloud Service Providers (CSPs) - Amazon Web Services (AWS), Google Cloud, IBM Cloud, MS Azure.	
UNIT IV	**10 hours**
Project Development: Students have to do a mini-project involving website deployment.	
Text Books	
1. C. Xavier. "Web Technology and Design", First Edition, New Age Publications, 2018/ Latest Edition	
2. Anand Nayyar. "Handbook of Cloud Computing", BPB Publications, 2019/Latest Edition	
Reference Book	
1. Mark Wilkins. "Learning Amazon Web Services (AWS)", Addison-Wesley Professional, 2019/Latest Edition 2. Cloud Computing (Principles and Paradigms), Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011/Latest Edition	

Human Values and Professional Ethics

Course Code: HMC-102 **Contact Hours:** L-3 T-0 P-0 **Course Category:** HMC	**Credits:** 3 **Semester:** 2

Introduction: Values and Ethics are very relevant in today's environment of conflicts and stress in every profession, with obligations to be met by one person in many directions. A formal study will certainly improve one's ability and judgment and refine one's behavior, decisions, and actions in performing the duty to the family, organization, and to the society.

Course Objectives:

- To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way.
- To inculcate Ethics and Human Values into the young minds and develop moral responsibility and mould them as best professional which will create ethical vision and achieve harmony in life.

Prerequisite: None

Course Outcomes: Having successfully completed this course, the student will be able to:

CO1: Develop the capability of shaping themselves into outstanding personalities through a value-based life.

CO2: turn themselves into champions of their lives.

CO3: take things positively, convert everything into happiness, and contribute to the happiness of others.

CO4: become potential sources for contributing to the development of the society around them institutions/organizations they work in.

CO5: shape themselves into valuable professionals, and follow professional ethics to solve their ethical dilemmas.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT-I	10 Hours
Human Values: Morals, Values and Ethics, Integrity, Work Ethic, Respect for Others, Living Peacefully, Caring, Sharing, Honesty, Valuing Time, Co-operation, Commitment, Empathy, Self Confidence, Character, Spirituality. Indian values (on the conceptual framework of Vedas): Purusharth, Niskama karma, Religion and Human Values, Towards a World Religion, Ethical Living and Harmony in Life.	
UNIT-II	**10 Hours**
Ethics and Engineering Profession: Profession and Professionalism, Ethical Theories: Kohlberg's Theory, Gilligan's Theory, Moral Dilemmas, Types of Enquiry, Uses of Ethical Theories, Engineering Profession, Engineering Professionals- Training, Skill Set, Life Skills, Engineering Ethics: MakingSenses and Issues, Ethical Obligations of Engineers, Ethical Codes for Engineers.	
UNIT-III	**12 Hours**
Engineering as a Social Experimentation, Safety Responsibility and Rights: Engineering as experimentation, Engineers as responsible Experimenters, Concept of Safety and Risk, Engineer's Responsibility for Safety, Risk – Benefit Analysis, Case Studies: The challenger case study, The Three Mile Island, Fukushima Nuclear Disaster, Bhopal Gas Tragedy. Disaster Management, Professional Rights, Employee Rights, Intellectual Property Rights (IPRs), Human Rights and Human Responsibilities. Major Ethical Issues.	
UNIT-IV	**10 Hours**
Ethics and Global Issues: Ethics in Global Scenario, Multinational corporations, Environmental ethics, computer ethics, Business Ethics. Corporate Social responsibility, Weapons Development, Research Ethics.	

Text Books	
1.	Govindarajan M., Natarajan S., Senthil Kumar V. S., "Engineering Ethics", Prentice Hall India Learning Private Limited, New Delhi, 2004/ Latest Edition.
2.	Subramaniam R., "Professional Ethics", Oxford University Press, New Delhi, 2013/ Latest Edition.
3.	Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill Education, 4th Edition,2004/ Latest Edition.
4.	RR Gaur, R Sangal, GP Bagaria, "A Foundation Course in Human values and Professional Ethics", Excel Books Pvt. Ltd, New Delhi, 2009/ Latest Edition.
5.	A.N.Tripathi, "Human Values", New Age International Publishers, New Delhi, 2nd Edition, 2004/ Latest Edition.
Reference Books	
1.	B.P. Banerjee, "Foundation of Ethics and Management", Excel Books, 2005/ Latest Edition.
2.	Fleddermann, Charles D., "Engineering Ethics", Pearson Education, 2004/ Latest Edition.
3.	Harris, Charles E., Protchard, Michael S. And Rabins, Michael, J., Wadsworth, "Engineering Ethics- Concepts and Cases", Thompson Learning, 2000/ Latest Edition.
4.	Boatright, John R., "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003/ Latest Edition.
5.	Swami Ranganathananda, "Universal Message of the Bhagavad Gita: An exposition of the Gita in the light of modern thought and modern needs", Vol. I – III, AdvaitaAshrama (Publication Department), Kolkata., 2000/ Latest Edition.
6.	Peter Singer, "Practical Ethics", Oxford University Press, 1993/ Latest Edition.

Generic Open Elective

Course Code: GEC-102 **Contact Hours:** L-0 T-2 P-0 L-0T-0 P-4 L-2T-0 P-0 **Course Category:** GEC	**Credits:** 2 **Semester:** 2

Introduction: A Generic Elective (GE) course is an inter-disciplinary course provided to the students chosen generally from an unrelated discipline/subject and allowing them a chance at comprehensive education. GEs are introduced as part of the CBCS. The students can choose their preference from a pool of courses from various disciplines/subjects. Elective courses do much more than filling in the gaps to fulfill the high school graduation requirements. It gives a chance to explore new options, allowing students to study more about the subject they are passionate about, and enables them to 'test drive' new activities. They provide students with the necessary skills to improve creativity that they might not find in the classroom. The main purpose of the elective course is to seek exposure to a new discipline/subject and to provide the students with an alternative option for desired fields.

Course objectives:

- Students will have exposure to a new discipline/subject.
- Prepare students to look for inter-disciplinary research.
- GE can fulfil the limitation to pursue master's study in desired field.
- Help discover new things that never existed and might change the course of student's life.

Prerequisite: Basic knowledge of the selected domain of elective course

Course Outcomes: After completion of the elective course, the students will be able to:

CO1: Identify new discipline and learn new subject for future careers.

CO2: Apply their knowledge to understand and solve the real-life problems.

CO3: Analyse creative design process through the integration and application of diverse technical knowledge and expertise to address social issues.

CO4: Develop the habit of working independently to attain self-motivation, discipline, and confidence to achieve their goals.

Design and Analysis of Algorithms

Course Code: MCA-201 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 3

Introduction: Algorithms play a crucial and fundamental role in computer science. Given that algorithms are present in all domains of computer science, it is important for students to learn techniques to analysis a given algorithm. In addition, different approaches to design algorithms are important to write one's own algorithm.

Course Objectives:

- Introduction, learning and analysis of performances of algorithmic efficiency of approaches such as searching, sorting etc.
- Introduction, learning and analysis of greedy paradigms.
- Introduction, learning and analysis of dynamic programming and backtracking
- Introduction, learning and analysis of computational complexity and branch & bound.

Prerequisite: Data Structures

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

CO1: Understand asymptotic complexities of the algorithms and design algorithms using Divide and Conquer strategy.

CO2: Apply greedy and dynamic programming approaches for designing algorithms.

CO3: Implement various graph algorithms and design algorithms using backtracking approach and branch and bound techniques

CO4: Implement different string-matching algorithms and understand the concept of NP-complete problems.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted

UNIT I	10 hours
Introduction to Algorithms: Need for algorithm, Growth of Functions, Exercises based on Asymptotic Notations, Solving Recurrence Relations – Iterative method, Substitution method & Master method. Space vs Time Complexity Tradeoff. **Divide and Conquer Technique:** Merge Sort, Quick Sort, Median and Order Statistics, Maximum-subarray Problem, Strassen's Matrix Multiplication.	
UNIT II	**10 hours**
Dynamic Programming: Elements of Dynamic Programming, Matrix Chain Multiplication, Longest Common Subsequence, 0/1 Knapsack and Optimal Binary Search Tree problems. **Greedy Algorithms:** Elements of Greedy strategy, Activity Selection problem, Huffman Codes, 0/1 Fractional Knapsack, Task Scheduling problem	
UNIT III	**12 hours**
Graph Algorithms: Representation of Graphs, Breadth First Search, Depth First Search, Topological Sort, Strongly Connected Components, Algorithm for Kruskal's and Prim's for finding Minimum cost Spanning Trees, Dijkstra's and Bellman Fort Algorithm for finding Single source shortest paths. All pair shortest paths and matrix multiplication, Floyd – Warshall algorithm for all pair shortest paths.	
UNIT IV	**10 hours**
String Matching: The naïve String-Matching algorithm, The Rabin-Karp Algorithm, String Matching with finite automata, The Knuth-Morris Pratt algorithm. **NP-Completeness:** Polynomial-time verification, NP-Completeness and Reducibility, NP-Completeness Proof, NP-Complete problems.	
Text Books	
1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009/ Latest Edition.	
2. Jon Kleinberg and Eva Tardos, "Algorithm Design", Pearson, Latest Edition.	
3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamental of Computer Algorithms", Orient Longman, Latest Edition.	
Reference Books	
1. Johnsonbaugh, "Algorithms", Pearson, 3rd Edition	
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education.	
3. Sara Baase and Allen Van Gelder, "Computer Algorithms - Introduction to Design and Analysis", Pearson Education.	
4. A.V. Aho, J. E. Hopcroft and J.D.Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education.	
5. R. S. Salaria, Khanna, "Data Structure & Algorithms", Book Publishing Co. (P) Ltd	

Big Data and NoSQL

Course Code: MCA-203 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 3

Introduction: This class will prepare students on current and emerging practices for dealing with big data (data in peta- and exa-scale) and large-scale database systems used by many social networking services. Information is being generated at an exponential scale and handling and analyzing these data need new types of tools and processes. Many areas are experiencing this growth from astronomy to finance to medicine to zebra fish genomics. Similarly, social networking sites, such as Facebook and Twitter, also deal with data that need different database requirements compared to traditional business applications. These applications are highly data intensive and require heavy read/write workloads. They also do not need some of the stringent ACID properties that are central to relational databases. These databases belong to an emerging genre called NoSQL databases that are mainly open source, non-schema oriented, having weak consistency properties and heavily distributed over large and evolving clusters of off-the-shelf server systems. The use and management these systems differ very much from traditional relational database systems. We will look at several such systems in this course.

Course Objectives:

- Study the requirements of non-traditional large-scale data applications
- Compare the properties of social networking sites against ACID properties of traditional databases
- Explore the fundamentals of NoSQL systems and big data analytics
- Examine application of very large clusters of COTS computing systems for solving large data problems
- Gain experience with NoSQL systems and Hadoop through hands-on projects.

Prerequisite: Data Structures, Basic Programming knowledge, Machine Learning.

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

CO1: Perform data gathering of large data from a range of data sources.

CO2: Critically analyse existing Big Data datasets and implementations, taking practicality, and usefulness metrics into consideration.

CO3: Understand the role of statistics in the analysis of large of datasets.

CO4: Apply suitable statistical measures and analyses techniques for data of various structure and content and present summary statistics.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted

UNIT I	10 hours
Introduction to Big data, Why big data, Unstructured data, Industry examples of big data, web analytics, Big data and algorithmic trading, Big data in healthcare, Big data in medicine, RDB Review, Motivation, CAP Theorem, Big Table, GFS, Chubby, Bloom Filters	
UNIT II	**12 hours**
Data format, Analyzing data with Hadoop, Hadoop streaming, Hadoop pipes, Design of Hadoop distributed file system (HDFS) , HDFS concepts , Java interface , Data flow , Hadoop I/O , Data integrity , compression, Serialization, Map-Reduce, introduction to Hadoop Hadoop, Pig and Hive, MongoDB, Dynamo, Cassandra, Voldemort	
UNIT III	**10 hours**
Map Reduce workflows, Unit tests with MRUnit , Test data and local tests – anatomy of Map Reduce job run , Classic Map-reduce , YARN , Failures in classic Map-reduce and YARN, Job scheduling, Shuffle and sort, Task execution, MapReduce types, Input formats, Output formats, MemCached, Memcachedb, TokyoCabinet, HBase, HDFS, Zookeeper, Accumulo, SimpleDB, CouchDB	
UNIT IV	**8 hours**
Neo4J, JENA, NewSQL, NuoSQL, More Big Data Analytics, Pig , Grunt , Pig data model, Hive , Data types and file formats, HiveQL data definition, HiveQL data manipulation – HiveQL queries	
Text Books	
1. T. White, "Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale", O'Reilly Media, 4th Edition 2015/ Latest Edition.	
2. M. Minelli et al., "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 1st Edition 2013/ Latest Edition.	
Reference Books/Materials	
1. Shmueli, Patel& Bruce,"Data Mining for Business Intelligence",Wiley Interscience Publications,2ndEdition, 2010/ Latest Edition.	
2. Michael Minelli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications,2013/Latest Edition.	
3. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012/ Latest Edition.	

Software Testing and Quality Assurance

Course Code: MCA 205 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 3

Introduction: Software testing helps in finalizing the software application or product against business and user requirements. It is very important to have good test coverage in order to test the software application completely and make it sure that it's performing well and as per the specifications. Software testing makes sure that the testing is being done properly and hence the system is ready for use. Software Quality Assurance includes standards and procedures that developers may use to review and audit software products and activities to verify that the software meets quality criteria which link to standards.

Course Objectives:

- The students should understand software testing and quality assurance as a fundamental component of software life cycle.
- Finding defects which may get created by the programmer while developing the software.
- Gaining confidence in and providing information about the level of quality.
- To make sure that the end result meets the business and user requirements.
- To gain the confidence of the customers by providing them a quality product.

Prerequisite: Software Engineering, Programming Skills, Database Management System.

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

CO1: Understand the fundamental concepts of a software testing and software quality assurance.

CO2: Derive test cases using different testing strategies.

CO3: Generate and prioritize test cases to prove the correctness of program implementations and understand testing at different levels

CO4: Understand software Quality Assurance methods, models and measurement.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Introduction to Software Testing: Testing as an Engineering Activity, Testing Fundamentals, Software Testing Process, Software Testing principles, Defects-Hypothesis and Tests, Test Strategy, Test Plan, Software Testing Tools **Software Quality**: Software Quality Fundamentals, Software Quality Management Process, Practical Considerations, Software Quality Tools	
UNIT II	**10 hours**
Testing Techniques: Levels of Testing, Functional Testing: Boundary value analysis, Equivalence partitioning, Decision table, White Box Testing: Static testing techniques, Static analysis tools, Control flow testing, Code complexity testing, Data flow testing, Tools for software testing	
UNIT III	**10 hours**
Integration, System and Acceptance Testing: Integration testing approaches, System testing, Non-functional testing techniques, Acceptance Testing, **Fault based testing:** Regression testing, Regression test process, Regression, Mutation Testing, Test Minimization, Software Test Automation	
UNIT IV	**10 hours**
Software Quality Assurance: Software Quality, Software Quality Indicators, Concepts of Quality Control, Garvin's Quality Dimensions, McCall's Quality Factors, Software Quality Dilemma, Achieving Software Quality, Elements of Software Quality Assurance, Software Quality Assurance Metrics, Quality Assurance Models, Total Quality Management, Software Quality Assurance Plan	
Text Books	
1. Yogesh Singh, "Software Testing", Cambridge University Press, 2013/ Latest Edition.	
2. Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", Auerbach Publications,4th Edition, 2013/ Latest Edition.	
Reference Books/Materials	
1. Ilene Burnstein, "Practical Software Testing: A Process-Oriented Approach", Springer, 3rd Edition, 2003/ Latest Edition.	
2. Aditya P. Mathur, "Foundations of Software Testing", Pearson, 2nd Edition, 2013/ Latest Edition.	
3. S. Naik, P. Tripathy," Software Testing and Quality Assurance", Wiley, 2010/ Latest Edition.	
4. Milind Limaye, "Software Quality Assurance", McGraw-Hill publication, 2011/ Latest Edition.	
5. https://nptel.ac.in/courses/106/101/106101163/	

Cyber Security

Course Code: MCA-207 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction: Cyber security refers to the body of technologies, processes, and practices designed for computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks. The importance of Cyber Security increases as the government, military, corporate, financial, and medical organizations deal with an enormous amount of data on computers and other devices. The amalgamation of ICT in different sectors whether large or small are in the crosshairs of cyber-attacks. Relentless, well-funded and financially as well as criminally motivated cybercriminals with no boundaries are continuously working harder to utilize all latest technologies for posing security challenges in front of public and private sectors around the globe to undermine their credibility through variety and volume of cyber threats.

Course Objective: To make students understand

- Various threats, vulnerabilities, attacks and the motivation behind them.
- Cryptographic concepts and their applications in network security.
- Various types of security standards compliances.

Prerequisite: Computer Networks

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

CO1: Analyze and evaluate the cyber security needs of an organization. Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.

CO2: Diagnose and investigate cyber security events or crimes related to computer systems and digital evidence.

CO3: Protect data and respond to threats that occur over the Internet and locally.

CO4: Study the IPSec and various Communication Protocols along with defense countermeasures and standards.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Introduction: Cyber Security Concepts, Security Goals, Security Services and Mechanism, Vulnerabilities, Sources of Security Threats, Target assets, Vulnerabilities, Insider threats, Intruders and Hackers, Network threats: Active/Passive, Malicious Software, Virus, Trojan, Worms, Spywares, Rootkit, Ransomware, Adware, Backdoor, Bots, Social Engineering, Phishing, Key logging, Mail Bombs, Pornography, Intellectual Property Theft, Session Hijacking, ARP Spoofing, DoS, DDoS, Advanced Persistent Threat, Mobile Codes: Anonymity Networks, Proxy Servers, Surface, Deep and Dark Web.	
UNIT II	**10 hours**
Cyber Crime: Types of Cybercrime, Cyber Attacks methodology, Credit card fraud, Software Piracy and legal issues, Security issues in M-commerce e.g. mobile wallet, mobile payment m-banking, Identity Theft, Password Cracking, Spamming, Stalking and Obscenity in Internet, Social Network Account attack, Security and Privacy Issues on Social Networking Websites, Security issues in Cloud based Services, Security issues of Smart Phones, digital tablets and smart Devices, Cyber Warfare, Cyber Terrorism and Hacktivism.	
UNIT III	**10 hours**
Device Security: Securing PC, Securing Smart Phone, Securing Laptops/Tabs, Securing Pen drives, Wi-Fi security, Browser security, Cloud Security, OS Security, Data Security, Database Security; **Cryptography:** basics, Symmetric Vs asymmetric Cryptography, Key management, Message Authentication Code, Message Digest, Properties of message authentication code, Hash Function, Properties of Hash Function, Secured Hash Algorithm, Digital Signatures, Application of cryptography in network security: SSL/TLS, IPSec, SSH, Email Security, Wireless Network Security, S/MIME, PGP.	
UNIT IV	**10 hours**
Defenses, Security Countermeasures: Access Control, Secure Design Principles, Defense Models: The Lollipop Model, The Onion Model, Security Policies and Procedures, Firewalls, IDS, IPS, Log Files, Honey Pots, VPN, Network Admission Control (NAC), Trusted Computing and multilevel security, Physical and infrastructure security, Electronic Voting, Human factors : Security awareness, training, Email and Internet use policies, Risk Management, Information Security Standards, Copyright, Software Licenses, Semiconductor and Patent Law, IPR, ISO/IEC 2700, HIPAA, COBIT, NIST, Indian IT ACT and Standards.	
Text Books	
1. W. Stallings and L. Brown, "Computer Security: Principles and Practice", Pearson Education, 4th Edition, 2018/ Latest Edition.	
2. M. Ousley, "Information Security: The Complete Reference", McGraw Hill Education, 2nd Edition , 2013/ Latest Edition.	
Reference Books	
1. W. Stallings, "Network security essentials: Applications and Standards", Pearson Education, 6th Edition, 2018/ Latest Edition.	
2. M. Bishop, "Computer Security: Art and Science", Addison Wesley Professional, 2nd Edition, 2018/ Latest Edition.	
3. W. Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education, 7th Edition, 2017/ Latest Edition.	
4. N. Godbole and S. Belapure, "Cyber Security", Wiley, 1st Edition, 2011/ Latest Edition.	

Cloud Computing and IoT	
Course Code: MCA-213 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction: Cloud computing is a scalable services provider platform that provides on-demand and pay per use computing service for various types of shared pool of resources such as memory, servers, storage, networking, software, database, applications designing etc., with the help of the internet. The Internet of Things (IoT) is a course about the new paradigm of objects interacting with people, with information systems, and with other objects. This course will introduce numerous aspects of cloud computing with basic fundamentals of IoT and its protocols. The course includes fundamentals of cloud computing and IoT, load balancing techniques in cloud, security challenges in cloud, case studies and industrial applications of cloud-based services along with basic fundamentals of IoT and its relation to cloud. This will help students to use and explore the cloud computing and IoT platforms.

Course Objectives:

- To learn how to use Cloud Services and Cloud Deployment models.
- To learn how to use the concept of virtualization in cloud computing.
- To learn resource management and load balancing algorithms.
- To provide basic concepts of security attacks and their provisions at various levels of cloud computing.
- To Understand Smart Objects and IoT Architectures.
- To learn about various IoT-related protocols.
- To understand concepts of cloud in the context of IoT.

Prerequisite: Basics of Computer Architecture and Organization, Networking.

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

CO1: To articulate key concepts of cloud computing and computing techniques, strength and limitations of cloud computing with possible application domains.

CO2: To identify the architecture and infrastructure of cloud computing including SaaS, PaaS, IaaS, public cloud, private cloud and hybrid cloud.

CO3: To interpret various data, scalability and cloud services to acquire efficient database for cloud storage.

CO4: To explain the core issues of cloud computing such as security, privacy and interoperability and deal with controlling mechanism for accessing sage cloud service.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Fundamentals of Cloud Computing: Introduction of cloud computing, History of cloud computing, Fog Computing, NIST definition of cloud computing, Cloud deployment models: Public cloud, Private cloud, Hybrid cloud, Community cloud, Green cloud computing, Service models: IaaS, PaaS, SaaS, BPaaS, Disaster recovery as a service, Cloud provider Lock-in, Backup and recovery solutions in cloud, Total cost of ownership in cloud computing.	
UNIT II	**10 hours**
Cloud Architecture and Virtualization: Basic concepts of Virtualization, Hardware Virtualization: Full virtualization, Partial virtualization, Memory virtualization, Compute virtualization, Storage virtualization, Storage models, Implementation: Microsoft Hyper V, Vmware features and infrastructure, Virtual Box, Thin client.	
UNIT III	**10 hours**
Cloud Security and Industrial Applications: Data Security issues, Security challenges and preventive methods: Infrastructure level security, Network level security, Application-level security, Identity access management and Trust in cloud computing. Cloud Industrial Applications: Amazon EC2, Amazon EC service level agreement, Google MapReduce, Hadoop, Salesforce.com, Google app engine, Microsoft Azure.	
UNIT IV	**10 hours**
Fundamentals of IoT and Protocols: Evolution of Internet of Things, Enabling Technologies, IoT Architectures, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Cloud of things architecture, Web of things vs. internet of things, IoT Protocols – M2M, BacNet, ModBus, Bluetooth, Wifi, ZigBee.	
Text Books	
1. B. Sosinsky, "Cloud Computing Bible", Wiley-India,1st edition, 2011/ Latest Edition..	
2. R. Buyya, C. Vecchiola and S. T. Selvi, "Mastering Cloud Computing: Foundations and Applications Programming", McGraw Hill Education, 1st edition, 2017/ Latest Edition..	
Reference Books/ Materials	
1. R. Buyya,J. Broberg and A. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley publishers, 1st Edition, 2013/ Latest Edition.	
2. A. Shawish and M. Salama, "Inter-cooperative Collective Intelligence: Techniques and Applications", Springer, Berlin, Heidelberg, 1st Edition, 2014/ Latest Edition.	
3. G. Schulz, "Cloud and Virtual Data Storage Networking", Auerbach Publications, 1st Edition,2011/ Latest Edition.	
4. T. Mather, S. Kumaraswamy and S. Latif, "Cloud Security and Privacy: Enterprise Perspective on Risks and Compliance", O'Reilly Media, 1st Edition , 2009/ Latest Edition.	
5. https://swayam.gov.in/course/4413-cloud-computing https://nptel.ac.in/courses/106/105/106105167/	
6. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs20/ https://nptel.ac.in/courses/106/105/106105166/	

Blockchain Technologies	
Course Code: MCA-215 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction: Blockchain can be described as a data structure that holds transactional records and while ensuring security, transparency, and decentralization. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability and verifiability. A blockchain is a distributed ledger that is completely open to any and everyone on the network. Once information is stored on a blockchain, it is extremely difficult to change or alter it. Blockchain and Cryptocurrency are vastly discussed nowadays in all research domains to bring decentralization. This course is to understand Blockchain and its main application cryptocurrency.

Course Objective:

- Build expertise in Blockchain and Distributed Ledger Technology.
- Understanding the basics of Cryptocurrency - Bitcoin.
- Understanding Smart Contracts.

Prerequisite: Basics of Elliptic Curve Cryptography, Decentralized or Distributed Computing, Peer-to-peer Computing, Basic knowledge of programming.

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

CO1: Understand basic concepts of block chain Technology and its platforms

CO2: To develop various types of environments in Block chain technology

CO3: Discuss the major requirements of the design of a Smart contract.

CO4: To provide security prospects in an organization.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Introduction: Distributed Database and Distributed Record Keeping (Distributed Ledger), Atomic Broadcast, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. **Techniques Borrowed in Blockchain**: Hash function, Hash Pointers, Puzzle Friendly Hash, Collision Resistant Hash, Consensus Algorithms, Byzantine Fault-Tolerant Distributed Computing, Digital Signature - ECDSA, Memory Hard Algorithm, Verifiable Random Functions, Zero Knowledge Proof and Systems.	
UNIT II	**10 hours**
Blockchain 1.0: Introduction-Bitcoin Blockchain, Advantage over conventional distributed database, Challenges and Solutions, Blockchain Network, Mining Mechanisms, Distributed Consensus, Nakamoto Consensus, Bitcoin Scripting Language and applications, Life of Blockchain application, Soft & Hard Fork, Private and Public Blockchain, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy.Distributed Consensus: Nakamoto Consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Energy utilization and alternate.	
UNIT III	**10 hours**
Blockchain 2.0: Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and Verification Challenges, Using Smart Contracts to enforce Legal Contracts, Comparing Bitcoin Scripting and Ethereum Smart Contracts, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Name coin.Blockchain 3.0: Hyperledger Fabric, Plug and Play Platform and Mechanisms in permissioned blockchain	
UNIT IV	**10 hours**
Privacy, Security Issues in Blockchain: Pseudo-anonymity vs. anonymity, Zcash and zk-SNARKS for anonymity preservation, Attacks on Blockchains – Sybil Attacks, Selfish Mining, 51% Attacks, Advent of Algorand and Sharding based Consensus Algorithms to prevent these. Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy. Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.	
Text Books	
1. A. Narayanan, J. Bonneau, E. Felten, A. Miller and S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, illustrated Edition, 2016/ Latest edition.	
2. R. Wattenhofer, "The Science of the Blockchain", Create Space Independent Publishing Platform, 1st Edition, 2016/ Latest edition.	
Reference Books/Materials	
1. S. Balamurugan, "Principles of Blockchain, Bitcoin and Cryptocurrency Technologies: Applications and Case Studies", Scholars Press, 2018/ Latest Edition.	
2. E. Elrom, "The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects", A press, USA, 1st. Edition, 2019/ Latest Edition.	
3. K. Saurabh, A. Saxena, V. K. Saraswat, B. K. Roy and C. P. Gurnani, "Blockchain Technology - Concepts and Applications.", Wiley, 1st Edition, 2020/ Latest Edition.	
4. K. Werbach, "The Blockchain and the New Architecture of Trust", MIT Press, 2018/ Latest Edition.	
5. https://nptel.ac.in/courses/106/105/106105184/	

Mobile Computing

Course Code: MCA-219 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction: This course introduces students to perform computing on mobile platforms by developing mobile applications. It introduces students to a number of concepts related to mobile application development in the most widely used open-source operating system (Android).

Course Objectives:

- To give the students an understanding of the principles behind the development of mobile applications on Android Smartphones.
- To enable students to solve a computational problem using mobile applications.

Prerequisite: Java Programming.

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Course Outcomes: Upon successful completion of this course, students will be able :

CO1: To make students understand the concept of Mobile computing paradigm, its novel Applications and limitations.

CO2: To provide the typical mobile networking infrastructure knowledge through a popular GSM architecture.

CO3: To furnish the knowledge of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer.

CO4: To Provide the concepts of platforms and Protocols used in broadcasting and Synchronization in the mobile environment.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Students would be encouraged to develop a course project that involves mobile application development. Emphasis would be given on programming assignments.

UNIT I	10 hours
Review of Java: Data Types, Strings, Loops, Conditions, OOP concepts, Interfaces, Exceptions, Threads. Android Programming: Android Studio, Project Structure, First App, App Deployment on Mobile, App Extensions – Buttons, Toast.	
UNITII	**10 hours**
Android Activity. Material Design. Android Life Cycle. Android Layout: Linear Layout, Constraint Layout, Table Layout. View, Widget & Style, Beautiful Layout with Card View & Scroll View.	
UNIT III	**10 hours**
Menus and Action Modes. User Interface Components using Fragments. Home Screen Widgets, Search, System UI. Data Storage mechanisms. Alerts and Notifications.	
UNITIV	**10 hours**
Interfacing with Touch Screen and Sensors. Graphics and Animations. Open GL. Multimedia: Sound and Camera. Case Study based projects.	
Text Books	
1. John Horton, "Android Programming for Beginners", Packt Publishing,2nd Edition, 2018/ Latest Edition.	
2. Rick Boyer, "Android 9 Development Cookbook", O'reilly, 3rd Edition, 2017/Latest Edition.	
Online Reference	
1. Pushpendra Singh, "Mobile Computing", Online Course, NPTEL-106, 2016/ Latest Edition. (URL: https://nptel.ac.in/courses/106/106/106106147/)	

Web Based Programming

Course Code: MCA-223 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction: Web is playing a significant role and affecting the online user behaviors in many ways. Very often, it is the web design that draws users towards the website. User experience of a website is very essential. It is important to learn different technologies for developing web pages. This course shall be an introduction to web-based programming for students.

Course Objectives:

- Understand the fundamentals of web technologies
- Develop web-based portal

Prerequisite: Basic web-development language knowledge such as HTML, JS, XML, Web designing

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

CO1: Understand HTML tags and JavaScript Language programming concepts and techniques.

CO2: Understand different web technologies required to develop websites.

CO3: Develop web-based application using suitable client side and server-side web technologies

CO4: Develop a web-based portal to provide requisite services to the users.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Web – Protocols, Search Engines, Web Server. HTML - Structure & Tags, Forms, Media, Dynamic HTML and HTML5. **CSS** - Selectors, Box Model, Navigation bars, Image Gallery, CSS Responsive and CSS Grid design.	
UNIT II	**10 hours**
JavaScript - data types, functions, strings. JS callbacks, asynchronous. JS HTML DOM Model, Event handling. AJAX – Components, Dynamic HTML with AJAX, JS AJAX, JS JSON. Jquery.	
UNIT III	**10 hours**
PHP – basic working, data types, strings, numbers, if-else, switch, loops, functions, regex. PHP Forms and validation. Advanced PHP – file handling, cookies, sessions, filters, callbacks, JSON and exception handling.	
UNIT IV	**10 hours**
Web Frameworks: Bootstrap – Grid and Tags; Case Studies (web portal development) on any one of web based frameworks: Django, Ruby on Rails, and AngularJS framework.	

Text Books

1. M. Srinivasan, "Web Technology Theory and Practice", Pearson, 1st Edition, 2012/ Latest Edition.
2. Jeffrey Jackson, "Web Technology: A Computer Science Perspective", Pearson Education, 1st Edition, 2007/ Latest Edition.

Reference Books

1. S. A. Gabarro, "Web Application Design and Implementation", Wiley, 1st Edition, 2006/ Latest Edition.
2. T.Powell and F.Schneider, "JavaScript 2.0: The Complete Reference", McGraw-Hill, 3rd Edition, 2017/ Latest Edition.
3. L.Lemay, R.Colburn and J.Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing", BPB Publications , 1st Edition, 2016/ Latest Edition.
4. S.Jain and M.G Iyer, "Web Designing and Publishing" , BPB Publications , 1st Edition, 2020/ Latest Edition.

Conceptual Modelling

Course Code: MCA-235 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction: Conceptual Modelling is the second stage in the systems development life cycle and lies between requirements engineering and construction design phases. During this phase, systems requirements are converted into a platform-independent system design. The system design is then represented in concepts of the desired platform in the third phase of the Software Development Life Cycle.

Course Objectives:

- To learn the fundamental concepts of conceptual modelling
- To gain and apply the acquired knowledge pertaining to platform independent system design

Prerequisite: DBMS, Object Oriented Programming

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Explain the term conceptual modelling and the need of conceptual modelling.

CO2: Understand the use of different components used in conceptual modelling.

CO3: Illustrate the different modelling techniques used to design conceptual schema.

CO4: Develop business process models by using conceptual model

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	16 hours
Need for Conceptual Modelling, The Conceptual and 100% principles, The Structure Model; Relationships and cardinalities, Attributes and their types, Aggregations and compositions; ISA hierarchies, Constraints on ISA hierarchies. Conversion to the relational model	
UNIT II	**12 hours**
Behaviour Modelling: actors, roles, use cases, use case variants, and use case diagrams, Generalization, Include, Extend; Interaction diagrams: sequence diagrams and collaboration diagrams, Events, states, state machines and state charts	
UNIT III	**14 hours**
Process Modelling: Event Process Chains and Business Process Modeling Notation, rules for sequence and message flows, events and their attributes, start, end, intermediate; activities, activity attributes, sub-process and task; gateways: inclusive, exclusive, parallel, complex; pool and lanes; artifacts and their definitions, data object, text annotation	
Text Books	
1. Olive A., Conceptual Modelling of Information Systems, Springer, Latest Edition.	
2.Rumbaugh and Blaha, Object Oriented Modeling and Design with UML, Pearson, 2nd Edition, 2007/Latest Edition.	
3.Rumbaugh et al, Object Oriented Modeling and Design, Prentice Hall, 2006/ Latest Edition.	
Reference Material	
1. UML standard : https://www.omg.org/spec/UML/2.5/About-UML	
2. BPMN standard : https://www.omg.org/spec/BPMN/2.0/About-BPMN	

Natural Language Processing	
Course Code: MCA-237 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction:

Natural Language Processing (NLP) is concerned with automatically processing human language. Applications include machine translation, search, automatic summarization, and dialog systems. NLP has proved to be a hard task, among other things because of the complexity of the structure of human language, and because of the massive amount of world knowledge that humans use in language understanding. This course provides a broad introduction to NLP with a particular emphasis on core algorithms, data structures, and machine learning for NLP.

Course Objectives:

- To describe the architecture of and basic design for a generic NLP system
- To discuss the current and likely future performance of several NLP applications, such as machine translation and Semantic analysis
- To briefly describe a fundamental technique for processing language for several subtasks, such as morphological analysis, syntactic parsing, word sense disambiguation etc
- To explain how NLP techniques draw on and relate to other areas of (theoretical) computer science, such as formal language theory, formal semantics of programming languages,

Prerequisite: Proficiency in at least one programming language.

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

CO1: Define the characteristics of machine learning techniques used in NLP

CO2: Understand what constitutes a probabilistic language model and understand the difference in assumptions between different types of such models (e.g. bag-of-words, n-gram, HMM, topic model)

CO3: Analyze the syntax, semantics, and pragmatics of a statement written in a natural language.

CO4: Develop speech-based applications that use speech analysis (phonetics, speech recognition, and synthesis).

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted

UNIT I	**10 hours**
Introduction: Stages of NLP, Classic problems, Regular Expressions and Automata, Words and Transducers, N-grams, Words: Structure (Spellcheck, morphology using FSTs), Words: Semantics (Lexical Semantics, WordNet and WordNet based Similarity measures, Distributional measures of similarity, Concept mining using Latent Semantic Analysis), Word Sense Disambiguation, supervised, unsupervised and semi-supervised approaches)	
UNIT II	**10 hours**
Words: Part of Speech (POS) tagging using Brill's Tagger and HMMs. Sentences: Basic ideas in compositional semantics, classical parsing (Bottom up, top down, Dynamic Programming, CYK Parser, parsing using probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters.	
UNIT III	**10 hours**
Word Embeddings (Word2Vec, GloVe, LDA, TF-IDF), Skip-gram model, CBOW, Topic modelling: Latent Dirichlet Allocation, Gibbs sampling for LDA, LDA variations and applications, Semantic Analysis: Introduction, Affective lexicons (Learning and Computation), Language modelling: Basic ideas and smoothing techniques	
UNIT IV	**10 hours**
Machine translation with case studies (Rule based techniques, Statistical Machine Translation, parameter learning in SMT (IBM models) using EM). Information Extraction: Introduction to Named Entity Recognition and Relation Extraction, relation between Information Retrieval and NLP. Natural language Generation: the potential of using ML for NLG, Advanced language modelling (LDA), Summarization (Single document, Multiple documents, query based), Question answering. Text to image and vice versa. Deep neural nets and ANNs for NLP.	

Text Books

1. Daniel Jurafsky and James H. Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Upper Saddle River, NJ: Prentice-Hall, 2nd Edition, 2009/ Latest Edition.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary, Oxford University Press,2008/Latest Edition

Reference Books/Materials

1. Christopher D. Manning and Hinrich Schuetze. Foundations of Statistical Natural Language Processing. Cambridge, MA: MIT Press. Latest Edition.
2. Allen, J:" Natural Language Understanding.". Latest Edition, The Benajmins/Cummings Publishing Company Inc. 1994. ISBN 0-8053-334-0
3. https://nptel.ac.in/courses/106/105/106105158/
4. https://nptel.ac.in/courses/106/106/106106211/

Wireless Networks	
Course Code: MCA-239 **Contact Hours:** L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 3

Introduction: This course is about teaching the fundamental concepts of wireless networks and has a basic knowledge of the different types of ad-hoc networks and underlying protocols. Course will provide the understanding of the architecture of wireless networks for its various application setups. .

Course Objectives:

- Understanding the basics of wireless networks
- Become Familiar to the challenges involved in wireless networks with respect to wired networks.
- To study various types of wireless networks, i.e cellular networks, Bluetooth, Ad hoc networks, wireless mesh networks and wireless sensor networks.

Prerequisite: Basic Knowledge of Computer networks

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Define the Fundamental Concepts and applications of ad hoc and wireless sensor networks.

CO2: Classify existing adhoc network protocols for MAC layer, Network layer and transport layer.

CO3: Discover the design, performance, energy, security and privacy issues in wireless adhoc and sensor networks.

CO4: Design and simulate various MAC and routing protocols of Adhoc Networks.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped classroom teaching will be adopted.

UNIT I	10 hours
Introduction: Introduction to Ad-hoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - Indoor and outdoor models. **MAC Protocols:** design issues, goals and classification. Contention based protocols, IEEE Standards: 802.11, 802.15.	
UNIT II	**10 hours**
Network Protocols: Routing Protocols: Design issues, Proactive Vs reactive routing protocols, Unicast routing protocols, Multicast routing protocols, hybrid routing protocols, Energy aware routing protocols, Hierarchical Routing protocols **Transport Layer:** Issues in designing Transport Layer, Transport layer classification, Ad-hoc transport protocols.	
UNIT III	**10 hours**
Wireless Mesh Networks: Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic Routing, Heterogeneous Mesh Networks, Vehicular Mesh Networks.	
UNIT IV	**12 hours**
Wireless Sensor Networks: Introduction, Sensor Network architecture, Data Dissemination, Data Gathering, Location discovery, Quality of Sensor Networks, Sensor Network Platforms and Tools, Energy Efficient Approaches	

Text Books

1. C.S.R Murthy and B. S. Manoj, "Ad hoc Wireless Networks Architectures and Protocols", Pearson Education, 2nd Edition, 2004/ Latest Edition..
2. H. Karl and A. Willig, " Protocols and Architectures for Wireless Sensor Networks", John Wiley, Student Edition (Indian), 2016/ Latest Edition..

Reference Books

1. R. Hekmat, "Ad-hoc Networks: Fundamental Properties and Network Topologies", Springer, 1st Edition, 2006/ Latest Edition.
2. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 1st edition, 2015/ Latest Edition.
3. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley, 2010/ Latest Edition.
4. E. Charles "Ad hoc networking", Pearson Education India, 1st Edition, 2008/ Latest Edition.

Industrial Training/Internship	
Course Code: MCA- 253 **Contact Hours**: **Course Category**: DCC	**Credits**: 1 **Semester**: 3

Course Objectives: Students will carry on the industrial training/internship for at least six weeks in the summer break of previous academic session. The idea of the training is to make them capable of handling the implementation of their theoretical knowledge in the practical field. To facilitate the development of a holistic perspective among students towards life, industry experts teach advanced technologies. Through Industrial training, students get familiarize with the environment of an organization and a company. Students get a certificate which validates their skills and helps them in getting a job quickly. The assessment for the same will be done within the first two weeks of opening of academic session by the respective department.

Course Outcomes: After completion of the course, the students should be able to:

CO1: Understand the Organizational Structure of a company.

CO2: Develop work habits and attitudes necessary for job success (technical competence, professional attitude, organization skills etc.)

CO3: Develop written communication and technical report writing skills.

CO4: Develop an awareness for the need and applications of standards in the industry.

Financial Reporting and Analysis	
Course Code: HMC-203 **Contact Hours**: L-3 T-0 P-0 **Course Category**: HMC	**Credits**: 3 **Semester**: 3

Introduction: The course will help the students to understand the commonly used accounting terminologies, the users of accounting information and their respective requirements. This course will enable the learners to have an overall understanding of the Financial Statements of a company, understand the financial statements like the Balance Sheet, Income Statement (Statement of Profit and Loss), Cash Flow Statement and their various elements.

Course Objectives: This course aims at enabling the students understand the contents of Financial statements and its analysis. It also sensitizes the students to understand the element and nature of costs, methods and techniques.

Prerequisite: knowledge of business reporting and data analysis

Course Outcomes: After completion of the course, the students should be able to:

CO1: Understand how accounting decisions affects real company practices.

CO2: Understand the concepts of Deprecation, Inventory valuation and the methods employed by Indian Companies.

CO3: Strengthen the foundations of the analytical approach to Managerial decision-making.

CO4: Understand consumer behaviour.

CO5: Understand the production problem and how managers make input purchase decisions.

CO6: Understand the various market structure and how supply is determined in each.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	10 hours
Basics of Financial Reporting: Purpose of financial reporting, Users of Financial reports, Conceptual Framework of financial reporting. Define, understand, and apply accounting concepts, Regulatory Framework of Accounting: setting Indian accounting standards, convergence of international accounting standards, International Financial Reporting Standards (IFRS).	
UNIT II	**11 hours**
Preparation of Financial Reports: Accounting Process- Books of Original Record. Ledger& Trial Balance, Concepts and contents of financial reports and drafting of Financial Reports: statements of Financial Position (Balance Sheet), Statement of Earnings (Profit and Loss Statement).	
UNIT III	**10 hours**
Elements of Financial Statements: AS-2 Valuation of inventories AS-9 Revenue Recognition AS-10 Accounting for Fixed Asset AS-22 Accounting for taxes on Income AS-26 Accounting for Intangible Assets.	
UNIT IV	**11 hours**
Financial Analysis: Financial Ratios used in Annual Reports, Management use of Financial Analysis, Graphing Financial Information, Analysis and interpretation of financial statements: Ratio Analysis; Liquidity, Leverage, Solvency and Profitability ratios–Du Pont Chart -Horizontal Analysis and Vertical Analysis.	

Text Books	
1	Narayanswamy R. , "Financial accounting: A Managerial Perspective", PHI, 2017/ Latest Edition.
2	Jawahar and Sucheta, "Financial Reporting and Analysis", Himalaya Publishing House, 2018/ Latest Edition.
Reference Books	
1	Anthony and R.N, "Essentials of Financial Accounting", Prentice Hall,4th Edition, 2010/ Latest Edition.
2	A. Banerjee, "Financial Accounting", Excel Books, New Delhi, 3rd Edition,2009/ Latest Edition.
3	Vij and Madhu , Management Accounting, Excel Books, 1st Edition, 2013/ Latest Edition.

Disaster Management

Course Code: HMC-202 **Contact Hours:** L-1 T-0 P-2 **Course Category:** HMC	**Credits:** 2 **Semester:** 4

Introduction: Natural and technological hazards affect the everyday life as well as long-term development plans. For many decades the prevailing approach in dealing with disasters was focus on response and recovery, however lately pre-disaster actions to minimize the disaster risks are getting importance. The course introduces Disaster Management, focusing on natural disasters.

Course Objective:

- The objective of the course is to acquaint the students about the concept of information system in business organizations, and also the management control systems.
- To increase the knowledge and understanding of the disaster phenomenon, and its different contextual aspects, impacts, and public health consequences
- To ensure knowledge, skills, and abilities to analyze the potential effects of disasters and the strategies and methods for disaster reduction.

Prerequisite: Knowledge of Risk identification, Risk analysis, monitoring search and rescue activities.

Course Outcome: After completion of the course, the students should be able

CO1- Learning and understanding the basic knowledge of Disaster Management concepts and different approaches to reduce the impact of the disaster.

CO2- Understand the types of a disaster, their origin causes and their management, and the disaster profile of India.

CO3- Apply technical knowledge for monitoring and managing the disaster.

CO4- Drill-based learning of disaster management

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

UNIT I	4 hours
Concepts and Definitions of Disaster - hazard, vulnerability, resilience, risks, rehabilitation, reconstruction, search and rescue before, during and after disasters. Disaster Profile of India – Mega Disasters of India and Lessons Learnt.	
UNIT II	**10 hours**
Categories of disasters -Natural disasters – earthquake, cyclone, landslide, flood, tsunami, heatwaves, cold waves, avalanches, Man-made disasters – fire, urban fire, forest fire, Chemical, biological, radiological and nuclear disasters, armed conflict and civil strife, oil and Gas leakage, Transport disasters Factors affecting Vulnerabilities, impact of Development projects such as dams, high rise constructions etc.	
UNIT III	**6 hours**
Geo-informatics in Disaster Management (RS, GIS, GPS and RS), Disaster Communication System (Early Warning and Its Dissemination), Use of ICT, mobile technology, alarms etc., Application of Drone.	
UNIT IV	**8 hours**
Disaster Management Act 2005, Disaster Management National Policy, Disaster Management Cycle, Role of Government (local, state and national), Non-Government, Inter-Governmental and UN Agencies.	

Text Books	
1	Savindra Singh, Jeetendra Singh, Disaster management, Pravalika Publications, Allahabad,2016
2	Alexander David, Introduction in Confronting Catastrophe, Oxford University Press, 2000.
3	Kapur, Anu& others, Disasters in India Studies of grim reality, Rawat Publishers, Jaipur, 2005.
4	Mukta Girdhar, Natural Disasters, Amy publication, Dariyaganj, New Delhi, 2019.
Reference Books/Materials	
1	Andharia J., Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social Sciences Working Paper No. 8, 2008/ Latest Edition.
2	Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.
3	https://ndma.gov.in/en/

Generic Open Elective	
Course Code: GEC-202 **Contact Hours:** L-0 T-2 P-0 L-0T-0 P-4 L-2T-0 P-0 **Course Category:** GEC	**Credits:** 2 **Semester:** 4

Introduction: A Generic Elective (GE) course is an interdisciplinary course provided to the students chosen generally from an unrelated discipline/subject and allowing them a chance at comprehensive education. GEs are introduced as part of the CBCS. The students can choose their preference from a pool of courses from various disciplines/subjects. Elective courses do much more than filling in the gaps to fulfill the high school graduation requirements. It gives a chance to explore new options, allowing students to study more about the subject they are passionate about, and enables them to 'test drive' new activities. They provide students with the necessary skills to improve creativity that they might not find in the classroom. The main purpose of the elective course is to seek exposure to a new discipline/subject and to provide the students with an alternative option for desired fields.

Course objectives:

- Students will have exposure to a new discipline/subject.
- Prepare students to look for inter-disciplinary research.
- GE can fulfil the limitation to pursue master's study in desired field.
- Help discover new things that never existed and might change the course of student's life.

Prerequisite: Basic knowledge of the selected domain of elective course

Course Outcomes: After completion of the elective course, the students will be able to:

CO1: Identify new discipline and learn new subject for future careers.

CO2: Apply their knowledge to understand and solve the real-life problems.

CO3: Analyse creative design process through the integration and application of diverse technical knowledge and expertise to address social issues.

CO4: Develop the habit of working independently to attain self-motivation, discipline, and confidence to achieve their goals.

Major Project	
Course Code: MCA-202 **Contact Hours**:- **Course Category**: DCC	**Credits**: 18 **Semester**: 4

Introduction: The academic projects of the students only have the power to show a right path to them for their career. Nowadays, there are many innovative domains for academic projects in both hardware as well as the software area.

Course Objectives:

- To improve student's exposure to future career, practical thinking and approach of utilizing their theoretical knowledge
- Exposure to the job opportunities after completing the courses.

Prerequisite: knowledge of the subject opted for performing the project task

Course outcome: After completing the major projects the students will be able to:

CO1: An excellent academic project enhances the percentage of a student's degree. In the same way, good marks in the project work attract and divert the interviewer's attention.

CO2: Additionally, research-based projects and industry oriented tremendously increases the weightage of your resume. This enlarges your job prospects. This favors students because industry professional always searches for an employee with good project background.

CO3: Helps the students to enhance their admission to higher education in their preferred National and International universities.

CO4: Analyzing, designing, and implementing various projects, students are assigned significant projects based on the languages they have learned so far