RCOEM

Shri Ramdeobaba College of Engineering and Management, Nagpur

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR - 440013

An Autonomous College affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur,Maharashtra (INDIA)

PROGRAMME SCHEME

2022-23

MASTER OF COMPUTER APPLICATIONS (MCA)

About the Department

The Department of Computer Application started functioning at Shri Ramdeobaba College of Engineering (RCOEM) in the year 2001, offering a Two-Year postgraduate degree in Computer Applications (MCA). The management at RCOEM nurtured the first shift of MCA through the years, allowing it to take roots firmly. The huge success of the course and its demand as a viable career option resulted in the establishment of the second shift in the year 2010. Today the department successfully runs two shifts to full capacity with a total intake of 120 students (60 in each shift). With phenomenal placements and institute backed internship efforts, it has become one of the most preferred destinations for students who opt for the MCA course.

Department Vision

To pursue excellence in quality education, research and innovation through team work with a focus on computer applications for the benefit of the industry, students and society.

Department Mission

The Department of Computer Application is working with the mission to excel in imparting quality education with dedicated and strongly motivated faculty. We also strive to foster mutually beneficial relationship with industry and academia.

Program Educational Objectives

1. To provide students with sound foundation of computer fundamentals, core computer knowledge, techniques, tools and skills from mathematics required to solve problems in computer application.

2. To provide students with the knowledge of system development life cycle (SDLC) so that they can create computing solutions for various fields of IT and able to understand the importance of environmental, social, professional and ethical issues.

3. To provide exposure to emerging technologies, professional and ethical attitude, effective communication skills, adequate training & opportunities to work as part of a team in multidisciplinary projects and adapt to current industry trends by engaging in lifelong learning.

Program Outcomes

1. An ability to apply knowledge of computing fundamentals and mathematics across disciplines.

2. An ability to identify, formulate and implement complex computing solutions using principles of mathematics, computing and relevant domain knowledge.

3. An ability to design, analyze and evaluate solutions for complex computing problems taking into account cultural, societal and environmental aspects.

4. An ability to design and conduct experiments, analyze and interpret data to provide valid conclusion.

5. An ability to apply current techniques, skills and appropriate tools in various domains in the field of IT.

6. An ability to understand professional ethics, legal and social issues along with the cyber regulations.

7. An ability to engage in life-long learning and continuing professional development.

8. Apply the understanding of management principles with computing knowledge to manage the projects in multidisciplinary environments as a dedicated team.

9. To inculcate an ability to communicate effectively in written and verbal form to a variety of audiences about complex computing activities.

10. An ability to understand the impact of local and global computing on individuals, organizations and society.

11. An ability to apply the principles of teamwork, leadership and collaborations to function productively and professionally.

12. An ability to develop oneself as an entrepreneur in the software domain through innovative approach to benefit the society at large.

Program Specific Outcomes

1. Understand, analyze and develop computer programs in the area related to algorithms, system software, multimedia, web design and networking for efficient design of computer-based systems of varying complexity.

2. Apply standard Software Engineering practices using open-source programming environment to deliver a quality product for business success.

3. Be acquainted with the contemporary issues, latest trends in technological development and thereby innovate new ideas and solutions to existing problems.

Teaching Scheme for Master of Computer Applications

SEMESTER -I										
Sr. No.	**Code**	**Course**	**L**	**T**	**P**	**Credits**	**Maximum Marks**			**Exam Duration**
							Continuous Assessment	**End Sem Exam**	**Total**	
1	MCT540	Introduction to Operating Systems	3	1	0	4	40	60	100	3 Hrs.
2	MCP540	Elective Lab-I	0	0	2	1	25	25	50	-
3	MCT541	Object Oriented Programming	3	0	0	3	40	60	100	3 Hrs.
4	MCP541	Object Oriented Programming Lab	0	0	2	1	25	25	50	-
5	MCT542	Principles of Programming Languages	3	0	0	3	40	60	100	3 Hrs.
6	MCP542	Principles of Programming Languages Lab	0	0	2	1	25	25	50	-
7	MCT543	Concepts in Software Engineering	3	0	0	3	40	60	100	3 Hrs.
8	MCP543	Concepts in Software Engineering Lab	0	0	2	1	25	25	50	-
9	MCT544	Theory of Automata and Formal Languages	3	1	0	4	40	60	100	3 Hrs.
10	MCP544	Elective Lab-II	0	0	2	1	25	25	50	-
11	HUT503	Elective Humanities-I	2	0	0	0	-	-	-	-
TOTAL			**17**	**2**	**10**	**22**				
			29Hrs.							

Elective Lab-I	
Course Code	**Course Name**
MCP540-1	Operating Systems Lab with Linux System Administration
MCP540-2	Multimedia and Its Applications

Elective Humanities-I	
Course Code	**Course Name**
HUT503-1	Soft Skills
HUT503-2	Professional Practice & Ethics

Elective Lab-II	
Course Code	**Course Name**
MCP544-2	Applied Mathematics and Statistical Lab
MCP544-3	Problem Solving with Python Lab

SEMESTER -II										
Sr. No.	**Code**	**Course**	**L**	**T**	**P**	**Credits**	**Maximum Marks**			**Exam Duration**
							Continuous Assessment	**End Sem Exam**	**Total**	
1	MCT545	Database Management Systems	3	0	0	3	40	60	100	3 Hrs.
2	MCP545	Database Management Systems Lab	0	0	2	1	25	25	50	-
3	MCT546	Design and Analysis of Algorithms	3	0	0	3	40	60	100	3 Hrs.
4	MCP546	Design and Analysis of Algorithms lab	0	0	2	1	25	25	50	-
5	MCT547	Computer Networks	3	0	0	3	40	60	100	3 Hrs.
6	MCP547	Computer Networks Lab	0	0	2	1	25	25	50	-
7	MCP548	Full Stack Web Development using MEAN	0	0	4	2	25	25	50	-
8	MCP549	Elective Lab-III	0	0	2	1	25	25	50	-
9	MCT627	Open Elective (Offered by other departments)	4	0	0	4	40	60	100	3 Hrs.
10	MCT553	Software Documentation	2	0	0	0	-	-	-	-
TOTAL			**15**	**0**	**12**	**19**				
			27Hrs.							

Elective Lab-III	
CourseCode	**Course Name**
MCP549-1	Foundations of Data Analytics Lab
MCP549-2	Design Patterns Lab

Open Elective (Offered by other Departments) *	
MBT699	Entrepreneurship Development
ENT699	Arduino Playground
HUT599-1	Psychology for Professional Growth
CST699-1	Foundation of Business Intelligence
CST699-2	Mobile Technology
ECT599-1	Evolution in Communication Technologies
ENT599-3	Designing with Raspberry Pi

SEMESTER -III										
Sr. No.	**Code**	**Course**	**L**	**T**	**P**	**Credits**	**Maximum Marks**			**Exam Duration**
							Continuous Assessment	**End Sem Exam**	**Total**	
1	MCT640	Artificial Intelligence	3	0	0	3	40	60	100	3 Hrs.
2	MCP640	Artificial Intelligence Lab	0	0	2	1	25	25	50	-
3	MCT641	Data Mining	3	0	0	3	40	60	100	3 Hrs.
4	MCP641	Data Mining Lab	0	0	2	1	25	25	50	-
5	MCT642	Cloud Computing	3	0	0	3	40	60	100	3 Hrs.
6	MCP642	Cloud Computing Lab	0	0	2	1	25	25	50	-
7	MCT644	Elective-I	3	0	0	3	40	60	100	3 Hrs.
8	MCT643	Elective-II	3	0	0	3	40	60	100	3 Hrs.
9	MCP644	Elective Lab-IV	0	0	4	2	25	25	50	-
10	MCP645	Elective Lab-V	0	0	4	2	25	25	50	-
TOTAL			**15**	**0**	**14**	**22**				
			29Hrs							

Elective Lab-IV	
Course Code	**Course Name**
MCP644-1	Mobile Application Development Lab
MCP644-2	Web Programming Lab

Elective-II	
Course Code	**Course Name**
MCT643-1	Information Security
MCT643-2	Graph Theory

Elective Lab-V	
Course Code	**Course Name**
MCP645-1	Information Security Lab
MCP645-3	DevOps Lab

Elective -I	
Course Code	**Course Name**
MCT644-1	Image Processing
MCT644-2	Introduction to Real Time Operating Systems
MCT644-3	Pattern Recognition
MCT644-4	Distributed Systems

SEMESTER -IV										
Sr. No.	**Code**	**Course**	**L**	**T**	**P**	**Credits**	**Maximum Marks**			**Exam Duration**
							Continuous Assessment	**End Sem Exam**	**Total**	
1	MCT646	Elective-III	3	0	0	3	40	60	100	3 Hrs.
2	MCP646	Elective Lab-VI	0	0	2	1	25	25	50	-
3	MCT647	Elective-IV	3	0	0	3	40	60	100	3 Hrs.
4	MCP647	Elective Lab-VII	0	0	2	1	25	25	50	-
5	MCT648	Elective-V	3	0	0	3	40	60	100	3 Hrs.
6	MCP649	Elective Lab-VIII	0	0	2	1	25	25	50	-
7	MCP650	Project Work	0	0	8	4	75	75	150	-
TOTAL			**9**	**0**	**14**	**16**				
			23Hrs.							

Elective-III	
Course Code	**Course Name**
MCT646-1	Introduction to Internet of Things
MCT646-2	Operations Research
MCT646-3	Computer Graphics and its Applications

Elective-IV	
Course Code	**Course Name**
MCT647-1	Compiler Construction
MCT647-2	Soft Computing
MCT647-3	Social Networks
MCT647-4	Wireless and Mobile Network
MCT647-5	Advanced Computer Architecture

Elective-V	
Course Code	**Course Name**
MCT648-1	Advanced Databases
MCT648-2	Information Retrieval
MCT648-4	Introduction to Deep Learning

Elective Lab-VI	
Course Code	**Course Name**
MCP646-1	Introduction to Internet of Things Lab
MCP646-2	Computer Graphics and its Applications Lab
MCP646-3	Operations Research Lab

Elective Lab-VII	
Course Code	**Course Name**
MCP647-1	Big Data and Analytics Lab
MCP647-2	Software Architecture Lab
MCP647-3	Compiler Construction Lab
MCP647-4	API Level Programming Lab
MCP647-5	R Programming Lab

Elective Lab-VIII	
Course Code	**Course Name**
MCP649-4	Information Retrieval Lab
MCP649-5	Introduction to Deep Learning Lab
MCP649-6	Advanced Databases Lab

1 Year Internship (Semester-III and IV)

Sr. No.	Code	Course	Contact Hours/ Sem			Credits	Maximum Marks			Exam Duration
			L	T	P		Continuous Assessment	End Sem Exam	Total	
1	MCP651	Project Work- Full Time (Phase-I)	0	0	36	22	350	300	650	-

Course Code	Elective
MCP651-1	Project Work- Full Time (Phase-I)

Sr. No.	Code	Course	Contact Hours/ Sem			Credits	Maximum Marks			Exam Duration
			L	T	P		Continuous Assessment	End Sem Exam	Total	
1	MCP652	Project Work- Full Time (Phase-II)	0	0	32	16	300	300	600	-

Course Code	Elective
MCP652-1	Project Work- Full Time (Phase-II)

Note: 1 year internship students will take MCP651-1 and MCP652-1. Six months internship students will take MCP652-1. MCP652-1 will be applicable for students pursuing 1 year internship as well as those pursuing 6 months internship.

Bridge Program

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Continuous Assessment	End Sem Exam	Total	
1	MCT550	Computer Architecture and Organization	3	1	0	0	-	-	-	-
2	MCT551	Data Structures	3	1	0	0	-	-	-	-
3	MCT552	Discrete Structures and Digital Logic	3	1	0	0	-	-	-	-

Credits Distribution Semester-wise:

SEM-I	SEM-II	SEM-III	SEM-IV	Total Credits
22	19	22	16	79

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT540				
Category	Program Core				
Course Title	Introduction to Operating Systems				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	1	0	4	

Course Objectives

To study various elements of operating systems and compare core functionalities of Windows and Linux operating systems. Students can learn concurrent processes problems, understand various memory management techniques, analyze deadlock handling methodologies and different protection and security concerns of operating system.

Course Outcomes

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

1. Identify various elements of operating system and compare core functionalities of Windows and Linux.
2. Identify and synchronize concurrent processes problems, analyze various memory management techniques and deadlock handling methodologies.
3. Understand different protection and security concerns of operating systems.

Syllabus

Section -I *(Weightage – 15%, Minimum Teaching Hours -6)*

Introduction - Types of OS, Operating system services, system calls.
File system introduction, Access methods, Allocation methods, Directory system, Disk and drum scheduling. Case study on Unix and Windows Operating System.

Section-II *(Weightage – 70%, Minimum Teaching Hours -28)*

Process - Introduction, Threads, CPU Scheduling algorithms, Inter-process communication, Critical section problem, Semaphores, Classical process coordination problem.
Deadlock -Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.
Memory Management – Concept of Fragmentation**,** Swapping, Paging, Segmentation.
Virtual memory-Demand Paging, Page replacement algorithm, Thrashing.

Section-III *(Weightage – 15%, Minimum Teaching Hours -6)*

Protection:-Goal, Domain of protection, Access matrix, Access control.
Security:-The security problem, Program threats, System and network threats, User authentication.

Text Books:

1. Operating System Concepts: *Siliberschatz Galvin: John Wiley & Sons.*
2. Modern Operating Systems: *Andrew Tanenbaum, PHI.*
3. Operating System, internals and Design Principles: Williams Stallings.

Reference Books :

1. An Introduction to Operating System: *H.M.Dietel, Pearson Education.*
2. Operating System: *Charles Crowley, IRWIN Publications.*
3. Operating systems: Archer J. Harris, Schaum's Outline, McGraw Hill Publication

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP540-1				
Category	Program Elective				
Course Title	Operating Systems Lab with Linux System Administration				
Scheme& Credits	L	T	P	Credits	Semester-I
	0	0	2	1	

Course Objective

The objective of the course is to know the basics of operating systems, Introduction of the Linux operating system and to learn OS concepts in Linux.

Course Outcomes

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

1. Install and work with various operating systems.
2. Use and run the commands of Linux.
3. Implement OS concepts in LINUX.

Syllabus

Minimum 4 practicals and assignments based on but not limited to the following topics:

- Introduction to virtualization. Preparing Multiboot systems.
- Creating Linux Virtual machines (or any variant eg Fedora / ubuntu / Kalilinux).
- Introduction to Linux/Unix/ Windows Operating Systems.
  .
- Studying file system of Linux.
- Compiling and executing C programs in Linux environment.
- Implementing OS concepts in Linux.

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP540-2				
Category	Program Elective				
Course Title	Multimedia and Its Applications				
Scheme& Credits	L	T	P	Credits	Semester-I
	0	0	2	1	

Course Objective

The objective of the course is to generate practical aspects of designing multimedia for the development of multimedia technologies and to understand the concepts, techniques and tools for creating and editing the interactive multimedia applications.

Course Outcomes

On the successful completion of this course student will be able to:

1. Create and edit the interactive multimedia applications
2. Learn the basic of multimedia tools for developing a web and mobile application
3. To evaluate multimedia application for its optimum performance

Syllabus

Minimum 8 Practicals based on Multimedia tools but not limited to the following topics:

- Graphic designing
- Audio and Video editing
- Web designing & Web development

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT541				
Category	Program Core				
Course Title	Object Oriented Programming				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	0	0	3	

Course Objectives

To develop the skills through which students will gain expertise in writing programs using object-oriented programming features. Students can learn to apply concepts of File handling, exception handling, Generics, Collections, multithreading along with the development of various programs using JDBC, JSP for skill development of basic web programming concepts and server-side scripting.

Course Outcomes

1. Understanding and analysis of different object-oriented programming features and ability to develop basic programming

2. Introduction to File handling, exception handling, Generics, Collections and multithreading to develop efficient programs with the concepts of error handling.

3. Understanding the concepts of JSP and JDBC to develop basic web programming concepts, database connectivity in addition to servlets to develop basic concepts

Syllabus

Section-I *(Weightage - 30%, Minimum Teaching Hours – 12)*
Features of Object Oriented Programming languages like data encapsulation, inheritance, polymorphism and late binding.Introduction to class and Methods, Access control of members of a class, instantiating a class, Constructors, Garbage Collection, finalize() Method.
Concept of inheritance, methods of derivation, use of super keyword and final keyword in inheritance, run time polymorphism. Abstract classes and methods, interface, implementation of interface, creating packages, importing packages, static and non-static members.

Section-II *(Weightage - 40%, Minimum Teaching Hours - 16)*
Exceptions, types of exception, use of try catch block, handling multiple exceptions, using finally, throw andthrows clause, user defined exceptions, Generics, generic class with two type parameter, bounded generics,Collection classes: Arrays, Vectors, Array list, Linked list, Hash set, Queues, Trees, Introduction to streams, byte streams, character streams, file handling in Java, Serialization Multithreading:Java Thread models, creating thread using runnable interface and extending Thread, thread priorities, Thread Synchronization, Inter-thread communications.

Section-III *(Weightage - 30%, Minimum Teaching Hours - 12)*

JSP-Why JSP?, JSP Directives, Writing simple JSP page, Scripting Elements, Default Objects in JSP, JSP Actions,Managing Sessions using JSP, JSP with beans. Java Database Connectivity, Servlets - Introduction Servlets vs CGI, Servlets API Overview, Servlets Life Cycle, Coding Writing & runningsimple Servlets, Generic Servlets, HTTPServlet, Servlets Config, Servlets Contest Writing Servlets to handle Get& Post methods.

Text Books:

1. JAVA The Complete Reference*: Herbert Schildt;*; Seventh Edition, Tata McGraw- Hill Publishing Company Limited 2007.
2. A programmer's Guide to Java SCJP Certification: A Comprehensive Primer: *Khalid A. Mughal and Rolf W.Rasmussen,* Third Edition.
3. Java Fundamentals: A Comprehensive Introduction:*HerbertSchildt and Dale Skrien*; Tata McGraw- Hill Education Private Ltd., 2013.

Reference Books:

1. Core JAVA Volume-II Advanced Features: *Cay S. Horstmann and Gary Cornell;* Eighth Edition; Prentice Hall, Sun Microsystems Press, 2008.
2. Java Programming: A Practical Approach: *C Xavier;* Tata McGraw- Hill Education Private Ltd., 2011

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP541				
Category	Program Core				
Course Title	Object Oriented Programming Lab				
Scheme& Credits	L	T	P	Credits	Semester-I
	0	0	2	1	

Course Objectives

The objective of the course is to prepare the students for applying the object-based programming techniques using objects and classes. Students can learn concepts like File handling, Multithreading, Exception handling, Streams, Generic, Collection classes, Java Server side concepts like JSP and Servlets through programming.

Course Outcomes

1. Develop programs using object-based programming techniques using objects and classes.
2. Develop programs using Specialized Java programming concepts like File handling, Multithreading, Exception handling, Streams, Generic and Collection classes
3. Develop programs using Java Server side concepts like JSP and Servlets.

Syllabus

Minimum 8 practicals based on but not limited to the following topics:

Classes and Objects, Inheritance, Overloading, Polymorphism, Collections, Generics, File Handling, Database connectivity, JSP and Servlets.

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT542				
Category	Program Core				
Course Title	Principles of Programming Languages				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	0	0	3	

Course Objectives

The objective of the course is to prepare the students to gain expertise in various programming language standards as well as they can enumerate various features of modern programming languages like structured programming constructs, abstraction and inheritance mechanisms, dynamic typing, etc. Students can learn to appreciate impact of implementation of different strategies of programming languages on the efficiency of the programs and flexibility of the language. This course can develop skills to design and implement algorithms for implementing different features of programming languages like dynamic memory management schemes, supporting variety of data types, exception handling mechanisms, etc.

Course Outcomes

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

1. Describe different programming language paradigms and demonstrate their utility as well as enumerate different features present in modern programming languages such as structured programming constructs, abstraction and inheritance mechanisms, dynamic typing, etc.
2. Differentiate between different strategies for implementation of programming languages and appreciate their impact on the efficiency of the programs and the flexibility of the language.
3. Design and implement algorithms for implementing different features of programming languages like dynamic memory management schemes, supporting variety of data types, exception handling mechanisms, etc.
4. Analyze an application at hand, choose an appropriate programming language for it and design and develop the application using the chosen language.

Syllabus

Section-I *(Weightage - 30%, Minimum Teaching Hours – 12)*

Introductory Concepts of Programming Languages

Characteristics of programming languages, Factors influencing the evolution of programming language, developments in programming methodologies, Language paradigms, Introduction to machine code, assembly code, assemblers, High level languages, Compilation, Interpretation, Bootstraping, T-Diagrams, Self-compiling compilers.

Names, Scopes and Bindings

Names, Binding and Binding Time, Lifetime, Heap Management, First fit, Best fit implementations, Buddy system, Fibonacci heaps, Garbage Collection, Reference Count, Mark and Sweep, Scope, Static and Dynamic Scoping, Symbol table, Aliases, Intern and Extern Static variables in C, Separate compilation.

Section-II *(Weightage - 35%, Minimum Teaching Hours - 14)*

Control Flow:

Expression evaluation, Assignment statements, Short-Circuit of expression evaluation, Selection statements, Case statements, Jump table, Iteration, Enumerated loops, While loop, C for loop, do-while loop, Activation Record format, Tail recursion, Thinking Recursively.

Data Types

Data Types, Numeric types, Implementations of int, float, bool, char, enum, subranges, Type equivalence, type conversion, coercion, type safety, Records, packed and unpacked implementations, Variant Records, Arrays, Row major allocation, Address calculation, Row/Column major allocation method impact, Row-pointer layout, Address calculation of row-pointer layout, Generation of code for array access, Stack Smashing due to lack of bound checks, Pointers, Recursive Data types, Tombstones/Lock and Key for Dangling Reference.

Section-III *(Weightage - 35%, Minimum Teaching Hours – 14)*

Subprogram and Control Abstraction

Calling Sequence, Access to local variables, Static link, non-local references, Caller and callee responsibilities, Register windows, inline function calls, Parameter passing, Special-Purpose parameters, Generic Subroutines and Modules, Exception Handling, Implementation of Exceptions, Coroutines, Event handling.

Data Abstraction and Object Orientation

Classes, Constructors and Destructors, Implementation issues, Operator Overloading, Templates, Implementation issues for Generic Templates, Representation of an object, Inheritance, Protected Specifier, Dynamic method binding and its implementation, Abstract Classes, Multiple Inheritance.

Text Books:

1. Michael L. Scott, “Programming Language Pragmatics”, Morgan Kaufmann Publishers.
2. Terrance W Pratt, "Programming Languages: Design and Implementation", PHI.

Reference Books:

1. Robert.W.Sabesta "Concept of Programming Language", 10th Edition, Pearson Publication.
2. Programming languages –Ghezzi, 3/e, John Wiley.
3. Fundamentals of Programming Languages, Galgotia Publications.

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP542				
Category	Program Core				
Course Title	Principles of Programming Languages Lab				
Scheme& Credits	L	T	P	Credits	Semester-I
	0	0	2	1	

Course Objectives

The objective of the course is to prepare the students for the development of skills through which they will gain expertise in various programming language standards. This course can help them to develop skills to design and implement algorithms for implementing different features of programming languages like dynamic memory Management.

Course Outcomes

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

1. Describe different programming language paradigms and demonstrate their utility as well as enumerate different features present in modern programming languages.
2. Design and implement algorithms for implementing different features of programming languages like dynamic memory Management.
3. Analyze an application at hand, choose an appropriate programming language for it and design and develop the application for the chosen language.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Implementation of various Data Types.
- Heap Management with various strategies.
- Implementation of Function Calling, Exception Handling mechanism, Inheritance Mechanism and Access Specifiers.
- Control Flow in Looping Structures

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT543				
Category	Program Core				
Course Title	Concepts in Software Engineering				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	0	0	3	

Course Objectives

The objective of the course is to enable the development of skills through which the student will gain expertise to engineer high quality software by following sound analysis and design principles. Students can learn to plan and execute the project effectively through requirements analysis, estimation, risk management and project scheduling activities along with the project management techniques for managing real world projects and object-oriented approach towards software engineering.

Course Outcomes

On successful completion of the course students will be able to:

1. Develop skills to engineer software of high quality by following sound analysis and design principles.
2. Learn successful project execution strategies like requirements analysis, estimation, risk management and project scheduling activities.
3. Use various project management techniques for managing real world projects and to develop an object-oriented approach towards software engineering.
4. Inculcate quality consciousness through effective software quality management.

Syllabus

Section -I *(Weightage – 20%, Minimum Theory Teaching Hours-8)*

Introduction to Software Engineering: Software engineering paradigms, Generic view of software engineering, Software metrics, Measures and metrics, Scheduling, Metrics of software quality.

Section -II *(Weightage – 50%, Minimum Theory Teaching Hours -20)*

Software Project Management:
Software project estimation and planning, Decomposition techniques, Risk Management, Requirement analysis.

Object Oriented Analysis:
Object oriented analysis and data modeling, Object oriented concepts, Class Based Modeling.

Agile Development:
About Agility, Agility and cost of change, Agile process, Agile process models (Adaptive software development, Scrum, Dynamic system development method), Agile Software development Approaches

Software Design Engineering:
The design process and fundamentals, Effective modular Design, Data flow-oriented design, Transform analysis, Transaction analysis, Design heuristics.

Section -III *(Weightage – 30% , Minimum Theory Teaching Hours -12)*

Software Quality Management:
Software quality assurance, Software testing techniques, S/W testing fundamentals, White box testing, Black box testing, Validation testing, System testing, Debugging, software maintenance: maintainability, Maintenance tasks, Reverse engineering and reengineering, Importance of Release Engineering.

Text Books:

1. Software Engineering: *Roger S. Pressman, TMH*
2. Software Engineering For Students: *D.Bell, AddisonWisley,*

Reference Books:

1. Fundamentals of Software Engineering: *Ghezzi, Jazayeri&Mandrioli, PHI.*
2. Software Engineering concept: *Richard Fairley, Tata McGraw Hill.*
3. Fundamental of Software Engineering: *Mall, PHI.*

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP543				
Category	Program Core				
Course Title	Concepts in Software Engineering Lab				
Scheme& Credits	L	T	P	Credits	Semester-I
	0	0	2	1	

Course Objectives

The objective of the course is to learn basic concepts of UML and its open-source tools. Students can learn various UML constructs and their usage.

Course Outcomes

On successful completion of the course students will be able to:

1. Use UML constructs.
2. Analyze and implement software development models using UML through open source tools.
3. Analyze and design software system using various UML constructs.

Syllabus

Minimum 4 practical's and assignments based on but not limited to the following topics:

- UML constructs and their usage.
- Different UML diagrams namely Use-case, Activity, Sequence, Class, Object, State Transition, Component and Deployment.

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT544				
Category	Program Core				
Course Title	Theory of Automata and Formal Languages				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	1	0	4	

Course Objectives

The objective of the course is to enable the development of skills and acquire knowledge through which the student will gain expertise in designing a finite automaton, optimize it as well learn the concept of Regular expression. Students can learn the concept of context free language and its representation using context free grammars and also understand the concept of push down automata for efficient designing of the same. Also Students can learn to inculcate Turing Machine for computing and to determine the decidability and intractability of computational problems.

Course Outcomes

On successful completion of the course students will be able to:

1. Apply knowledge through which the student will gain expertise in designing a finite automata, optimize it as well learn the concept of Regular expression.
2. Learn successfully the concept of context free language and its representation using context free grammars and also able to understand the concept of push down automata for efficient designing of the same.
3. Implement and learn a Turing machine for computation and analyze an unsolvable & undecidable decision problem.

Syllabus

Section -I *(Weightage – 40%, Minimum Theory Teaching Hours-16)*

Finite Automata

Informal picture of Finite automation model (FA), Deterministic Finite Automata, Definition and Notations of DFA, How a DFA processes Strings and Languages, Non-deterministic finite Automation, Definition, Equivalence of NFA & DFA, Conversion of NFA into DFA, Finite Automata with Epsilon transitions, Finite Automata with output: Moore& Mealy machines.

Regular Expressions

Regular expressions (RE), Operators and rules, Building regular expressions, Converting DFA's to RE and RE to Automata, Pumping lemma for regular languages, Closure properties of regular languages, Regular grammars (RG), Right linear and Left linear grammars, Interconversion between RE and RG, Minimization of FSM.

Section -II *(Weightage – 40%, Minimum Theory Teaching Hours-16)*

Context Free Grammar and Languages

Context-free grammars, Parse trees, Ambiguity in grammar and languages, Normal forms for Context- Free Grammars Chomsky normal form, Greibachnormal form, Reduction of CFG's, Elimination of ϵ- Productions, Unit Productions and Left Recursion, Useless Symbols, closure and decision properties of CFLs.

Push Down Automata

Definition of Pushdown Automata (PDA), Formal definition of PDA, Languages of PDA- Acceptance by final state and Empty Stack, , From PDA to CFG and CFG to PDA, Deterministic vs. Nondeterministic PDA .

Section -III *(Weightage – 20%, Minimum Theory Teaching Hours-8)*

Turing Machines & Undecidability

The Turing Machine, Transition diagrams for Turing machines, Languages, Turing machines and Halting, Extensions to basic Turing Machine, Universal Turing Machine, Recursive and Recursively enumerable languages, Undecidable Problem, Decidability, Rice's theorem, Post's Correspondence problem, Church's Hypothesis, Recursive function theory.

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Text Books:

1. Hopcroft Ulman, Introduction to Automata Theory, Languages and Computations, Pearson Education Asia, 2nd Edition, ISBN: 9788131720479.
2. Michael Sipser, Introduction to the Theory of Computation, CENGAGE Learning, 3 rdEdition ISBBN13:978-81-315-2529-6
3. Dr. O. G. Kakde, "Theory of Computation", University Science Press

Reference Books:

1. John C. Martin, Introduction to Language and Theory of Computation, TMH, 3 rd Edition, ISBN: 978-0-07-066048-9.
2. K.L.P. Mishra and Chandrasekaran, "Theory of Computer Science (Automata, Languages and Computation)", PHI, 3rd Edition
3. DanielI. A. Cohen, Introduction to Computer Theory, Wiley-India, ISBN: 978-81-265-1334-5.

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP544-2				
Category	Program Elective				
Course Title	Applied Mathematics and Statistical Lab				
Scheme& Credits	L	T	P	Credits	Semester-I
	0	0	2	1	

Course Objectives

This course will help student to apply proper approach for the analysis of data. The interpretation of the outcomes of the analysis can help the student to take correct decisions.

Course Outcomes

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

1. Demonstrate the mathematical and multivariate statistical techniques.
2. Interpret the results of the outcomes.

Syllabus

Minimum 8 practical's based on the following but not limited to:

1. Introduction to MATLAB environment and programming concepts.
2. Finding roots by Bisection method, Regular false method, Secant method and Newton's method.
3. Finding solution to the linear system of equation by Jacobi, Gauss-Seidel, and tri-diagonal system using Gauss-Thomas method.
4. Numerical Integration by Trapezoidal rule and Simpson's Rules.
5. Introduction to Multivariate analysis, MANOVA
6. Principle component analysis and canonical correlation
7. Factor analysis and Discriminate analysis.
8. Cluster Analysis and Conjoint analysis.

Note: Programming is to be done using MATLAB and various spreadsheets viz. Google Sheets/LibreOffice/Excel.

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP544-3				
Category	Program Elective				
Course Title	Problem Solving with Python Lab				
Scheme& Credits	L	T	P	Credits	Semester-I
	0	0	2	1	

Course Objective

Learn the basic concepts of Python programming and algorithmic problem solving using the Python environment as well as use of external libraries for providing solutions to diverse computational problems.

Course Outcomes

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

1. Implement basic concepts of Python programming.
2. Develop algorithmic solutions using Python programming constructs to solve simple problem statements.
3. Use external Python libraries for computational problem solving.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Introductory programming concepts
- Procedural programming
- Object Oriented Programming
- Designing a Problem-solving approach through problem understanding, abstraction and decomposition.

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	HUT503-1				
Category	Humanities				
Course Title	Soft Skills				
Scheme& Credits	L	T	P	Credits	Semester-I
	2	0	0	0	

Course outcomes

1. Ability to conceptualize fundamentals of effective group discussion strategies

2. Ability to conceptualize fundamentals of effective Personal Interview strategies

3. Ability to prepare effective resumes

Syllabus

Unit 1: Group Discussion

Introduction, Definition, Difference between GD and Debate, Number and duration, Personality traits evaluated in GD, GD etiquettes and mannerism, Opening and summarizing, tips for GD, mock GD sessions

Unit 2: Personal Interviews

Importance of personal interview, types of PI, Types of questions in PI, introduction to KYC, dressing, body-language

Unit 3: Resumé Making

Types of Resumé, Components of a resume, important features of a selling Resumé, sample Resumé

Text books

1. Sanjay Kumar, PushpaLata, *Communication Skills,* , Oxford Higher Education Publication
2. Meenakshi Raman, Sangeeta Sharma, *Technical Communication: Principles and Practice* , Oxford Higher Education Publication

Reference books

1. Dr. K Alex,*Soft Skills: Know Yourself & Know the World*, S.Chand Publishers
2. Barun K. Mitra,*Personality Development and Soft Skills*, 9th edition, , Oxford Higher Education Publication
3. ShitalKakkarMehra, *Business Etiquette: A Guide for the Indian Professionals*:, Harper Collins Publishers

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	HUT503-2				
Category	Humanities				
Course Title	Professional Practices & Ethics				
Scheme& Credits	L	T	P	Credits	Semester-I
	2	0	0	0	

Course Outcomes

1. Students will understand professional ethics
2. Students will understand various dimensions of professional ethical problems and dilemmas
3. Students will understand methods and strategies to resolve various ethical problems

Syllabus

Unit I: Professional Ethics: Professionalism and types of ethics, negative and positive face of ethics, responsibility of professionals.

Unit II: Ethical Problems: Technology optimism and pessimism, computer technology and dimensions of ethics, ethical issues in design, trust and reliability, case studies (bigdata mining, cyber Psychology).

Unit III: Ethical Resolution: Framing the problem, resolving problems, ethical resources for solving boundary-crossing problems, ethical obligations of professionals towards environment.

Reference Books:

1. Charles, E. Harris, Michael, S Pritchard, Michael J Rabins, *Engineering Ethics: Concepts and Cases,* CENGAGE Learning India Ovt Ltd, 2012.
2. R. Subramanian, *Professional ethics (including Human values),* Oxford publication, 2017

SYLLABUS OF SEMESTER –II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT545				
Category	Program Core				
Course Title	Database Management Systems				
Scheme& Credits	L	T	P	Credits	Semester-II
	3	0	0	3	

Course Objectives

To design, manipulate and manage databases. Students can learn to develop preliminary understandings, skills for designing a database information system, the concepts of SQL and PL/SQL and to implement database systems in real world.

Course Outcomes

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

1. Recognize the context, phases and techniques for designing and building database information systems in business.
2. Design and implement a database schema, database objects for a given problem-domain, organize database entities, understand the principles of storage structures and apply various Normalization techniques.
3. Apply concurrency control and recovery techniques to build application for real world problem and understand query processing techniques involved in query optimization.

Syllabus

Section -I ***(Weightage – 20%, Minimum Theory Teaching Hours -8)***

Introduction to Database Management Systems:

Introduction, Conventional File Processing System,
Components of DBMS, Advantages and Disadvantages, Three-level Architecture proposal for DBMS, Abstraction and Data Integration, Data Independence.
Data Models: Introduction, Types of Data Models, Entity-Relationship Model: E-R diagram, Reduction to relational schemas, Generalization, Specialization & Aggregation.
The Relational Model: Keys, Relationship, Integrity rules, Relational Algebra.

Section –II ***(Weightage – 67%, Minimum Theory Teaching Hours -27)***

SQL, Intermediate SQL and Relational Database Design:

SQL: Overview of SQL, DDL, integrity constraints, DML, set operations, null values, aggregate functions, sub-queries.

Intermediate SQL: Joins, Views, Indexes, Abstract Data type.

Advanced SQL: PL-SQL.

Relational Database Design: Functional Dependency, Normalization.

File Organization, Indexing and Hashing:

Introduction, Ordered indices, B-Tree and B+-Tree file organization, Static & Dynamic hashing.

Concurrency Control and Database Recovery:
Concept of Transaction, Serializability, locking protocols.
Deadlock Detection and Recovery, Log based Recovery, Recovery with concurrent transactions.

Section –III ***(Weightage –13%, Minimum Theory Teaching Hours -5)***

Query Processing and Optimization:
Query Processing: Overview, Measures of Query Cost, Selection Operation, Join Operation.
Query Optimization: Overview, Transformation of Relational Expressions, Cost-Based Optimization, Heuristic Optimization.

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Text Books:

1. Database Systems Concepts: *Silberschatz, Korth, Sudarshan, McGraw-Hill*.
2. An Introduction to Database Systems: *Bipin C. Desai, Galgotia.*
3. SQL & PL/SQL using Oracle: *Ivan Bayross, BPB Publications.*

Reference Books:

1. Fundamental of Database Systems: *Elmasri, Navathe, Somayajulu, Gupta Pearson Publications*
2. Database Management System: *Raghu Ramkrishan, Johannes, McGraw Hill*
3. An Introduction to Database Systems: *C.J.Date, Narosa*

SYLLABUS OF SEMESTER –II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP545				
Category	Program Core				
Course Title	Database Management Systems Lab				
Scheme& Credits	L	T	P	Credits	Semester-II
	0	0	2	1	

Course Objective

This course will help student to give a good formal foundation on the relational model of data, to present SQL, procedural interfaces to SQL comprehensively and to introduce the concepts and techniques relating to query processing by SQL Implementations.

Course Outcomes

1. Design and implement a database schema, database objects for a given problem-domain.
2. Declare and enforce business rules on a database using RDBMS.
3. Normalize a database, populate and query a database using SQL DML/DDL commands.

Syllabus

Minimum 4 practicals and assignments based on but not limited to the following topics:

- **SQL:** Overview of SQL, DDL, integrity constraints, DML, set operations, null values, aggregate functions, sub-queries.
- **Intermediate SQL:** Joins, Views, Indexes, Abstract Data type

SYLLABUS OF SEMESTER –II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT546				
Category	Program Core				
Course Title	Design and Analysis of Algorithms				
Scheme& Credits	L	T	P	Credits	Semester-II
	3	0	0	3	

Course Objectives

To introduce key techniques for designing and analyzing computer algorithms. This will enable students to point out the importance of designing efficient algorithms by comparing different complexity classes. Students will also be able to study algorithm design paradigms and approaches for their analysis. Which will give them an insight into tractable and intractable problems and different techniques to deal with them.

Course Outcomes

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

1. Define the basic concepts and analyze worst-case running times of algorithms using asymptotic analysis.
2. Identify how divide and conquer works and analyze complexity of divide and conquer methods by solving recurrence.
3. Illustrate Greedy paradigm and Dynamic programming paradigm using representative algorithms.
4. Describe the classes P, NP, and NP-Complete and be able to prove that a certain problem is NP-Complete.

Syllabus

Section -I *(Weightage – 20%, Minimum Teaching Hours-8)*

Elementary Algorithmic: What Is an Algorithm? Problems and Instances, The Efficiency of Algorithms, Average and Worst-Case Analysis, Elementary Operations, Need for Efficient Algorithms, Some Practical Examples on Sorting, Multiplication of Large Integers, Evaluating Determinants, Calculating the Greatest Common Divisor, Calculating the Fibonacci Sequence. **Analysis of Algorithms:** Asymptotic Notations, Analysis of algorithms, Amortized Analysis, Solving Recurrences Using the Characteristic Equation.

Exploring Graphs: Depth-First Search, Breadth-First Search.

Section -II *(Weightage – 40%, Minimum Teaching Hours -16)*

Network Flow: Maximum flow problem and Ford – Fulkerson algorithm, maximum flows and minimum cuts in a network.

Divide and Conquer: Introduction, Binary Searching, Sorting by Merging, Quicksort, Selection and the Median, Arithmetic with Large Integers, Matrix Multiplication.

Greedy Algorithms: Introduction, Greedy Algorithms and Graphs, Minimal Spanning Trees, Shortest Paths Greedy Algorithms for Scheduling: Minimizing Time in the System, Scheduling with Deadlines, Greedy Heuristics: Colouring a Graph, The Travelling Salesperson Problem, Knapsack Problem.

Section -III *(Weightage – 40%, Minimum Teaching Hours -16)*

Dynamic Programming:
Introduction, The Principle of optimality, knapsack problem, Chained Matrix Multiplication, Shortest Paths, Optimal Search Trees, The Travelling Salesperson Problem, Memory Functions.

Back Tracking & Branch Bound: N-Queens problem, Branch and Bound.
Introduction to NP and Intractability: Introduction to NP-Completeness, The Classes P and NP, NP-Complete Problems, Cook's Theorem, Some Reductions, Non-determinism.

Text Books:

1. ALGORITHMICS: Theory and Practice: *Gilles Brassard and Paul Brately, Prentice Hall India Ltd.*
2. Introduction to Algorithms: *Thomas H. Cormen et.al, Prentice Hall of India.*
3. Algorithm Design: *Jon Klienberg & Eva Tardos, Pearson India Education services Pvt. Ltd.*

Reference Book:

1. Computer Algorithms–Introduction to Design and Analysis: *Sara Baase and Alien Van Gelder – Addison –Wesley Publishing Company.*
2. An Introduction to Analysis of Algorithms: *Robert Segdewick, Philippe Flajolet.*
3. Fundamentals of Computer Algorithms: Ellis Horowitz and Sartaj Sahani.

SYLLABUS OF SEMESTER –II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP546				
Category	Program Core				
Course Title	Design and Analysis of Algorithms Lab				
Scheme& Credits	L	T	P	Credits	Semester-II
	0	0	2	1	

Course Objectives

To understand and differentiate between the different algorithm design paradigms. This will be helpful to identify the application areas for these algorithm design techniques.

Course Outcomes

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

1. Design algorithms using different algorithm design techniques.
2. Compare the time complexities and develop efficient programming solutions for real time problems.

Syllabus

Practical Examples based on but not limited to following:

1. Sorting problems and time complexity.
2. Multiplication of Large Integers and its time complexity.
3. Calculating the Greatest Common Divisor and calculating time complexity.
4. Calculating the Fibonacci Sequence and calculating time complexity.
5. Depth-First Search, Breadth-First Search on directed and undirected graphs,
6. Binary Searching, Sorting by Merging, Quicksort, Selection sort using Divide and conquer and calculating time complexity.
7. Greedy Algorithms for Minimal Spanning Trees, Shortest Path problems, Scheduling problems, Knapsack Problem.
8. Dynamic programming algorithms for Colouring a Graph, The Travelling Salesperson Problem, Knapsack Problem.
9. Simulating 4 Queen's problem or any other variant.
10. Simulating Tic-Tac-Toe.

Text Books:

1. ALGORITHMICS: Theory and Practice: *Gilles Brassard and Paul Brately, Prentice Hall India Ltd.*
2. Introduction to Algorithms: *Thomas H. Cormen et.al, Prentice Hall of India.*
3. Algorithm Design: *Jon Klienberg & Eva Tardos, Pearson India Education services Pvt. Ltd.*

Reference Book:

1. Computer Algorithms–Introduction to Design and Analysis: *Sara Baase and Alien Van Gelder – Addison –Wesley Publishing Company.*
2. An Introduction to Analysis of Algorithms: *Robert Segdewick, Philippe Flajolet*
3. Fundamentals of Computer Algorithms: Ellis Horowitz and Sartaj Sahani.

SYLLABUS OF SEMESTER -II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT547				
Category	Program Core				
Course Title	Computer Networks				
Scheme& Credits	L	T	P	Credits	Semester-II
	3	0	0	3	

Course Objectives

The objective of the course is to enumerate the layers of the OSI model and TCP/IP and understand the function(s) of each layer. Students can acquire in-depth knowledge of error detection and correction, flow control technique, multiple access control techniques along with switching, and routing. Also study the various protocols used in Network and Transport Layer.

Course Outcomes

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

1. Interpret topological network architectures to design networks and understand the data flow to several application formats from the underlying layers and their utilization.
2. Estimate reliability issues based on error control, flow control and pipelining by using bandwidth, latency, throughput and efficiency.
3. Identifying several Routing algorithms in practice and knowing TCP, UDP protocols in Transport Layer.

Syllabus

Section-I (*weightage – 15% , Minimum Teaching Hours-6)*

Introduction: Introduction to Networks, LAN, MAN, WAN, PAN, Internet, Intranet, Internetwork, Protocol Hierarchy, DesignIssues for the Layers, OSI Model, TCP/IP Model. **Network Devices:** Hub, Switch, Router and Access Point Physical **Layer**: Transmission of Digital Media, Transmission Media, Transmission Impairment, Multiplexing.

Section-II *(weightage – 75% , Minimum Teaching Hours-30)*

Data LinkLayer

Data Link Layer Design issues**,** Services Provided to the Network Layer,Framing, Error Control and Flow Control. **Error Detection and correction codes:** HammingCode and CRC. **Elementary DLL Protocols:** Unrestricted Simplex, Stop-and-Wait and Noisychannel. Sliding Window protocols, HDLC Protocol. **Medium Access Control**: Channel allocationof Static and Dynamic allocation, **Multiple Access Protocols:** PureALOHA, Slotted ALOHA, CSMA, WDMA

Network Layer

Network Layer Design Issues, **Switching Techniques:** Circuit and Packet Switching, Connectionlessand Connection-oriented Services, Virtual Circuit and Datagram Subnets. Autonomoussystem. **Organization of the Internet:** ISP, Content Providers, Routers, Routing versusforwarding, **Routing Algorithms:** Optimality principle, shortest path routing, flooding,Distance Vector routing, link state routing, hierarchical routing. **Congestion Control**

andQOS: General Principles, Congestion prevention policies, Load shading, Jitter Control,Quality of Service, Internetworking. **Network layer Protocols:** ARP, RARP, IP protocol, IPV6,ICMP, Unicast Routing Algorithms: RIP, OSPF, BGP.

Transport Layer

Services and service primitives, **Elements of Transport protocol:** Addressing, Connection establishment and release, flow control and buffering, Multiplexing, Crash recovery, **UDP:** Introduction, **TCP:** Introduction, Model, protocol, header, connection establishment and release, connection management, Transmission policy, congestion control, timer management, RPC, Transport layer in Mobile network, Real Time Streaming Protocol RTSP, RTP, RTCP

Section-III *(weightage – 10% , Minimum Teaching Hours-4)*

Application Layer

Domain Name System (DNS), Naming and Address Schemes, DNSservers, **Email:** MIME, SMTP and POP3. Remote login, File Transfer Protocol (FTP), SNMP, DHCP and BOOTP. World Wide Web, HTTP.

Text Books

1. "Computer Networks", by Tanenbaum A. S., Pearson Education, 2008, ISBN-978-81-7758-165-2, 4th Edition
2. "Computer Networking- A Top-Down Approach", by James F. Kurose and Keith W Ross, Person Education, ISBN- 978-81-317-9054-0, 5th Edition.

Reference Books

1. "Data Communications and Networking", by Forouzan B. A, Tata McGraw-Hill Publications,
2006, ISBN-0-07-063414-9, 4th edition.
2. "Communication Networks- Fundamental Concepts and Key Architectures", by LeonGarcia-Wadjaja, Tata McGraw-Hill Publications, ISBN-978-0072463521.

Additional Reading

1. "Computer Networks and Internet", by Comer D., Pearson Education, ISBN-81-297- 0330-0, 2nd Edition.
2. "Computer Networks- A Systems Approach", by Larry L. Peterson and Bruce S. Davie, Morgan Kaufmann, ISBN-978-81-312-1045-1, 4th Edition.

SYLLABUS OF SEMESTER -II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP547				
Category	Program Core				
Course Title	Computer Networks Lab				
Scheme& Credits	L	T	P	Credits	Semester-II
	0	0	2	1	

Course Objective

The objective of the course is to understand different networking techniques for switching, and routing and packet trafficking using different protocols.

Course Outcomes

On successful completion of the course, students will be able to:
1. Implementing different networking techniques for switching and routing.
2. Simulate efficient packet trafficking using several Routing algorithms in practice and knowing TCP, UDP protocols in Transport Layer.

Syllabus

Computer Networks Lab

Syllabus

Minimum 6 to 8 Practicals based on theory topics.

SYLLABUS OF SEMESTER -II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP548				
Category	Program Core				
Course Title	Full Stack Web Development using MEAN				
Scheme& Credits	L	T	P	Credits	Semester-II
	0	0	4	2	

Course Objectives

To learn basic knowledge of full stack implementation in MEAN. After learning it, students should be able to develop server-side web applications using MEAN technology.

Course Outcomes

On the successful completion of the subject students will be able to:

1. Implementing NodeJS server and writing code with node modules along with Express middleware
2. Creation of databases and collections using MongoDB for CRUD operations and developing rich user interactivity applications by using AngularJS.

Syllabus

Section – I (Approximately 3 Practicals based on following topics **)**

Basics: HTML tags usage, Embedding Javascript in webpage, stylizing webpagejs using CSS.

Section – II (Approximately 8 Practicals based on following topics **)**

Node: Installing NodeJS**,** Setting-up NodeJS Server, listening on ports,REPL, using NPM packages, Node modules, implementing Asynchronous Coding.
Express: Installing express, MVC pattern, rendering views, serving static files, Routes implementation.

Section – III (Approximately 8 Practicals based on following topics)

MongoDB: Installation of MongoDB instance and running, creating databases, creating collections, performing CRUD operations, Introduction to Mongoose package, connecting webpage using MongoDB.
AngularJS: Creating AngularJS modules, using AngularJS Directives, AngularJS Data Binding, Dependency injection.

Text Books:

1. MEAN Web Development by Amos Q. Haviv, PACKT Publishing.
2. Full Stack Javascript by AzatMardan, Apress.

Online Resources:

1. www.w3schools.com
2. http://docs.mongodb.org/manual/
3. https://expressjs.com/
4. http://docs.angularjs.org/guide/
5. https://nodejs.org/api/

SYLLABUS OF SEMESTER -II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP549-1				
Category	Program Elective				
Course Title	Foundations of Data Analytics Lab				
Scheme& Credits	L	T	P	Credits	Semester-II
	0	0	2	1	

Course Objectives

To explore the social, business, technical based problems where the students can apply proper techniques for the analysis of various data sets. This will help them to interpret the outcomes of the analysis for correct decision making.

Course Outcomes

On successful completion of the course, students will be able to:
1. Describe the structure and characteristics of the data sets.
2. Achieve a basic understanding of statistical techniques.
3. Demonstrate and interpret the results of the outcomes.

Syllabus

Minimum 10 practicals based on the following but not limited to:

- Introduction to Data Analytics, Tools of Data Analytics
- Data Objects and Attribute Types, Statistical Descriptions of Data
- Data handling and exploring data for missing values and outliers
- Data Visualization, Measuring Data Similarity and Dissimilarity
- Descriptive statistical approach: Mean, Median, Mode, SD, etc
- Bivariate Analysis: Correlation and Simple Regression Analysis
- Multiple Regression Analysis and Logistic Regression
- Components of Time series analysis, Trend Analysis and Moving Average
- Hypothesis Testing, ANOVA and Chi square test
- Mini Project

SYLLABUS OF SEMESTER -II, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP549-2				
Category	Program Elective				
Course Title	Design Patterns Lab				
Scheme& Credits	L	T	P	Credits	Semester-II
	0	0	2	1	

Course Objectives

The objective of the course is to prepare the students for the development of skills through which they will gain expertise in various design pattern standards. This course can help them to develop skills to design and implement algorithms for implementing different features of programming languages like designing and implementing micro service.

Course Outcomes

On successful completion of the course, students will be able to:
1. Describe different programming language paradigms and demonstrate their utility as well as enumerate different features present in modern programming languages.
2. Design and implement algorithms for implementing different features of programming languages like designing and implementing micro service.
3. Analyze an application at hand, choose an appropriate programming language for it and design and develop the application for the chosen language.

Syllabus

Minimum 5 practical based on the following but not limited to:

- Defining design patterns, studying design patterns, java design patterns.
- Creational patterns - the factory pattern, the abstract factory pattern, the singleton pattern, the builder pattern, the prototype pattern.
- Java foundation classes - Writing a simple JFC program, mediators and command objects.
- Advance java concepts - Spring, spring boot, hibernate.
- API - Design of micro services, annotations.
- Design patterns for CRUD operations.
- Structural patterns - The adapter pattern, the bridge pattern, the composite pattern.
- Behavioral patterns - Chain of responsibility, the command, the interpreter.
- The template pattern - Double dispatching, switching between states, the MVC architecture as an observer.

SYLLABUS OF SEMESTER - II, MCA (Master in Computer Application)

Course Code	MCT553				
Category	Program Core				
Course Title	Software Documentation				
Scheme& Credits	L	T	P	Credits	Semester-II
	2	0	0	0	

Course Objectives

To learn various software documentation techniques of the considered system and to understand various guidelines for successful software documentation

Course Outcomes

On successful completion of the course students will be able to:

1. To be able to design and construct various software documentation techniques of the considered system.
2. To be able to create successful software documentation using various documentation guidelines.

Syllabus

Section -I ***(Weightage – 20%, Minimum Teaching Hours -8)***

Task Orientation, Principle of Software Documentation, Definition of task orientation, forms of software documentation, tutorial documentation, procedural documentation, reference documentation, processes of documentations.

Section -II ***(Weightage – 40%, Minimum Teaching Hours -16)***

Writing to teach tutorials, writing to guide procedures, writing to support reference. Analyzing users, planning and writing documents, getting useful reviews, conducting usability tests, editing and fine tuning.

Section -III ***(Weightage – 40%, Minimum Teaching Hours -16)***

Designing for task orientation, laying out pages and screens, getting the language right, using graphics effectively and designing indexes.

Reference Books:

1. Writing software documentation: Thomas Barker, Pearson publisher.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT640				
Category	Program Core				
Course Title	Artificial Intelligence				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives

To study various search, heuristic techniques for solving AI problems, learn various knowledge representation techniques, understand various reasoning and learning techniques and to discuss the learned concepts for designing and solving AI related problems.

Course Outcomes

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

1. Identify and specify a problem definition for a given real world problem domain.
2. Apply and analyse both deterministic and non-deterministic Artificial Intelligence search techniques to a well-defined problem domain.
3. Formulate a problem description for CSP, Understand and apply knowledge representation, reasoning, machine learning techniques and Uncertainty methods to solve real-world problems.

Syllabus

Section -I ***(Weightage – 15%, Minimum Teaching Hours -6)***

Introduction to Artificial Intelligence: Definition and Concepts, History, Overview, Intelligent Agents, Performance Measure, Rationality, Structure of Agents, Problem-solving agents, Problem Formulation, Uninformed Search Strategies.

Section-II ***(Weightage – 70%, Minimum Teaching Hours -28)***

Search and Exploration:A* search, Memory bounded heuristic search, Heuristic functions, inventing admissible heuristic functions, Local Search algorithms, Hill-climbing, Simulated Annealing, Genetic Algorithms, Online search.

Constraint Satisfaction Problems: Backtracking Search, variable and value ordering, constraint propagation, intelligent backtracking, local search for CSPs.

Adversarial Search: Games, The minimax algorithm, Alpha- Beta pruning.

Knowledge and Reasoning: Knowledge Based Agents, Logic, Propositional Logic, Inference, Equivalence, Validity and satisfiability, Resolution, Forward and Backward Chaining, Local search algorithms.

First Order Logic: Syntax and Semantics of FOL, Inference in FOL, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Learning and Uncertainty: Rote Learning, learning by taking advice, learning in problem solving, learning from examples: Induction, Explanation based learning, Discovery, Analogy. Basic Probability Notations, Axioms of Probability, Baye's Rule and its use.

Section-III*(Weightage – 15%, Minimum Teaching Hours -6)*

Applications of Artificial Intelligence: Introduction to Neural networks-supervised, unsupervised learning algorithms, Introduction to Deep Learning, Introduction to Robotics, Case studies.

Text Books:

1. Artificial Intelligence: A Modern Approach: Stuart Russel and Peter Norvig, Prentice Hall

2. Artificial Intelligence: E. Rich and Knight, Tata McGraw Hill.

Reference Books :

1. Artificial Intelligence: E. Charniack and D. Mcdermott, Addison Wesley.
2. Introduction to Knowledge Systems: Mark Stefik, Morgan Kaufmann.
3. https://www.coursera.org/learn/gcp-big-data-ml-fundamentals
4. https://www.coursera.org/learn/natural-language-processing

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP640				
Category	Program Core				
Course Title	Artificial Intelligence Lab				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	2	1	

Course Objectives

To learn various AI search algorithms, fundamentals of knowledge representation, inference, theorem proving and learn to build simple knowledge-based systems.

Course Outcomes

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

1. Use key logic-based techniques in a variety of research problems.
2. Communicate scientific knowledge at different levels of abstraction.
3. Build knowledge based systems.

Syllabus

Minimum 8 practical implemented using Tensor flow/Torch Tools/Python

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT641				
Category	Program Core				
Course Title	Data Mining				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives

To learn the basics of Data Mining, to describe and demonstrate basic data mining algorithms, methods and tools, use of Data Mining as a business intelligence tool for building competitive advantage through proactive analysis, predictive modelling, identifying new trends and behaviours.

Course Outcomes

On the successful completion of the subject students will be able to:

1. Conceptualize need and utility of Data Mining.
2. Familiarize with the concepts of various types of data used in Data Mining.
3. Discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems, make predictions of outcomes.
4. Conceptualize latest technologies & techniques in Data Mining.

Syllabus

Section-I ***(Weightage - 30%, Minimum Teaching Hours – 12)***

Data Mining: Introduction, Importance of Data Mining, Kinds of Data and Patterns to be Mined, Technologies used in Data Mining, Data Mining Applications, Major issues in Data Mining.

Data Preprocessing: Data Preprocessing: An overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

Mining Frequent Patterns, associations and Correlations: Basic Concepts, Frequent Itemset Mining Methods, Pattern Evaluation Methods.

Section-II

(Weightage - 40%, Minimum Teaching Hours - 16)

Advanced Pattern Mining: Pattern Mining in Multilevel and Multidimensional Space, Constraint-Based Frequent Pattern Mining.

Introduction: Mining High-Dimensional Data and Colossal Patterns, Mining Compressed Patterns, Pattern Exploration and Application

Classification: Basic Concepts, Decision Tree Induction, Rule Based Classification, Model Evaluation & Selection, Techniques to Improve Classification Accuracy.

Introduction: Bayesian Belief Networks, Support Vector Machines, Classification using Frequent Patterns, Lazy Learners, Other Classification Methods.

Section-III

(Weightage - 30%, Minimum Teaching Hours - 12)

Cluster Analysis: Cluster Analysis basic concepts, **Partitioning Methods:** k-Means and k-Medoids, **Hierarchical Methods:** BIRCH, CHAMELEON, Probabilistic Hierarchical

Clustering, **Density-Based Methods:** DBSCAN, OPTICS, DENCLUE, **Grid-Based Methods:** STING, CLIQUE, Evaluation of Clustering.

Data Mining Trends and Research Frontiers: Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining Trends.

Text Books:

1. Data Mining- Concepts and Techniques: Jiawei Han, Micheline Kamber Morgan Kaufmann Publishers, Third Edition.
2. Mining of Massive Datasets: Anand Rajaraman, Jeff Ullman, Jure Leskovec.

Reference Books:

1. Advances In Knowledge Discovery And Data Mining,: Usama M.Fayyad, Gregory Piatetsky Shapiro, Padhrai Smyth And Ramasamy Uthurusamy, The M.I.T Press, 1996.
2. The Data Warehouse Life Cycle Toolkit: Ralph Kimball, John Wiley & Sons Inc., 1998.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP641				
Category	Program Core				
Course Title	Data Mining Lab				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	2	1	

Course Objective

To learn various tools used in Data Mining and implement real life problems of Data Mining.

Course Outcomes

On successful completion of the course students will be able to:
1. Identify various live scenarios of Data Miming
2. Analyze and implement various concepts of Data Mining in Weka/Orange tool

Syllabus

A mini project on data mining application using large datasets.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT642				
Category	Program Core				
Course Title	Cloud Computing				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives

Students should be able to understand Cloud Computing concepts, models, underlying virtualization concepts. Also gaining knowledge of different service models of Cloud and prominent service providers, identifying different tools, security and legal aspects in Cloud computing.

Course Outcomes

On the successful completion of the subject students will be able to:

1. Analyze the cloud deployment models and understanding virtualization features.
2. Compare cloud services offered by providers and relevant tools.
3. Identify security and legal issues in cloud computing.

Syllabus

Section -I ***(Weightage – 30%, Minimum Teaching Hours -12)***

Cloud Computing Fundamentals : Computing Paradigms, Principles of Cloud computing, Requirements for Cloud services.

Cloud Deployment Models : Private, Public, Community, Hybrid clouds.

Virtualization : Virtualization Opportunities, Different approaches to Virtualization, Hypervisors. Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services.

Section-II ***(Weightage –45%, Minimum Teaching Hours -18)***

Cloud Service Models : Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Evolution of SaaS, Challenges of SaaS paradigm, SaaS integration services, SaaS integration of products and platforms, Aneka Cloud platform.

Cloud Service Providers : Google, Amazon, Microsoft, IBM, SAP labs etc.

Tools : Tools for IaaS, SaaS, PaaS; Tools for Research, Tools for Distributed Systems.

SLA Management : Types of SLA, Life cycle of SLA, SLA management in cloud

Security in Cloud Computing : Cloud general Challenges, Data Security, Virtualization Security, Network Security, Platform related Security.

Section-III ***(Weightage – 25%, Minimum Teaching Hours -10)***

Legal Issues in Cloud Computing : Data Privacy and Security Issues, Cloud Contracting models, Jurisdictional Issues, Commercial and Business Considerations.

Advanced Concepts : Intercloud , Cloud Management , Mobile Cloud , Media Cloud , Interoperability and Standards , Cloud Governance , Computational Intelligence in Cloud , Green Cloud, Cloud Analytics.

Text Books:

1. Cloud computing principles and paradigms, Rajkumar Buyya, Wiley.
2. Essentials of Cloud Computing, K. Chandrasekaran, CRS Press.
3. Enterprise Cloud Computing, Gautam Shroff, Cambridge.

Reference Books :

1. Cloud Computing, Dr. Kumar Saurabh, Wiley Publication.
2. Cloud and virtual data storage networking, Greg Schulr, CRC Press .
3. Cloud Computing, Barrie Sosinsky, Wiley India.
4. Judith Hurwitz, Robin Bloor, Marcia Kaufman ,Fern Halper, Cloud computing for dummies- Wiley Publishing, Inc, 2010.

SYLLABUS OF SEMESTER -III, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP642				
Category	Program Core				
Course Title	Cloud Computing Lab				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	2	1	

Course Objectives

Students should be able to develop web applications in cloud. Also to learn the design and development process involved in creating a cloud based application.

Course Outcomes

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

1. Configure various virtualization tools such as Virtual Box, VMware workstation
2. Design and deploy a web application in a PaaS environment
3. Simulate a cloud environment to implement new schedulers.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8. Case Study: PAAS(Facebook, Google App Engine) or Amazon Web Services.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT644-1				
Category	Program Elective				
Course Title	Image Processing				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives:

To learn the fundamental concepts and applications of digital image processing, learn the concepts of and how to perform Intensity transformations, spatial filtering, image segmentation, restoration and reconstruction, color image processing, image compression and watermarking.

Course Outcomes:

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

1. Illustrate the fundamental concepts of a digital image processing system.
2. Apply different image Filtering Models, Image restoration and reconstruction
3. Apply the different segmentation algorithms and image compression standards for Computer vision & image analysis.
4. Apply the different techniques of Image representation and description.

Syllabus

Section -I *(Weightage – 20%, Minimum Teaching Hours-8)*

Introduction - Fundamental steps in Digital Image Processing, Components of an Image Processing System. A Simple Image Formation Model, Image Sampling and Quantization, Basic relationship between pixels, Neighbors of pixel, Adjacency, Connectivity, Regions, Boundaries: Labeling of connected components, Distance measure, Application of image processing.

Section -II *(Weightage – 50%, Minimum Teaching Hours -20)*

Intensity Transformations and Spatial Filtering -Some Basic Intensity Transformation Functions, Histogram equalization and histogram matching, Fundamentals of Spatial Filtering, Introduction to Smoothing and Sharpening Spatial Filters. Filtering in the Frequency Domain, Image Smoothing.

Image Restoration and Reconstruction - Degradation model, Restoration in the Presence of Noise Only—Spatial domain, Periodic Noise Reduction by Frequency Domain, Geometric Mean Filter.

Image Compression - Coding Redundancy, Spatial and Temporal Redundancy, Fidelity Criteria, Image Compression Models, Huffman Coding, LZW Coding, Lossy Compression,

Section -III *(Weightage – 30%, Minimum Teaching Hours -12)*

Image Segmentation - Image Segmentation–Detection of Discontinuities, Edge Linking and Boundary Detection,

Thresholding: Foundation, Basic Global Thresholding, Region Growing, Region Splitting and Merging

Representation and Description - Representation Schemes like Chain Coding, Polygonal Approximation Approaches, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, and Regional Descriptors.

Text Books:

1. Digital Image Processing: R.C.Gonzalez & R.E. Woods, Addison Wesley Pub.
2. Fundamentals of Digital Image Processing: A.K.Jain, PHI Pub.
3. Fundamentals of Electronic Image Processing: A.R.Weeks.

Reference Books:

1. Digital Image Processing: S.Sridhar, Oxford Uni. Press.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT644-2				
Category	Program Elective				
Course Title	Introduction to Real Time Operating Systems				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives:

To identify the principles, design methods and scheduling techniques of real-time operating systems as well as to learn about resource allocation and resource access control.

Course Outcomes:

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

1. Describe the basic concepts and identify the issues that arise in designing real-time operating systems.
2. State various scheduling as well as resource allocation techniques and check their correctness.
3. Apply Real Time scheduling theory to solve the Real time scheduling problems.

Syllabus

Section -I : *(Weightage – 15%, Minimum Teaching Hours-6)*

Introduction:

Hard and soft real time systems, timing constraints, A Reference model of Real-time systems, temporal parameters, precedence constraints & dependencies, scheduling Hierarchy, commonly used approaches to scheduling, cyclic and priority drive approaches, Optimality of EDF and LST.

Section -II: *(Weightage – 80%, Minimum Teaching Hours-32)*

Scheduling of jobs and Resources:

Clock Driven Scheduling: Static timer driven scheduler, Cyclic Executives, Improving Average Response times of Aperiodic Jobs, Scheduling Sporadic jobs, Practical Considerations, Pros and Cons of Clock Driven Scheduling.

Priority-driven scheduling of periodic tasks: Fixed priority vs Dynamic Priority schemes, Maximum schedulable Utilization, Optimality of the RM and DM algorithms, As Schedulable Test for Fixed Priority Tasks, Practical Factors.

Scheduling Apriodic and Sporadic Jobs in Priority - driven scheduling: Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth, and Weighted Fair-Queuing Servers, Scheduling of Sporadic Jobs.

Resource access control: Non-preemptive critical sections, basic priority-inheritance, ceiling protocol, multiprocessor scheduling, predictability and validation of dynamic multiprocessor systems flexible applications, tasks with temporal distance constraints.

Section–III: Real Time Operating System:*(Weightage –5%, Minimum Teaching Hours-2)*

Overview, Time Services and Scheduling Mechanisms, Basic Operating System Functions, Processor Reserves and Resource Kernel, Open System Architecture, Capabilities of Commercial RTOS.

Text Books:

1. Real-Time Systems: Jane W.S. Liu, Pearson Education Asia Pub.

Reference Books:

1. Real time Systems: C.M. Krishna & Kang G. Shin, McGraw Hills.

SYLLABUS OF SEMESTER –III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT644-3				
Category	Program Elective				
Course Title	Pattern Recognition				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives

Students should be able to introduce the fundamental algorithms for pattern recognition, to instigate the various classification and clustering techniques

Course Outcomes

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

1. Apply a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques
2. Illustrate the major approaches in statistical pattern recognition.
3. Use the clustering algorithm and cluster validation.
4. Design and construct a pattern recognition system.

Syllabus

Section-I (Weightage - 30%, Minimum Teaching Hours -12)

Introduction - Basics of pattern recognition system, various applications, Machine Perception, classification of pattern recognition systemStatistical Pattern Recognition: Review of probability theory, Gaussian distribution, Bayes decision theory and Classifiers, Optimal solutions for minimum error and minimum risk criteria, Normal density and discriminant functions, Decision surfaces.

Bayes Decision Theory: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete features.

Section-II (Weightage- 50%, Minimum Teaching Hours -20)

Parameter Estimation Methods - Maximum-Likelihood estimation: Gaussian case. Maximum a Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models. Sequential Pattern Recognition. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs. Nonparametric techniques for density estimation.

Dimensionality reduction: Principal component analysis - it relationship to eigen analysis. Fisher discriminant analysis - Generalised eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Non negative matrix factorisation - a dictionary learning method.

Linear discriminant functions: Gradient descent procedures, Perceptron, Support vector machines - a brief introduction.

Section-III (Weightage- 20%, Minimum Teaching Hours -8)

Artificial neural networks: Multilayer perceptron - feedforwark neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.

Non-metric methods for pattern classification: Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART).

Text Books:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Reference Books

1. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
2. Robert J. Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
3. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4/e, Academic Press, 2009. 4.Tom Mitchell, Machine Learning, McGraw-Hill 5. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London 1974.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT644-4				
Category	Program Elective				
Course Title	Distributed Systems				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives

To explore the differences between concurrent, networked and distributed systems. Learn and analyse the concept of resource allocation, distributed deadlock detection, avoidance techniques and commit and voting protocols.

Course Outcomes

On the successful completion of the subject students will be able to:
1. Describe the architectures and components of distributed computing environment.
2. Understand the correlation between the various distributed algorithms and recent programming aspects.
3. Analyze the importance of the resource management, recovery and fault tolerance issues in distributed systems.
4. Implement the distributed computation services using case studies.

Syllabus

Section -I ***(Weightage – 30%, Minimum Teaching Hours -12)***
Introduction: Examples of Distributed System, Resource Sharing and the Web-Challenges, case study on World Wide Web.
System Models: Introduction, Architectural Models, Fundamental Models, Remote Invocation: Remote Procedure Call.
Distributed Operating Systems: Introduction, Issues, Inherent Limitation, Clock Synchronization, Lamport's Logical Clock; Vector Clock;
Distributed File Systems: Architecture, Mechanisms, Design Issues, Case Study: Sun Network File System.
Distributed Shared Memory: Architecture, Algorithms, Memory Coherence: Protocols, Design Issues.

Section -II ***(Weightage – 60%, Minimum Teaching Hours -24)***
Distributed Scheduling: Issues, Components, Load Distributing Algorithms, Load Sharing Algorithms.
Distributed Deadlock Detection: Issues, Centralized Deadlock, Detection Algorithms, Distributed Deadlock, Detection Algorithms.
Distributed Mutual Exclusion-Non-Token based Algorithms, Token based Algorithms.
Recovery: Introduction, Basic Concepts, Classification of Failures, Backward Error Recovery: Basic Approaches, Recovery in Concurrent Systems.
Fault Tolerance: Introduction, Issues, Commit Protocols, Non-Blocking Commit Protocols, Voting Protocols, Dynamic Voting Protocols.

Section -III ***(Weightage – 10%, Minimum Teaching Hours -4)***

Designing Distributed System: Google Case Study: Introducing the Case Study: Google-Overall architecture and Design Paradigm, Communication Paradigm, Data Storage and Coordination Services, Distributed Computation Services.

Text Books:

1. Distributed Systems Concepts and Design: *George Coulouris, Jean Dellimore and Tim KIndberg, Pearson Education,5th Edition.*
2. Advanced Concepts in Operating Systems: *Mukesh Singhal and N.G.Shivaratri, McGraw-Hill*.
3. Distributed Operating Systems: *Pradeep K. Sinha, PHI,2005*

References Books:

1. Distributed Computing-Principles,Algorithms and Systems: *Ajay D.Kshemkalyani and Mukesh Singhal Cambridge University Press.*
2. Distributed Algorithms, *Nancy A.Lynch, Morgan Kaufmann Publishers*.
3. Grid Computing: *Joshy Joseph and Craig Fellenstein , IBM Press*.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT643-1				
Category	Program Elective				
Course Title	Information Security				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives

To understand the basic concept of cryptography and their mathematical foundation required for various cryptographic algorithms. It also helps to study signature schemes using well-known signature generation and verification algorithms. It is able to describe and analyze existing authentication protocols for two party communications and analyze key agreement algorithms.

Course Outcomes

On the successful completion of the subject students will be able to:

1. Describe and apply appropriate encryption techniques to solve problems.
2. Analyze various message authentication codes and hash functions.
3. Identify measures of detection and prevention of various attacks.

Syllabus

Section -I ***(Weightage – 34%, Minimum Teaching Hours -14)***

Classical Encryption Techniques: Substitution Cipher, Transposition Ciphers, Stream and block Ciphers; Modern Symmetric Key Ciphers: Modern Block cipher, Modern Stream Ciphers. **Data Encryption Standers (DES):** Structure of DES, Analysis of DES, Strength of DES, Differential and Linear Cryptanalysis., 3-DES, IDEA, Blowfish.

Number Theory and Finite Fields: Integer Arithmetic, Modular Arithmetic, Polynomial Arithmetic, Euclidean Algorithm, Groups, Rings and Fields, GF(p), GF(2n). **Mathematics of Asymmetric Key Cryptography:** Prime Numbers, Fermat's and Euler's Theorems, Testing of Primality, Chinese Reminder Theorem.

Section -II ***(Weightage – 33%, Minimum Teaching Hours -13)***

Public Key Cryptography: Principles of Public Key Cryptosystem, RSA algorithm. Diffie-Hellman Key Exchange, ElGamal Cryptographic System, Elliptic Curve Cryptograph.

Key Management and Distribution: Key Distribution using Symmetric Encryption and Asymmetric Encryption, Distribution of public key, X.509 Certificates, Public key Infrastructures.

Cryptographic Hash Function: Application of Hash Function, Description of MD and SHA family, cryptanalysis. **User Authentication:** Authentication principles, Remote user Authentication using Symmetric and Asymmetric Encryption, Kerberos, Federated Identity Management.

Section -III ***(Weightage – 33%, Minimum Teaching Hours -13)***

Message Authentication Codes (MAC): Requirements, Functions, Security of MAC, HMAC and CMAC. **Digital Signature:** Process, Services, Attacks on digital Signature, RSA Digital Signature Scheme, ElGamal Digital Signature Scheme, Digital Signature Standard (DSS).

Transport Layer Security: SSL Architecture, Four Protocols, Message Formats. IP Security: Security Overview, Policy, Encapsulating Security Payload (ESP). **E-Mail Security:** Pretty Good Privacy, S/MIME. **System Security:** Intruders, Malicious Software, Firewalls.

Text Book:

1. Cryptography and Network Security Principles and Practice, William Stallings.
2. Cryptography and Network Security, Behrouz A. Forouzan and Debdeep Mukhopadhyay.
3. Information Security: The Complete Reference, Second Edition by Mark Rhodes-Ousley ISBN-13:978-0071784351 ,ISBN-10:0071784357

Reference Book:

1. Cryptography and Network Security: Atul Kahate, Mc Graw Hill.
2. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
3. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
4. Introduction to Network Security: Neal Krawetz, CENGAGE Learning
5. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning MOOCS Courses

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT643-2				
Category	Program Elective				
Course Title	Graph Theory				
Scheme& Credits	L	T	P	Credits	Semester-III
	3	0	0	3	

Course Objectives

Students can study the fundamental definitions and concepts of graph theory. This course will help them to understand and prove theorems/lemmas and relevant results in graph theory. The students will be able to apply graph theory tools in solving practical problems

Course Outcomes

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

1. Identify some important classes of graph theoretic problems.
2. Describe and apply some basic algorithms for graphs.
3. Use graph theory as a modelling tool.

Syllabus

Section -I ***(Weightage – 35%, Minimum Teaching Hours -14)***

Fundamental concepts of graphs: Basic definitions of graphs and multigraphs; adjacency matrices, isomorphism, girth, decompositions, independent sets and cliques, graph complements, vertex coloring, chromatic number, important graph like cubes and the Petersen graph, Paths, cycles, and trails; Eulerian circuits, Vertex degrees and counting; large bipartite subgraphs, the handshake lemma, Havel-Hakimi Theorem. Directed graphs: weak connectivity, connectivity, strong components. Induction and other fundamental proof techniques.

Trees: equivalent characterizations of trees, forests. Spanning trees and 2-switches, Distance and center, Optimization: Kruskal's Theorem and Dijkstra's Theorem

Section-II***(Weightage – 40%, Minimum Teaching Hours -16)***

Matching and covering: Bipartite matching, vertex cover, edge cover, independent set, M-alternating path, Hall's Theorem, König-Egeváry Theorem, Gallai's Theorem

Connectivity: Vertex cuts, separating sets, bonds; vertex and edge connectivity, block-cutpoint tree b. Menger's Theorem: undirected vertex and edge versions

Network flow: Ford-Fulkerson Labeling algorithm, flow integrality, Max-flow/Min-cut Theorem, proof of Menger's Theorem

Section-III***(Weightage – 25%, Minimum Teaching Hours -10)***

Coloring: Chromatic number: lower bounds from clique number and maximum independent set, upper bounds from greedy coloring (& Welsh-Powell), Szekeres-Wilf, and Brooks' Theorem. k-critical graphs, cartesian product of graphs, and interval graphs. k-Chromatic graphs: Mycielski's construction, Turán's Theorem. Edge coloring, line graphs, Vizing's Theorem.

Planarity: Embeddings, dual graphs, Euler's formula, Kuratowski's Theorem, Coloring, including the 5-color theorem.

Text Books:

1. Introduction to Graph Theory, Douglas Brent West, Pearson.
2. Frank Harary, Graph Theory, Narosa Publishing House/CRC Press, 2018.
3. Reinhard Diestel: Graph Theory, Springer.

Reference Books :

1. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Dover Publications.
2. Pearls in Graph Theory: A Comprehensive Introduction, Nora Hartsfield, Dover Books on Mathematics.
3. Graph Theory and its Applications, J.L. Gross & J. Yellen, Chapman & Hall/CRC
4. Christopher Griffin: Graph Theory: Penn State Lecture Notes, 2011-2017.

SYLLABUS OF SEMESTER-III, M.C.A.(MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP644-1				
Category	Program Elective				
Course Title	Mobile Application Development Lab				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	4	2	

Course Objectives

To know about various platforms and tools available for developing mobile applications. It is to realize the differences between the development of conventional applications and mobile applications, and also learn programming skills in Android SDK.

Course Outcomes

On the successful completion of this course student will be able to:

1. Understand Android O.S & SDK.
2. Work with Android Studio for creating Android applications.
3. Create real life Android applications and deploy them.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Install Android studio and Environment setup
- Android architecture , component and activity life cycle
- Android Layout / User Interface (UI) design
- Android – Sending Email, SMS; Phone call
- Android SQLite database and content provider
- Android Location API
- Google Maps Android API
- Publishing android application

SYLLABUS OF SEMESTER III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP644-2				
Category	Program Elective				
Course Title	Web Programming Lab				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	4	2	

Course Objective

Basic understanding to use HTML, CSS, Javascript language and to know the fundamentals of server-side website programming.

Course Outcomes

On successful completion of the course, students will be able:

1. To implement basic webpage programming using HTML, CSS and Javascript.
2. To implement a dynamic website using PHP / Asp.Net / MEAN.

Syllabus

Minimum 10 Practicals based on following topics but not limited to:

1. A Couple of case study practicals based on HTML tags and their usage in a webpage.
2. Implementation of HTML5 tags like File API, Canvas, Video and Geo-location etc.
3. A couple of practicals based on PHP language for designing dynamic websites.
4. A couple of practicals based on Asp.Net language for designing dynamic websites.
5. A couple of practicals based on MEAN stack technology for creating dynamic webpages.

Text Books:

1. Beginning HTML, XHTML, CSS, and JavaScript – *Jon Duckett (Wrox)*
2. Getting MEAN with Mongo, Express, Angular, and Node - *Simon Holmes (Manning).*
3. PHP, MySQL, Javascript& HTML5 All-in-one for Dummies - *Steven Suehring, Janet Valade* (*Wiley*)
4. Mean Web Development - *Amos Q. Haviv, PACKT Publishing.*
5. Asp.Net Web Developer's Guide – Mesbah Ahmed, Chris Garett (Syngress)

Reference Books:

1. HTML5, JavaScript, and jQuery 24-Hour Trainer - *Dane Cameron (Wrox)*
2. Web Development with Node & Express – *Ethan Brown (O'Reilly)*
3. Programming PHP – *Kevin Tatroe, Peter MacIntyre(O'Reilly)*
4. ASP.NET: The Complete Reference - *Matthew Macdonald (McGraw Hill)*

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP645-1				
Category	Program Elective				
Course Title	Information Security Lab				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	4	2	

Course Objectives

To understand the basics of concepts of cryptography. It is to identify and analyse the cryptography algorithm in order to use in different applications, and also learn the ideas about key exchange, hash function, and digital signature.

Course Outcomes

On the successful completion of this course student will be able to:

1. Understand various mathematical techniques for cryptography
2. Apply various Symmetric and Public key cryptography techniques.
3. Implements Hashing and Digital Signature techniques

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Substitution Cipher, Transposition Ciphers Encryption Techniques
- Symmetric algorithm: DES, IDEA, Blowfish algorithm
- Fermat's and Euler's Theorems, Testing of Primality
- Euclidean Algorithm
- Public key cryptography: RSA algorithm, etc.
- Diffie-Hellman Key Exchange algorithm
- Cryptographic Hash Function
- Digital Signature Standards (DSS)

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP645-3				
Category	Program Elective				
Course Title	DevOps Lab				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	4	2	

Course Objectives

Understand the DevOps fundamentals and problems it solves by doing hands-on exercises. Get introduced to technologies used for solving DevOps problems and Implement solutions for some of the DevOps problem areas.

Course Outcomes

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

1. Explain what problems DevOps solves.
2. Demonstrate implementation of solutions for problems solved by DevOps

Syllabus

Two major areas which are addressed by DevOps –

1. Software build and Release
2. Infrastructure creation and management.

Objective: Software build and Release

1. Setup Jenkins master and slave architecture on Linux machines so that it can used for writing pipelines for software release.
2. Write Scripted pipeline to build and release the Java software.
3. Parameters as inputs to the pipeline
    a. Name of GitHub repo with full path to checkout
    b. Branch of the GitHub repo to checkout
    c. Location where the Jar files will be stored after building it. [E.g., AWS s3 bucket, shared file system, local folder on a machine etc.]
4. Pipeline implements following stages:
    a. Checkout the GitHub repo using the indicated branch.
    b. Build the Java code and create a Jar file.
    c. Store the Jar file in the indicated location.

Objective: Building container images using Pipeline

1. Setup Jenkins master and slave architecture on Linux machines so that it can used for building docker images.
2. Write Scripted pipeline to build and release Docker images.
3. Parameters as inputs to the pipeline
    a. Name of GitHub repo with full path to checkout
    b. Branch of the GitHub repo to checkout

    c. Push the docker image to dockerhub.io in a public repository.
4. Pipeline implements following stages:
    a. Checkout the GitHub repo using the indicated branch.
    b. Build the docker image using the Dockerfile checked out from the repo/branch.
    c. Push the docker image to dockerhub.io in a public repository.
5. Test the docker image
    a. Pull the docker image and start the container from the image.
    b. Confirm that the container is getting successfully started.

Objective: Creating and manging infrastructure using GitOps way (Ref: https://www.weave.works/technologies/gitops/)

Prerequisite: Requires a free account with any cloud service provider

Part A:

1. Download and Setup Terraform on your local laptop.
2. As per your cloud service provider refer to the terraform registry file. E.g., for Oracle cloud service provider, the registry is documented at: https://registry.terraform.io/providers/oracle/oci/latest/docs
3. Write a terraform code to create a virtual machine in the cloud. Note: before a virtual machine can be created, a basic virtual network (VPC/VCN) is required to be present. You can create this manually using cloud console if required.
4. Plan and apply the terraform code and check that the virtual machine is created.
5. Check-in the code to a GitHub repository

Part B:

1. Change the shape (say memory) of the virtual machine from the cloud console.
2. Run your terraform code (plan) again and observe what message is indicated by the Terraform.
3. Run terraform apply and see what happens the virtual machine. [The state of virtual machine should get reset to as earlier]

Part C: Objective: Learn Terraform modules

1. Write a Terraform module which uses the terraform code as created in the Part A.
2. Call the terraform module to create a virtual machine.
3. Confirm that the virtual machine got created in the cloud.
4. Create another instance of the virtual machine by calling the module again from the same code. So not two different environments/machines are created in cloud. This way multiple cloud environments are created using terraform module which reuses the code written once.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT646-1				
Category	Program Elective				
Course Title	Introduction to Internet of Things				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives:

This course will help to understand the vision and purpose of IoT, to learn Data and Knowledge Management using Devices in IoT Technology. Students can understand State of the Art – IoT Architecture, real world IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Outcomes

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

1. Understand the vision of IoT from a global context and its Market perspective.
2. Analyze and study different H/W devices, Gateways and Data Management in IoT.
3. Built state of the art architecture in IoT.
4. Conceptualize applications of IoT in industrial and commercial building automation and real-world design constraints.

Syllabus

Section -I

(Weightage – 25%, Minimum Theory Teaching Hours-10)

Introduction to Internet of Things: IoT basics, Connected devices evolution, Introduction to communication mechanisms in IoT, Challenges with IoT, Applications of IoT.

Hardware in IoT: Introduction to RFID, Types of RFID, Simple and programmable Beacons, Various sensors prominently used in mobile devices.

Communication in IoT: Physical layer protocols used in IoT communication. IP Protocols used in communication such as HTTP based protocols - CoAP and MQTT, Specific aspects of protocols covering IoT communication.

Section-II

(Weightage – 50%, Minimum Theory Teaching Hours-20)

Sensor networks and M2M Architecture: High level M2M requirements, ETSI M2M services architecture, ZigBee network and its architecture. 6LoWPAN related standards.

IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Section-III

(Weightage – 25%, Minimum Theory Teaching Hours-10)

Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

Applications of IoT: Case Studies of IoT Applications: IoT in Cities/Transportation, IoT in the Home, IoT in Retail, IoT in Healthcare and IoT in Sports.

Text Books:

1. Learning Internet of Things By: Peter Waher Publisher: Packt Publishing

Reference Books:

1. The Internet of Things: Key Applications and Protocol By: Olivier Hersent; David Boswarthick; Omar
Elloumi, Publisher: John Wiley & Sons

2. M2M Communications: A Systems Approach By: David Boswarthick; Omar Elloumi; Olivier Hersent,
John Wiley & Sons

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT646-2				
Category	Program Elective				
Course Title	Operations Research				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

This course will help the students to get acquaint with the applications of Operations research to formulate and optimize business and industry related problems. Students can realize the need for mathematical tools to take decisions in a complex environment. This course will also improve the analytical thinking, algorithmic approach and modeling abilities related to programming, networking, queuing models.

Course Outcomes

On the successful completion of the subject students will be able to:

1. Demonstrate the models of Operations research.
2. Implement the tools of decision making and network scheduling.
3. Solve the real-life problems of Inventory control and queuing theory.

Syllabus

Section -I ***(Weightage – 34%, Minimum Teaching Hours -14)***

Introduction to Operations Research (OR): Origin and Development of OR, Nature of OR, Characteristics of OR, Classification of Problems in OR, Models in OR, Phases of OR, Uses and Limitations of OR, Methodologies in OR, Applications in OR. Linear Programming – Concept of Linear Programming Model, Mathematical Formulation of the Problem, Graphical solution Methods. Linear Programming Methods - Simplex Methods, Big M methods, Dual Simplex Method, Two Phase Methods, Duality Rules, Formulation of Dual Problem.

Transportation Problem: Mathematical Model for Transportation Problem, Types of Transportation Problem. North-West Corner Rule, Least Cost Cell Method, Vogel Approximation Method, MODI Method. Assignment Problem – Zero-One programming model for Assignment Problem, Types of assignment Problem, Hungarian Method, Branch and Bound Technique for Assignment Problem, Travelling Salesman Problem.

Section-II ***(Weightage – 33%, Minimum Teaching Hours -13)***

Decision Theory: Introduction, Decision under Certainty, Decision under Risk, Decision under Uncertainty, Decision Tree. Game Theory – Terminologies of Game Theory, Two person Zero-Sum Games, The Maximin-Minimax Principle, Saddle Point, Game of Mixed Strategies, Dominance Property, Graphical Solution of 2xn and mx2 Games.

Network Scheduling By CPM/PERT: Introduction, Basic Concept, Constraints in Network, Critical Path Methods (CPM), PERT Network, PERT calculations, PERTvs.CPM., Project Cost, Crashing Algorithm,

Section-III ***(Weightage – 33%, Minimum Teaching Hours -13)***

Inventory Control: Introduction, Inventory Control, Selective Control Techniques, Types of Inventory, Economic Lot Size Problem, Problem of EOQ without and with shortage(Purchase and Manufacturing Models) , Inventory Control with Price Breaks.

Queuing Theory: Introduction, Terminologies of Queuing System, Operating Characteristics of Queuing System, Poisson Process and Exponential Distribution, Classification of Queues, Definition of Transient and Steady States, Poisson Queues(M/M/1:∞/FCFS) and (M/M/N:∞/FCFS) models, Non-Poisson Queuing System(M/Ek/1: ∞/FCFS), Cost-Profit Models in Queuing, Queuing Control.

Text Books:

1. Operations Research: Kanti Swarup, P.K.Gupta, Man Mohan, Sultan Chand.
2. Operations Research: R. Panneerselvam, PHI.
3. Operations Research: Hira and Gupta, S. Chand.

Reference Books :

1. Introduction to Operations Research: Billy Gillett, Tata McGrawHill
2. Operations Research Theory & Application: Sharma J. K, MacMillan.
3. Operations Research: Hemdy Taha, IEEE.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT646-3				
Category	Program Elective				
Course Title	Computer Graphics & its Applications				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

This course will help to study the various algorithmic approaches, modeling abilities related to computer graphics, to acquaint with the applications of computer graphics to formulate and optimize industry related problems. Students can realize the need for mathematical tools and learn to use them in different graphics applications.

Course Outcomes

On successful completion of the course students will be able to:

1. Specify, design and implement 2D and 3D computer graphics algorithms.
2. Implement 2D and 3D transformations, projection and viewing.
3. Demonstrate advanced computer graphics including modeling, curves & surfaces, etc.

Syllabus

Section -I ***(Weightage – 40%, Minimum Teaching Hours -16)***

Scan Conversion-Geometry & Line generation, Points, Lines, Planes, Pixels and Frame buffers, Types of Display Devices, Line algorithms-DDA line generation algorithm, Bresenham's Line generation Algorithm, Circle generation-DDA circle generation algorithm, Midpoint circle generation algorithm, Bresenham's circle generation algorithm, Antialiasing.

Polygons, Segments, 2D Transformations-Graphics primitives, Display files, Polygon generation, Polygon filling, 2D transformations Segment tables, Operations on Segments.

Section-II ***(Weightage – 30%, Minimum Teaching Hours -12)***

Windows and Clipping-Clipping Window, Viewport, Viewing Transformations, Line clipping- Cohen Sutherland algorithm, Midpoint subdivision algorithm, Cyrus Beck Line Clipping Algorithm. Polygon Clipping-Sutherland Hodgman Polygon clipping algorithm.

3D Transformations and 3D Projections-3D Graphics, 3D primitives, Projections: Parallel, Perspective, viewing transformations, viewing parameters.

Section -III ***(Weightage – 30%, Minimum Teaching Hours -12)***

Hidden lines and Surfaces-Hidden Surfaces and Line removal.: Backface removal algorithm, Z-buffer algorithm, A-buffer Algorithm, Warnock's algorithm, Painters Algorithm, scan line algorithm, Hidden line methods.

Curve generation and Raster graphics-Curves and Surfaces, Cubic Bezier and cubic B-Spline curves, Raster Graphics Architecture, Standard Graphics Pipeline. Introduction to Image File format Standards.

Text Books:

1. Computer Graphics: Steven Harrington, TMH.
2. Procedural Elements for Computer Graphics : *David F. Rogers , McGraw-Hill.*
3. Multimedia System Design: *Prabhat. K .Andleigh and Kiran Thakrar, PHI publication.*

Reference Books:

1. Principles of Interactive Computer Graphics: *Newman & Sproul, McGraw-Hill.*
2. Mathematical Elements for Computer Graphics: *David F Rogers & Adams, McGraw-Hill.*
3. Multimedia making it works: *Vaughan, Tata McGraw-Hill.*
4. Computer Graphics : *Hearn Baker [PHI]*

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP646-1				
Category	Program Elective				
Course Title	Introduction to Internet of Things Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

This course will help to introduce the terminology, technology and its applications, the concept of M2M (machine to machine) with necessary protocols, the Raspberry PI platform, that is widely used in IoT applications. Students can learn to introduce the implementation of web-based services on IoT devices.

Course Outcomes

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

1. Understand the vision of IoT from the industrial perspective.
2. Study different H/W devices used in IoT.
3. Implement a case study in IoT.
4. Implement web services in IOT

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Introduction to IOT devices and hardware
- IoT Physical Devices and Endpoints
- Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
- Introduction to the concept of M2M (machine to machine) with necessary protocols
- To introduce the implementation of web-based services on IoT devices.
- To implement a small case study on any verticals of IOT

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP646-2				
Category	Program Elective				
Course Title	Computer Graphics and its Applications Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

This course will help to create applications using graphics primitives in 2D and 3D respectively. Students can learn to create applications related to computer graphics / animations.

Course Outcomes

On successful completion of the course students will be able to:

1. Design and implement 2D and 3D computer graphics algorithms.
2. Create interactive graphics applications.
3. Demonstrate advanced computer graphics including animation texturing, modeling, curves & surfaces, etc.

Syllabus

Minimum 4 practicals and assignments based on but not limited to the following topics:

- DDA line generation algorithm, Bresenham's Line generation Algorithm
- Circle generation-DDA circle generation algorithm
- Midpoint circle generation algorithm,
- Bresenham's circle generation algorithm,
- Antialiasing.
- Polygon generation,
- Polygon filling,
- 2D/3D transformations
- Backface removal algorithm,
- Z-buffer algorithm,
- A-buffer Algorithm,
- Warnock's algorithm,
- Painters Algorithm, scan line algorithm, Hidden line methods.
- Curves and Surfaces,
- Cubic Bezier and cubic B-Spline curve.

SYLLABUS OF SEMESTER-IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP646-3				
Category	Program Elective				
Course Title	Operations Research Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

This course will help students to explore the social, business, technical based problems. This course navigates the proper optimisation techniques for the analysis of various models. The students can interpret the outcomes of the analysis to take correct decisions.

Course Outcomes

On the successful completion of the subject students will be able to:

1. Identify the various optimisation models of Operations research.
2. Demonstrate various optimisation models for decision making.
3. Interpret the results of the outcomes.

1. Linear Programming Model by
    a) Simplex Method Program
    b) Big-M Method
2. Transportation Problem using
    a) North West Corner Rule
    b) Least cost Cell Method
    c) Vogel Approximation Method
3. Assignment Problem by
    a) Hungarian Method
    b) Branch and Bound Approach
4. Implementation of Travelling Salesman Problem
5. Implementation of Decision Making Under Uncertainty methods
6. Implementation of Game Theory Model
    a) Saddle point
    b) Dominance Rule
    c) Value of the Game
7. Critical Path Method
8. Program Evaluation and Review Technique
9. Economic Order Quantity without and with shortage
10. Implementation of (M/M/1:∞/FCFS) and(M/M/N:∞/FCFS) models

Note: Program implementation using C/C++/Java/Matlab

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT647-1				
Category	Program Elective				
Course Title	Compiler Construction				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

To teach students the basic techniques that underlies the practice of Compiler Construction. This will also help to understand the design tradeoffs involved in each phase of compilation: lexical analysis, parsing, intermediate form, and code generation. Students will be able to learn introduction to Compiler Construction and to understand the concepts of scanning, parsing and code generation. Students will also be able to identify application areas where we need a syntax-directed analysis of symbolic expressions and languages as well as their translation into a lower-level description.

Course Outcomes

At the end of the course student will be able to:

1. Students understand concepts and principles of compiler design.
2. Basic understanding of grammars and language definition.
3. Know the various phases of designing a compiler.

Syllabus

Section -I*(Weightage – 40%, Minimum Teaching Hours -16)*

Introduction Compilers and translators, Phases of compiler design, cross compiler, Bootstrapping, Design of Lexical analyzer.

Syntax Analysis - Specification of syntax of programming languages using CFG, Top-down parser, design of LL(1) parser, bottom up parsing technique, LR parsing, Design of SLR, CLR,LALR parsers.

Section-II*(Weightage – 30%, Minimum Teaching Hours -12)*

Syntax directed translation - Study of syntax directed definitions & syntax directed translation schemes, implementation of SDTS, intermediate notations- postfix, syntax tree, TAC, translation of expressions, controls structures, declarations, procedure calls, Array reference.

Introduction to Lex and YACC - Lex-A scanner Generator, YACC-A Parser generator, **Storage allocation & Error Handling**- Run time storage administration stack allocation, symbol table management, Error detection and recovery- lexical, syntactic, semantic.

Section -III*(Weightage – 30%, Minimum Teaching Hours -12)*

Code optimization - Important code optimization techniques, loop optimization, control flow analysis, data flow analysis, Loop invariant computation, Induction variable removal, Elimination of Common subexpression.

Code generation – Problems in code generation, Simple code generator, Register allocation and assignment, Code generation from DAG, Peephole optimization.

Text Books:

1. Compilers Principles Techniques and Tools: A.V.Aho, Sethi, Ullman, Pearson education.
2. Principles of Compiler Design: Alfred V. Aho& Jeffery D. Ullman, Narosa Pub. House

Reference Books:

1. Compiler Design: Dr.O.G.Kakde, university science press, fourth edition.
2. Andrew W Appel: Modern Compiler Implementation in C, First Edition, Cambridge University Press, 2010.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT647-2				
Category	Program Elective				
Course Title	Soft Computing				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario and to implement soft computing-based solutions for real-world problems. Also, to give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms and to provide student an hand-on experience on MATLAB to implement various strategies.

Course Outcomes

On the successful completion of the subject students will be able to:

1. Identify and describe soft computing techniques and their roles in building intelligent machines.
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Apply genetic algorithms to combinatorial optimization problems.
4. Evaluate and compare solutions by various soft computing approaches for a given problem.

Syllabus

Section -I ***(Weightage – 33%, Minimum Teaching Hours -13)***

Introduction to Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Section -II ***(Weightage – 34%, Minimum Teaching Hours -14)***

Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Section -III ***(Weightage – 33%, Minimum Teaching Hours -13)***

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.

Recent Trends and Techniques: Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Text Book:

1. Introduction to Soft Computing, Samir Roy, Udit Chakraborty, Pearson
2. Fuzzy and Soft Computing, Prentice Jyh:Shing Roger Jang, Chuen:Tsai Sun, Eiji Mizutani, Neuro, Hall of India.
3. Soft Computing using Matlab Programming, N. P. Padhy , S. P. Simon, Oxford

Reference Book:

1. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice
2. Soft Computing: Fundamentals and Applications. Dilip K. Pratihar, Narosa
3. Soft Computing and Intelligent Systems Design: Theory, Tools and Applications, Karray , Pearson

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT647-3				
Category	Program Elective				
Course Title	Social Networks				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

This course will help to understand a broad range of network concepts and theories, various detections and analytical concepts. The student will be able explore how these social technologies impact society and vice versa

Course Outcomes

On the successful completion of the subject students will be able to:

1. Appreciate how network analysis can contribute to increasing knowledge about diverse aspects of society.
2. Analyse social networks using Community detection and Link Prediction.
3. Develop skills at event detection and Social Influence Analysis

Syllabus

Section -I ***(Weightage – 33%, Minimum Teaching Hours -13)***

An Introduction Types of Networks: General Random Networks, Small World Networks, Scale-Free Networks; Examples of Information Networks; Network Centrality Measures; Strong and Weak ties; Homophily

Random walk-based proximity measures, Other graph-based proximity measures. Clustering with random-walk based measures

Section-II ***(Weightage – 34%, Minimum Teaching Hours -14)***

Algorithms for Community Detection- The Kernighan-Lin algorithm, Agglomerative/Divisive algorithms, Spectral Algorithms, Multi-level Graph partitioning, Markov Clustering; Community Discovery in Directed Networks , Community Discovery in Dynamic Networks, Community Discovery in Heterogeneous Networks, Evolution of Community.

Feature based Link Prediction, Bayesian Probabilistic Models, Probabilistic Relational Models, Linear Algebraic Methods: Network Evolution based Probabilistic Model, Hierarchical Probabilistic Model, Relational Bayesian Network. Relational Markov Network.

Section-III ***(Weightage – 33%, Minimum Teaching Hours -13)***

Event Detection: Classification of Text Streams, Event Detection and Tracking: Bag of Words, Temporal, location, ontology based algorithms. Evolution Analysis in Text Streams, Sentiment analysis.

Social Influence Analysis: Influence measures, Social Similarity - Measuring Influence, Influencing actions and interactions. Influence maximization.

Text Books:

1. M.E.J. Newman: Networks : An Introduction, OUP
2. Network Data Analytics, Ed. Charu C.Aggarwal, Springer

3. Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010

Reference Books :

1. David Easley, Jon Kleinberg: Networks, Crowds and Markets: Reasoning about a highly connected world, Cambridge Univ Press
2. S.Wasserman, K.Faust: Social Network Analysis: Methods and Applications, Cambridge Univ Press
3. Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT647-4				
Category	Program Elective				
Course Title	Wireless and Mobile Network				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

To study Wireless Communication Technologies , wireless networking, mobile network layer, WLAN and mobile adhoc networking. Also to understand issue of mobile transport layer and their solution.

Course Outcomes

1. Ability to learn internetworking in wireless systems.
2. Familiarize with Wireless and Mobile Communication standards.
3. Grasp the concepts and features of mobile computing technologies and applications.

Syllabus

Section-I *(Weightage - 30%, Minimum Teaching Hours – 12)*

Wireless Communication Technologies : Introduction**,** Antennas ,Propagation modes ,Signal encoding techniques, Spread spectrum, Introduction to cellular Network.

Wireless Networking: Satellite Communication: Application, basics, GEO,LEO,MEO, Routing, Localization, Handover.

Wireless LAN: Infrared and radio transmission, infrastructure and ad-hoc network.IEEE802.11 System architecture, protocol architecture, Medium Access Control Layer, 802.11a and 802.11b, Bluetooth

Section-II *(Weightage - 35%, Minimum Teaching Hours - 14)*

Mobile Telecommunication System: 1G, 2G, 2.5G, 3G and 4G, **Cellular concept:**Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving Coverage and Capacity in Cellular Systems

Medium Access Control: Need for a specialized MAC, **Different MAC schemes:** SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, CSMA, DAMA, PRMA, Reservation TDMA, MACA, CDMA.

GSM: Mobile services, system architecture, radio interface,Protocols,Localization and calling,Handover,security,new data services.

Section-III *(Weightage - 35%, Minimum Teaching Hours – 14)*

Mobile Network Layer: Mobile IP, Entities and Terminologies, IP packet delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations, IPv6, Dynamic Host Configuration protocol.

Mobile ad-hoc network: Routing, Destination sequence distance vector, Dynamic source routing, Alternative metrices, ad-hoc routing protocol.

Mobile Transport Layer: Traditional TCP,ClassicalTCP Improvement, Indirect TCP,Snooping TCP,Mobile TCP,Fast retransmit/fast recovery ,Transmission/Time-out freezing, selective retransmission, Transaction-oriented TCP.,TCP over2.3/3G wireless network.

Text Books:

1. Wireless Communication and Networking – William Stallings, PHI.
2. Mobile Communications – Jochen Schiller- Second Edition.
3. Wireless Communication: Theodore S. Rappaport, Pearson Education.

Reference Books:

1. Mobile Computing: AsokeTalukder, RoopaYavagal, Tata McGraw Hill.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT647-5				
Category	Program Elective				
Course Title	Advanced Computer Architecture				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objective

This course will help to study fundamentals of quantitative, memory hierarchy designs, different techniques of parallelism, Vector, SIMD, and GPU Architectures.

Course Outcomes

On successful completion of the course students will be able to:

1. Synthesize the concept of quantitative designs.
2. Conceptualize the optimization techniques to improve cache performance.
3. Conceptualize the different architectures of processors for parallelism.

Syllabus

Section-I*(Weightage – 15%, Minimum Teaching Hours -6)*

Fundamentals of Quantitative Design and Analysis

Classes of Computers, Defining Computer Architecture, Dependability, Measuring, Reporting, and Summarizing Performance, Quantitative Principles of Computer Design

Memory Hierarchy Design

Ten Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: virtual Memory and Virtual Machines, Crosscutting Issues

Section-II*(Weightage – 70%, Minimum Teaching Hours -28)*

Instruction-Level Parallelism and Its Exploitation

Instruction-Level Parallelism: Concepts and Challenges, Reducing Branch Costs with Advanced Branch Prediction, Overcoming Data Hazards with Dynamic Scheduling, Dynamic Scheduling, Advanced Techniques for Instruction Delivery and Speculation, Multithreading

Data-Level Parallelism in Vector, SIMD, and GPU Architectures

Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism

Section-III *(Weightage – 15%, Minimum Teaching Hours -6)*

Thread-Level Parallelism & Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism

Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors Contents, Distributed Shared-Memory and Directory-Based Coherence, Synchronization, Models of Memory Consistency,Programming Models and Workloads for Warehouse-Scale Computers, Computer Architecture of Warehouse-Scale Computers, Physical Infrastructure and Costs of Warehouse-Scale Computers

Text Books:

1. Computer Architecture A Quantitative Approach: John L. Hennessey, David A. Patterson 5th ed.

Reference Books:

1. Advanced Computer Architecture (Parallelism, Scalability, Programmability): Hwang, K McGraw Hill.
2. Parallel Computer: V. Rajaranam & C.S.R.Murthy, PHI.

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP647-1				
Category	Program Elective				
Course Title	Big Data and Analytics Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

This course will help students to understand and apply technologies for Big Data. Students can perform data analytics on different types of data sets e.g., structured, semi-structured and unstructured data. In addition, student can study modern technical tools based on Apache Spark.

Course Outcomes

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

1. Demonstrate the applications using Hadoop architecture and ecosystem tools.
2. Design and build APIs for large-scale data processing.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Simple program using Map Reduce Frame-work
- HDFS command set for distributed file systems
- Data Ingestion using Flume/Avro
- Simple program using Pig Scripting
- Simple program using Hive
- Simple program using Hbase
- Load and Inspect Data in RDD using Apache Spark
- Mini Project by integrating any of above topics

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP647-2				
Category	Program Elective				
Course Title	Software Architecture Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objective

This course will help to learn Principles of Software architecture, Different Software Architecture Patterns and also Frameworks and tools for building microservice architectures

Course Outcomes

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

1. Use Concepts of Software architecture.
2. Analyze and implement Software Architecture Patterns, Frameworks and tools for building microservice architectures.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Principles of Software architecture
    - Modularity
    - Coupling
- Different Software Architecture Patterns
    - Layered Architecture
    - Event Driven Architecture
    - Microservices architecture
        - Domain Driven Design
        - CQRS
        - Sagas
    - Microkernel architecture
- Choosing the Appropriate Architecture Style

Lab to focus on building

- microservice architecture

Frameworks and tools to use for building microservice architectures

- Example Problem statement to be given that can be built using microservice architecture
    - eLearning system or

    - E-commerce application
- Spring Boot and Spring Cloud Framework for backend services
- Event layer using Kafka or an equivalent one
- Docker containerization to build and deploy each of the microservice
- Implement at-least one pattern such as CQRS (Command and Query Responsibility Segregation)
- Front end to be built in decoupled manner using frameworks such as Angular or React.

Reference Books

- Software Architecture Patterns by Mark Richards
- Fundamentals of Software Architecture by Mark Richards, Neal Ford
- Microservices Patterns by Richardson.
- http://microservices.io

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP647-3				
Category	Program Elective				
Course Title	Compiler Construction Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

To learn and understand syntax analysis, lexical analysis phases of Compiler design. This will help students to learn and understand semantic analysis, parsing, intermediate code generation. This will also help to learn and understand the concepts of code optimization and code generation.

Course Outcomes

At the end of the course student will be able to:

1. Apply and implement syntax analysis, lexical analysis phases of compiler design.
2. Apply and implement semantic analysis, parsing, intermediate code generation.
3. Apply and implement code optimization and code generation.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics implemented using LEX / YACC/ java/ open-source platform:

1. Lexical analysis
2. Syntax analysis
3. Syntax directed translation schemes
4. Intermediate code generation
5. Symbol table management
6. Parsing
7. Code optimization
8. Code generation

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP647-4				
Category	Program Elective				
Course Title	API Level Programming Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

Students to gain understanding of different techniques used before evolution of API level Programming. Also, to learn and implement real life problems using API level programming.

Course Outcomes

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

1. Understand previous techniques and their implementations before API level programming came in.
2. Implementing API level Programming by using different languages and technologies.

Syllabus

Minimum 8 Practicals based on following topics but not limited to:

1. A Couple of case study practicals based on requirement of Application Programming Interface (API) in current software development trends.
2. Implementation of HTML5 API like File API, Canvas, Geo-location etc.
3. SOAP based messaging implementation using WCF services.
4. Fundamental understanding of RESTful services and their comparison with previous techniques.
5. 5 or more practicals based on API programming using different technologies like :
    i) PHP/XAMPP
    ii) Asp.Net Web API
    iii) Node.Js
    iv) Python
    v) Java etc.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP647-5				
Category	Program Elective				
Course Title	R Programming Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

Students can learn the features of R Programming to implement real life problems. The analytical tool can help to explore a Broad Range of Libraries, its Open-Source Environment and Support Across Different Platforms and Powerful Graphics.

Course Outcomes

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

1. Apply Predictictive Analytics to predict outcomes.
2. Explore data manipulation using R.
3. Apply Data Visualization to create fancy plots

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

- Basics of R programming
- Control structures & functions
- Vectors & matrices
- Reading and Writing Data
- Data Mining & Predictive Analysis using R
- Data Visualization
- Debugging Tools
- Simulation
- R Profiler.

Reference Book

1. W. N. Venables, D. M. Smith, An Introduction to R, R-core team, 2015.
2. R Programming- By Tutorials Point

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT648-1				
Category	Program Elective				
Course Title	Advanced Databases				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

This course will help to understand various database architectures, concepts of data storage structures and various types of advanced databases and their issues.

Course Outcomes

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

1. Examine types of database architectures.
2. Learn to implement different storage structures for different business applications.
3. Grasp deeper understanding of advanced databases.

Syllabus

Section-I *(Weightage - 30%, Minimum Teaching Hours – 12)*

Introduction: Database System Architectures: Centralized and Client-Server Architectures

Server System Architectures: Transaction Servers, Data Servers, Cloud-Based Servers.
Parallel Databases: Introduction, Speedup and Scale up, I/O Parallelism, Interquery & Intraquery parallelism, Interoperational & Intraoperational parallelism.
Cloud Based Databases: Data storage systems on cloud, Data Representation, Partitioning and Retrieving, Transactions and Replication, Challenges.

Data Storage for Modern High-Performance Business Applications: Implementing a Relational Database, Implementing a Key/Value Store, Implementing a Document Database, Implementing a Document Database, Implementing a Column-Family Database, Implementing a Graph Database.

Section-II *(Weightage - 40%, Minimum Teaching Hours - 16)*

Object-Based Databases: Overview, Complex Data Types, Structures Types and Inheritance in SQL Table Inheritance, Array and Multiset Types in SQL, Object-Identity and Reference Types in SQL, implementing O-R features, Object-Relational Mapping, Object-Oriented versus Object Relational Databases.

Temporal Databases: Time in Databases: Time Specification in SQL, Temporal Query Languages.
Mobility and Personal Databases: A Model of Mobile Computing, Routing and Query Processing, Broadcast Data, Disconnectivity and Consistency
Case studies on Temporal & Mobile Databases

Section-III *(Weightage - 30%, Minimum Teaching Hours - 12)*

NoSQL Databases: Introduction, Differences from Relational Databases, Basic Schema and data types, Types of NoSQL Databases, Concepts of replication, distribution, sharding, and resilience, Use of NoSQL in Industry.

Spatial and Geographic Data: Representation of Geometric Information, Design Databases, Applications of Geographic Data, Representation of Geographic Data, Spatial Queries, Indexing of Spatial Data Multimedia Databases, Mobility and Personal Databases.

Text Books:

1. Database Systems Concepts:*Silberschatz,Korth,Sudarshan,McGraw-Hill(6th Edition)*
2. Data Access for Highly-Scalable Solutions: Using SQL, NoSQL, and Polyglot Persistence
   Microsoft MSDN.

Reference Books:

1. Fundamentals of Database Systems *: R. Elmasri, S.B. Navathe, Pearson Education (4th Edition)*
2. Modern Database Management:*McFadden, Prescott and Hoffer(10th Edition)*

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT648-2				
Category	Program Elective				
Course Title	Information Retrieval				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objectives

This course will help to know how to design, manipulate, manage databases, develop preliminary understandings and skills for designing a database information system. Students can understand implementation of database systems in real world problems.

Course Outcomes

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

1. Design and implement a database schema, database objects for a given problem-domain.
2. Recognize the context, phases and techniques for designing and building database information systems in business.
3. Correctly use the techniques, components and tools to build application for real world problem.

Syllabus

Section -I ***(Weightage –43%, Minimum Teaching Hours -17)***

Introduction to Information Retrieval: The nature of structured and semi structured text, Inverted Index and Boolean Queries.
Dictionary and Postings: Tokenization, Stemming, Stop words, Phrases, Index Optimization.

Dictionaries and Tolerant Retrieval:Wild Card Queries, Permuterm Index, Bigram Index, Spelling Correction, Edit Distance.
Term Weighting and Vector Space Model: Term frequency and weighting, Vector Space model for scoring.

Section-II ***(Weightage – 43%, Minimum Teaching Hours -17)***

Performance Evaluation: Precision, Recall, F-Measure, E-Measure, Normalized recall.
Latent Semantic Indexing: Eigenvectors, Singular Value Decomposition, Lower rank approximation.

Probabilistic Information Retrieval: Probability ranking principle, The Binary Independence Model, Bayesian Network for text retrieval.
Text Classification: Introduction to text classification, Naïve Bayes text classification, Vector space classification, Support Vector Machine.

Section-III ***(Weightage – 14%, Minimum Teaching Hours -6)***

Web Information Retrieval: Introduction to web search basics, Web crawling and indexes, LinkAnalysis**.**

Text Books:

1. An Introduction to Information Retrieval: Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, Cambridge University Press, Cambridge, England, 2009
2. Information Retrieval: Implementing and evaluating search engines: Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack, MIT Press, 2010

Reference Books :

1. *Information Retrieval: Algorithms and Heuristics : David A. Grossman, Ophir Frieder, Springer.* Database Management System: *Raghu Ramkrishan, Johannes, McGraw Hill.*
2. Information Retrieval: Data Structures and Algorithms by Frakes, Pearson.
3. Soumen Chakrabarti, Mining the Web, Morgan-Kaufmann Publishers, 2002.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT648-4				
Category	Program Elective				
Course Title	Introduction to Deep Learning				
Scheme& Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	

Course Objective

To understand the fundamentals of Machine Learning, learn the basics of Deep Neural Networks and know about various deep learning algorithms and techniques.

Course Outcomes

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

1. Associate machine learning basics with development of deep learning technology.
2. Implement feedforward and backpropagation techniques in Deep Neural Networks along with their training and optimization.
3. Gain knowledge about CNN, RNN and autoencoders for solving various problems.

Syllabus

Section -I ***(Weightage –20%, Minimum Teaching Hours -8)***

Machine Learning Basics: Overview of machine learning tasks: Classification, Regression, Estimation, Prediction, Denoising, generating structured output, Object detection, Learning without labels. Probability Concepts: Rules of probability, probability distributions, Expectation, Co-variance, Bayes Theorem. Performance: Capacity, Underfitting, Overfitting, Hyperparameters, Estimators, Bias, Variance.

Section-II ***(Weightage – 43%, Minimum Teaching Hours -16)***

Deep Neural Networks: Basic Concepts and Terminology for Neural Networks, The Perceptron Rule, The Delta Rule, Multi-layer Perceptron, Gradient descent, Deep Feedforward Neural Networks, Backpropagation.

Optimizations for training deep models: The Idea of Regularization, L1 and L2 Regularization, Learning Rate, Optimization, Stochastic gradient descent, Momentum optimizer, Batch optimization. RMSProp, Adam, Dataset Augmentation, Early stopping, Dropout, Batch normalization.

Section-III ***(Weightage – 14%, Minimum Teaching Hours -16)***

Convolutional Neural Networks: The Basic Structure of a Convolutional Network, Training a Convolutional Network, Fully connected CNNs.

Sequence Modeling: Recurrent Neural Networks, Recursive Neural Networks, Gated RNNs, LSTM and GRU models.

Autoencoders: Learning Representations, Different Autoencoder Architectures, Sparse Autoencoders, Stacked Autoencoders.

Recent trends in Deep Learning: Residual Network, Skip Connection, Transfer Learning, Case Studies of Convolutional Architectures: AlexNet, ZFNet, VGG, MobileNet, GoogLeNet, ResNet,

Test book:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press

2. Neural Networks and Deep Learning, Charu C. Aggarwal, ISBN 978-3-319-94462-3 ISBN 978-3-319-94463-0 (eBook), Springer.

Reference Books:

1. Fundamentals of Deep Learning - Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma, O'Reilly Media, Inc.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP649-4				
Category	Program Elective				
Course Title	Information Retrieval Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

This course will help to know the basics of Information Retrieval System, to understand the concept of Vocabulary and Terms. Students can learn the concept of Scoring, Term-Weighting and Vector-Space Model.

Course Outcomes

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

1. To implement basics of Information Retrieval System
2. To learn and implement concept of Vocabulary and terms.
3. To implement Scoring, Term-Weighting and Vector-Space Model.

Syllabus

Minimum 4 practical's and assignments based on but not limited to the following topics:

- Stop Words
- Term Frequency
- Document Frequency
- Inverse Document Frequency
- Term-Document Matrix
- Index Construction

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP649-5				
Category	Program Elective				
Course Title	Introduction to Deep Learning Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objective

To know about datasets and their utility in deep learning, study various deep learning algorithms and techniques for optimizing deep neural networks.

Course Outcomes

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

1. Apply appropriate data sets to train the deep neural networks.
2. Understand and implement various deep learning algorithms in suitable programming language.
3. Implement various optimization techniques to improve the performance of deep learning algorithms.

Syllabus

Minimum 8 practicals and assignments based on but not limited to the following topics:

Training and optimization of Deep Networks

Convolutional Neural Networks

Convolutional architectures

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP649-6				
Category	Program Elective				
Course Title	Advanced Databases Lab				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	

Course Objectives

1. Learn NoSQL databases and its concepts.
2. Learn Temporal databases and its concepts.
3. Hands-on implementation of some of the above concepts.

Course Outcomes

1. NoSQL and Temporal database concepts are understood
2. Understood and tried technologies which are used for implementing the above concepts.

Syllabus

Minimum 5 practical's and assignments based on but not limited to the following topics:

Timeseries database: Objective learn how to create timeseries database using Cassendra NoSQL database

1. Download and install Cassendra database on your local laptop.
2. Create a Timeseries schema to store Home Automation IoT data. The data should contain following:
    a. Set of sensor columns: room temperature, room humidity, room number, light on/off, air conditioner on/off.
    b. Date and time column when the above values were recorded.
3. Push some sample database values and store them in the database.
4. Handle Schema change: consider that the user installs new light sensor in the room. These values should now be stored in the same table as above part (1).
5. Note: Storing additional senor value should not require schema change in this case as it is just another column that is getting added to the above database.
6. Note the above advantage of the NoSQL database as compared to the traditional relational database.

Document database: Objective learn how to store JSON documents in document database MongoDB

1. Download and install MongoDB database on your local laptop.

2. Create a schema to store JSON documents in the database.
3. Store some sample JSON documents in the database.
4. Run some database queries which are able to query the JSON database [To be confirmed if MongoDB supports direct JSON query]
5. Note the advantage of dealing with Document databases which are natively able to handle documents such as JSON douments.

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP650				
Category	Program Core				
Course Title	Project Work				
Scheme& Credits	L	T	P	Credits	Semester-IV
	0	0	8	4	

Course Objectives

This course will help to get familiar with the basics of project planning, designing and development. Also, students can learn to understand technology and processes associated in software industries.

Course Outcomes

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

1. Implement comprehensive project planning, designing and development process.
2. Acquire and understand Software industry needs.

Syllabus:

Project work to be carried out under the supervision of one external guide from industry and one internal guide as appointed by project coordinator.

1 Year Internship (Semester-III and IV)

SYLLABUS OF SEMESTER -III, MCA(MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP651-1				
Category	Program Elective				
Course Title	Project Work- Full Time (Phase-I)				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	36	22	

Course Objectives

This course will help to get familiar with the basics of project planning, designing and development. Also, students can learn to understand technology and processes associated in software industries.

Course Outcomes

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

1. Implement comprehensive project planning, designing and development process.
2. Acquire and understand Software industry needs.

Syllabus:

A full-time project work to be carried out under the supervision of one external guide from industry and one internal guide as appointed by project coordinator.

SYLLABUS OF SEMESTER -IV, MCA(MASTER OF COMPUTER APPLICATIONS)

Course Code	MCP652-1				
Category	Program Elective				
Course Title	Project Work- Full Time (Phase-II)				
Scheme& Credits	L	T	P	Credits	Semester-III
	0	0	32	16	

Course Objectives

This course will help to get familiar with the basics of project planning, designing and development. Also, students can learn to understand technology and processes associated in software industries.

Course Outcomes

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

1. Implement comprehensive project planning, designing and development process.
2. Acquire and understand Software industry needs.

Syllabus:

A full time project work to be carried out under the supervision of one external guide from industry and one internal guide as appointed by project coordinator.

Bridge Courses

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT550				
Category	Program Core				
Course Title	Computer Architecture and Organization				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	1	0	0	

Course Objectives

This course will help the students to recognize the elements of modern instructions sets, hardware components and their impact on processor design. Students can be able to discuss in detail computer arithmetic operations and control unit operations. Students can learn in detail function of each element of a memory hierarchy, I/O organization, Pipelining and to study the performance of CPU, memory and I/O operations.

Course Outcomes

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

1. Solve arithmetic operations of binary number system and the elements of modern instructions sets, hardware components and their impact on processor design.
2. Perform computer arithmetic operations and control unit operations.
3. Understand elements of a memory hierarchy, I/O organization, pipelining, and measure the performance of CPU, memory and I/O operations.

Syllabus

Section -I ***(Weightage – 15%, Minimum Teaching Hours -6)***

Basic Structure of Computer Hardware & Software: Introduction, Memory Locations and Address, Main memory operations, Instructions & Instruction Sequencing, Addressing modes, Assembly language, Basic I/O operations, Stacks, Subroutines.

Section-II ***(Weightage – 55%, Minimum Teaching Hours -22)***

The Processing Unit: Fundamental concepts, Execution of Complete Instruction, Multiple bus Organization, Hardwired control, Micro Programmed Control, Introduction to RISC, CISC.

Input–Output Organization: Accessing I/O devices, Interrupts, Direct Memory Access, Buses.

Arithmetic Operations: Number arithmetic, Addition & Subtraction, Arithmetic & Branching conditions, Multiplication of positive numbers, signed operand multiplication, Fast multiplication, Integer division, Floating point numbers & operations, IEEE standards.

Section-III ***(Weightage – 30%, Minimum Teaching Hours -12)***

The Main Memory: Semiconductor RAM, ROM memories, Multiple-module memories and Interleaving, Cache memories, Virtual memories, Memory management requirements.

Pipelining: Basic Concepts, Data Hazards, Instruction Hazard, Influence on Instruction Set.

Text Books:

1. Computer Organization: Carl Hamacher, ZvonkoVranesic&SafwatZaky. Mc-Graw Hill, Fifth edition.
2. Computer Architecture & Organization: J.P.Hayes , McGraw-Hill.
3. Computer organization and Design: David A. Patterson, John L. Hennessy

Reference Book:

1. Computer Organization & Architecture: William Stalling, Prentice Hall.
2. Computer Architecture: BehroozParhami, Oxford University Press.
3. Computer System Architecture: Morris Mano

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT551				
Category	Program Core				
Course Title	Data Structures				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	1	0	0	

Course Objectives

To study the concepts of arrays and linked list, their operations and use in different applications. Also identify stacks mechanism and the concepts of queues to design solution for real world problems. This will help to study tree data structure and hashing techniques to formulate the problem.

Course Outcomes

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

1. Understand the concepts of arrays, linked list and their various algorithms to design real world applications.
2. Apply stacks mechanism and algorithms to design various applications.
3. Understand the concepts of queues and select appropriate algorithm as per the properties of given problem.
4. Identify tree data structure and hashing techniques to formulate the problem, devise an algorithm and transform into code.

Syllabus

Section -I : ***(Weightage – 20%, Minimum Teaching Hours-8)***

Introduction to Data Structures: Definition, Arrays implementation in memory, Types of arrays. Applications of Arrays: Polynomial Representation Using Arrays, Addition and multiplication of Two Polynomial.

Sorting & Searching: General Background, Different Sorting & Searching Techniques and their complexities.

Section -II : ***(Weightage – 40%, Minimum Teaching Hours-16)***

Linked List - Concept of Linked Lists, Types, Operations on Linked lists, concept of Doubly Linked List, Header Linked List. Other Operation & Applications: Reversing a Linked List, Concatenation of Two Lists.

Stacks: Definition and example, primitive operations on Stacks, Arithmetic expressions (Infix, Postfix and Prefix), Evaluating postfix expression, converting an expression from infix to postfix. Applications of stacks: Tower of Hanoi Problem, Recursion, etc.

Section -III : ***(Weightage – 40%, Minimum Teaching Hours-16)***

Queues: Definition and examples of queues, primitive operations, Types of Queues.

Trees: Definition and Basic Terminology of trees, Binary Tree, Binary Search Tree, Tree Traversal.

Hashing: Introduction to Hashing, Different Hashing techniques, Collision handling mechanisms.

Text Books:

1. Data Structures and Program Design: Robert Kruse, PHI.
2. Classical Data Structure: Samanta, PHI.
3. Fundamentals of Data Structures: Elis Horowitz, Sartaj Sahani, Galgotia Publications.
4. Data Structures And Algorithms: Alfred V. Aho , John E. Hopcroft and Jeffrey D Ullman, Pearson.

Reference Books:

1. Schaum's Outlines Data structure: Seymour Lipschutz, Tata McGraw Hill 2nd Edition.
2. Data Structures and Algorithms, G A V Pai, Tata McGraw Hill.

SYLLABUS OF SEMESTER -I, M.C.A. (MASTER OF COMPUTER APPLICATIONS)

Course Code	MCT552				
Category	Program Core				
Course Title	Discrete Structures and Digital Logic				
Scheme& Credits	L	T	P	Credits	Semester-I
	3	1	0	0	

Course Objectives

Students can study the basics of set theory, relations and functions, Algebraic Structure and Combinatorics. Studens can explore several mathematical topics in order to understand the relation between exploration, Logic concept and discovery and proof. Students can learn to introduce number systems, codes, basic postulates of Boolean algebra, methods for simplifying Boolean expressions. Also it will help to outline the formal procedures for the analysis and design of combinational circuits and sequential circuits.

Course Outcomes

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

1. Solve the problems based on set theory, relations and functions, Algebraic Structure and Combinatorics.
2. Translate statements and reasoning from natural language to propositional and predicate logical language
3. Perform arithmetic operations with different number systems, use various optimization techniques to minimize and design digital circuits.
4. Analyze and design various combinational logic circuits and sequential circuits.

Syllabus

Section - I (Weightage –50%, Minimum Teaching Hours -20)

Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs, Set Identities.
Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Order of relations.
Functions: Definition, Classification of functions, Operations on functions.
Algebraic Structures: Definition, Groups, Subgroups and order, Semigroups, Monoids, Cyclic Groups, Cosets.
Combinatorics: Sum and product rule, Principle of Inclusion Exclusion, Permutations and Combination, Pigeon Hole Principle, Linear Recurrence relations.

Methods of Proof: Proof by Contrapositive, Proofs by Cases, Proofs by Contradiction, The Principle of Mathematical Induction.
Propositional Logic: Proposition, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Normal forms, Theory of Inference, Natural Deduction.
Predicate Logic: First order predicate, well-formed formula of predicate, quantifiers, Inference theory of predicate logic.

Section - II(Weightage – 50%, Minimum Teaching Hours -20)

Binary Systems: Digital Computers and Digital Systems, Number Systems, Representation of Signed Numbers and Binary Arithmetic in Computers,Binary Codes.

Logic gates: Truth table, properties and symbolic representation of NOT, AND, OR,

NOR, NAND, EX-OR, EX-NOR gates. NOR and NAND gates as a universal gate.

Boolean algebra: Axioms and Laws of Boolean Algebra, Duality, Canonical and Standard Forms, Minimization of switching functions: 2, 3, 4 variable Karnaugh map.

Combinational Logic - Adders, Subtractors (Half and Full), Decoders, Encoders, Multiplexers, Demultiplexers, code converter.

Sequential Logic - Flip-Flop, Concept of clock, Counters- Ring Counter, Johnson Counter.

Text Books:

1. Bernard Kolman, Robert Busby, Sharon C. Ross, Discrete Mathematical Structures, Pearson
2. Jean Paul Trembley, R Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hill
3. Digital Design: M. M. Mano, Prentice Hall.
4. Fundamentals of Digital Circuits: A. Anand Kumar, PHI.

Reference Books:

1. Liu and Mohapatra, “Elements of Discrete Mathematics”, McGraw Hill
2. Discrete Mathematics and its Applications - Kenneth H. Rosen 7th Edition -Tata McGraw Hill Publishers
3. Modern Digital Electronics: R.P.Jain.