NOTIFICATION

No. 37/2021 Date : 01/04/2021

Subject : Implementation of new syllabi of Semester I & II of Master in Computer Application (M.C.A.) (Two Year… Semester Pattern) (Choice Based Credit Grade System) in the Faculty of Science & Technology from the session 2020-2021 and onwards..

It is notified for general information of all concerned that the auhorities of the University have accepted to implement the new syllabus of Semester I & II of Master in Computer Application (M.C.A.) (Two Year… Semester Pattern) (Choice Based Credit Grade System) in the Faculty of Science & Technology from the session 2020-2021 and onwards as per **Appendix-A :**

Sd/-
(Dr.H.R.Deshmukh)
I/c Registrar
Sant Gadge Baba Amravati University

Appendix-A

SYLLABUS OF MASTER IN COMPUTER APPLICATION

(M.C.A.) (TWO YEAR… SEMESTER PATTERN) (CHOICE BASED CREDIT GRADE SYSTEM

SYLLABUS OF MASTER IN COMPUTER APPLICATION (Two Years C.B.C.S.)
SEMESTER I

Course Code	**MCA20101**
Course Name	**Advance Computer Architecture**
Credits	**03**
Course Outcomes:	On completion of the course, the students will be able to
	1. Explain fundamentals of parallel processing and pipeline processing
	2. Analyze and classify different pipelined processors
	3. Describe architectural features of advanced processors.
	4. Demonstrate concepts of parallelism in hardware/software.

Units	Contents	Total Hrs
I	Amdahl's law, Von Neumann machine architecture, Program development tools, Operating systems. Design of ALU, Bit slice processors. Concept of instruction formats and instruction set, instruction set types, types of operands and operations, Generation of memory addresses and addressing modes, Subroutine nesting using stacks to implement subroutine calls and calling conventions, Processor organizations, Register organization, Stack based organizations, Encoding of machine instructions, General features of RISC and CISC instruction sets, modern processors convergence of RISK with CISC, Processor microarchitecture-I - Fundamental concepts for data path implementation, Processor microarchitecture-II - Data path implementation, microprogrammed execution, recent innovations in execution unit design.	10
II	Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors. Conventional and EPIC architecture. Evolution of parallel processors, future trends and there architecture. Overview of Parallel Processing and Pipelining Processing Necessity of high performance, Constraints of conventional architecture, Parallelism in uniprocessor system, Evolution of parallel processors, future trends, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture. Principles of scalable performance: Performance Metrics and Measures, Speedup Performance Laws.	10

III	- Instruction pipeline, instruction pipeline hazards, overcoming hazards using a pipeline with forwarding paths, instruction set design influence on pipelining, example of pipelined CISC processor, example of pipelined RISC processor, VLIW (Very Long Instruction Word) processors, Vector processors, Multithreaded processors, Compilation techniques support to instruction level parallelism, Extracting parallelism.	10
IV	Virtual memory organization, mapping functions for translating the program pages in virtual to physical addresses space, partitioning, segmentation (superpages or page blocks) partitioning of virtual address space in to segment and page address, demand paging and swapping, cache and virtual swapping, cache and virtual memory, inverted page tables concept, protection between programs running on the same system, accessing I/O devices, programmed I/O, interrupts, direct memory access DMA, bus arbitration, interface circuits, I/O interfaces, I/O processors, external I/O devices.	10
V	Multiprocessor Architectures – Objectives, Introduction, Multiprocessor Architectures, Performance Charateristics of Multiprocessors, Multicore Architectures – Single Chip Multiprocessors, Flynn Classification, Interconnection Structures, Interconnection Networks – Dynamic and Static Multiprocessor System Interconnects, Banyan and Delta Networks (Banyan Multistage Networks), Interprocess Arbitration, Interprocess Communication, Memory Organization in Multiprocessors, Shared-memory Multiprocessor Systems, Synchronization – Memory Organization, Contention and Arbitration, Cache Coherence and Synchronization Mechanisms, Cache Coherence, Message Passing Systems, Issues in Cluster Computing	10
VI	Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions. Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming. Implementation issues of a multithreaded program.	10

Textbook :

1. Computer Architecture and Organization by Nicholus Carter &Rajkamal, Schaum Series Pub.
2. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hill International Edition

Reference Books :

1. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill
2. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.
3. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.
4. Kai Hwang, Scalable Parallel Computing.
5. Harrold Stone, High performance computer Architecture.
6. Richard Y. Kain, Advanced Computer Architecture
7. http://www.intel.com/products/processor (for Intel Itanium Processor)

Course Code	**MCA20102**
Course Name	**Data Structure & Algorithms**
Credits	**4**
Course Outcomes :	On completion of the course, the students will be able to
	1. Explain and identify fundamental concepts of data structures
	2. Understand various data searching and sorting methods with its complexity
	3. Demonstrate operations such as insertion, deletion, searching and traversing on data structures.
	4. Design algorithms for solving problems with the help of fundamental data structures

Units	Contents	Total Hrs
I	Data structures basics, Mathematical /algorithmic notations & functions, Complexity of algorithms, Sub-algorithms. String processing: storing strings, character data type,string operations, word processing, and pattern matching algorithms.	10
II	Linear arrays and their representation in memory, traversing linear arrays, inserting & deleting operations, Bubble sort, Linear search and Binary search algorithms. Multidimensional arrays, Pointer arrays. Record structures and their memory representation. Matrices and sparse matrices.	10
III	Linked lists and their representation in memory, traversing a linked list, searching a linked list.Memoryallocation & garbage collection.Insertion deletion operations on linked lists.Header linked lists, Two- way linked lists.	10
IV	Stacks and their array representation. Arithmetic expressions: Polish notation. Quick sort, application of stacks. Implementation of recursive procedures by stacks, Queues. Deques. Priority queues.	10
V	Trees, Binary trees & and their representation in memory,Traversing binary trees. Traversal algorithms using stacks, Header nodes : threads. Heap and heapsort.Path length & Huffman's algorithm.Generaltrees.	10
VI	Graph theory, sequential representations of graphs, Warshalls' algorithm, Linked representation, operations & traversing the graphs. Posets& Topological sorting. Insertion Sort, Selection Sort. Radix sort.	10

Textbook :	
	Seymour Lipschutz: "Data Structures with C", Schaum's Outline Series.

Reference Books :	
	1. Forouzan, Gilberg: Data Structures and Algorithms, CENGAGELearning. 2. ReemaThareja: Data Structures using C, Oxford University Press,2011. 3. Arpita Gopal: Magnifying Data structures, PHI (EEE),2010. 4. Ellis Horowitz, SartajSahni: Fundamentals of Data Structures,CBS Publications.

Course Code	**MCA20103**
Course Name	**Operating System**
Credits	**4**
Course Outcomes :	On completion of the course, the students will be able to
	1. Understand the concept of programs & processes along with the need of scheduling in operating systems
	2. Recognize different states of process and schedulers to apply scheduling algorithms to meet the scheduling objectives and acquire the knowledge of dealing with deadlocks.
	3. Apply memory management techniques & virtual memory concepts to avoid page faults and computing page replacement strategies
	4. Analyze and apply various protection and security mechanisms
	5. Compare different operating system

Units	Contents	Total Hrs
I	Introduction: OperatingSystem (OS) definition, OS Evolution, OS Components and Services. Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Interprocess Communication, Threads Overview, Multi-threading Models, Threading Issues, Java Threads.	10

II	CPU Scheduling Concepts, Scheduling Criteria and Algorithms. Process Synchronization: The Critical-Section Problem, Synchronization Hardware,Semaphores,Monitors. Deadlocks: Definition & Characterization, Deadlocks Prevention,Avoidance,Detection and Recovery from Deadlock.	10

III	Memory Management Background, Swapping, Contiguous Memory Allocation Schemes, Paging, Segmentation. Virtual Memory Management: Background, Demand Paging scheme, Process Creation, Page Replacement Policies, Allocation of Frames, Thrashing.	10
IV	File-System Interface; Directory structure, File-System Mounting, File Sharing & Protection. File-System Structure, File-System Implementation. Directory Implementation, Allocation Methods, Free- Space Management. File Recovery	10
V	I/O Systems: Overview, I/O Hardware, Application I/O Interface, and Kernel I/O Subsystem. Transforming I/O to Hardware Operations. Disk Scheduling, Disk Management,Swap – Space Management, RAID Structure.	10
VI	File protection & security: Goals of Protection, Principles of Protection, Revocation of Access Rights, Security Problem, Program Threats, Classifications, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems	10

Textbook :	
	Text Books :AviSilberschatz , P.B.Galvin, G. Gagne : “Operating System Concept” (Sixth Edition) John Wiley & Sons Publication.

Reference Books :	
	1. A .S.Tanenbaum,“Modern Operating Systems” Pearson education. 2. William Stallings,”Operating Systems”Prentice-Hall. 3. D.M.Dhamdhere ,“Operating Systems ”Tata McGraw-Hill. 4. M.Milankovic,“Operating Systems”McGraw-Hill. 5. AchuttGodbole, “Operating Systems” TataMcGraw-Hill.

Course Code	**MCA20104**
Course Name	**Data Communication & Networks**
Credits	**4**
Course Outcomes :	On completion of the course, the students will be able to
	1. Understand the concepts of Data Communication Systems and its components.
	2. Analyze various types of application layer protocols and its applicability in various domains.
	3. Generalize all transport layer protocols to understand end-to-end communication over a network.
	4. Demonstrate basic understanding of network layer protocols for data routing in network.
	5. Analyze functional & procedural means to transfer data between network entities.
	6. Acquire introductory knowledge about digital wireless communication systems.

Units	Contents	Total Hrs
I	**Data Communication:** Advantages, Basic Model of Communication System; **Data Transmission: Modes:** Simplex, Half Duplex,Full Duplex; **Methods/Types:** Parallel, Serial: Asynchronous,Synchronous, Isochronous; **Transmission Media:** Guided and Unguided; **Modulation:** Amplitude, Phase Shift, Frequency, PAM, PCM; **Multiplexing:** FDM, WDM, TDM; **Switching:** Circuit, Message, Packet; Delays in Packet Switched Network, Packet Loss; Telephone Networks, Network topologies, Types of Networks: LAN,MAN,WAN; **Network Reference Models:** ISO-OSI model, TCP/IP model	10
II	**Application Layer:** Services; **Processes:** Client-Server Model, Socket Interface; Services required by Application Layer; **HTTP:** Introduction, RTT, HTTP Handshake, types of HTTP Connections, HTTP Messages, Authentication and Cookies; **FTP:** Service Model, FTP Commands; Electronic Mail; SMTP; **DNS:** Services and working	10
III	**Transport Layer:** Services; Multiplexing and Demultiplexing Applications; Connectionless Transport – UDP; Principles of Reliable of Data Transfer (RDT); Stop-and-wait and Pipelined protocols; GBN protocol; Connection-Oriented Transport: TCP; Flow Control; Principlesof Congestion Control; Approaches towards Congestion Control; TCP Congestion Control	10
IV	**Network Layer:** Services; Network Service Model: Datagram, Virtual Circuit; Routing Principles; Routing Algorithms: Classifications; Hierarchical Routing; Internet Protocol: IP Addressing, IPv4: Classes and Packet format, DHCP; ICMP; Routing in the Internet: RIP, OSPF, BGP; Router; IPv6; Multicast Routing.	10
V	**Data Link Layer:** Services; Error Detection and Correction; Multiple Access Protocols in LANs: ALOHA, CSMA/CD; LAN Addresses and ARP; Ethernet; Hubs, Bridges andSwitches; Point-to-PointProtocol.	10
VI	**Wireless Communication:** Advantages, Applications; **Signals:** Characteristics, Propagation, Fading, Multipath Propagation; Spread Spectrum; Frequency Reuse Principle, Cellular System; Medium Access Control: SDMA, FDMA, TDMA, CDMA; Wireless LAN: IEEE 802.11; Bluetooth.	10

Textbook :	
	Data Communication and Networking – Behrouz A. Forouzan (McGrawHill)

Reference Books :	
	1. Computer Networking –James F. Kurose and Keith W. Ross(Pearson) 2. Data Communication and Networking – Behrouz A. Forouzan (McGrawHill) 3. Computer Network & Internet - Douglas E.Comer(Pearson) 4. Data and Computer Communication – WilliamStallings(Pearson) 5. Computer Networks - Andrew S.Tanenbaum(PHI) 6. Mobile Communications - JochenSchiller(Addison-Wesley)

Course Code	**MCA20105**
Course Name	**Mathematics & Statistical Techniques**
Credits	**4**
Course Outcomes :	On completion of the course, the students will be able to
	1. Understand the foundations of mathematics.
	2. Apply mathematical ideas to model real-world problems.
	3. Analyze data using Statistical Methods
	4. Identify the type of statistical situation and solve statistical problems

Units	Contents	Total Hrs
I	**Linear algebra:** **Algebraic view** - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo- inverse) Norms and spaces, eigenvalues andeigenvectors. **Geometric view** - vectors, distance, projections, eigenvalue decomposition	10
II	**Permutations & Combinations:** Factorial Notation, Fundamental Theorem, Definition of Permutations. Definition of Combinations, Simple examples of commercial application of permutations andcombinations. **Elementary ProbabilityTheory:** Concept of random experiment/trial and possible outcomes; Sample Space and Discrete Sample Space; Events their types, Algebra of Events, Mutually Exclusive and Exhaustive Events, Complimentary events. Classical definition of Probability, Addition theorem (without proof), conditional probability. Simple examples	10
III	**Functions and Derivatives:** **Concept of real functions:** constant function, linear function, x^n, e^x, a^x, log x. Demand, Supply, Total Revenue, Average Revenue, Total cost, Average cost and Profit function. Equilibrium Point, Break-evenpoint. **Derivatives of functions:** Constant function, x^n, e^x, a^x, log x. **Rules of derivatives:** Scalar multiplication, sum, difference, product, quotient (Statements only), simple problems.	10
IV	M**easures of central Tendency:** Arithmetic mean, Weighted mean, Median, Mode, Quartiles, Deciles and Percentiles. Locating median and quartiles through Ogives. Histogram to locate mode and mean. Numerical problems on central tendency **Measures ofdispersion**: Range, Quartile deviation, Mean deviation from mean, Standard deviation and their coefficients. Numerical problems on Range, quartile deviation, mean deviation.	10
V	**Variance:** Definition for grouped & ungrouped data, co-efficient of Dispersion, co-efficient of variation. Numerical problems on measures of dispersion. **Bivariate Linear Correlation:** Scatter Diagram, Computation of Karl Pearson's Coefficient of Correlation, and Computation of Spearman's Rank Correlation Coefficient (case of repeated ranks upto 2 repetitionsonly) Numerical problems on Bivariate Linear Correlation.	10
VI	**Bivariate Linear Regression:** Finding Regression lines by method of least squares. Properties of Regression Coefficients- i) r = √byxbxyii) ($\bar{x}$, $\bar{y}$) is the point of intersection of two regression lines. Numerical problems on BivariateLinear Regression. **Time series :**Definition of Time series & uses of time series. Components of Time series, Additive & multiplicative models. Methods of estimating trend by moving average method graphical method, semi-average method & by least square methods. Numerical problems on Time Series	10

Textbook :	
1.	Linear Algebra and its Applications by David C Lay, Pearson
2.	Business Mathematics by Kashyap Trivedi, Chirag Trivedi, Pearson
3.	Fundamental of Mathematical Statistics by S.C. Gupta & V. K. Kapoor.
4.	Applied Statistics And Probability For Engineers by Uglas Montgomery, Wiley.

Reference Books :	
1.	Higher Engineering Mathematics by B.S. Grewal.
2.	Statistical Methods by S.P. Gupta Fundamentals of Statistics by Goon, Gupta, Dasgupta.
3.	Modern Elementary Statistics by John E. Freund Emeritus, Gary A. Simon.
4.	Fundamentals of Mathematical Statistics by S.C. Gupta V. K. Kapoor, S. Chand & Sons.

Course Code	**MCA20107**
Course Name	**Lab1- Object Oriented Programming in JAVA**
Credits	**3**
Course Outcomes :	**Development of skills for implementing core concepts of Java.**

TEXT BOOK:	
	Herbert Schildt: Java The Complete Reference, Ninth EditionJava 2 (5/e) (Tata- McGraw Hill)

Units	Contents	Total Hrs
I	Java Basics, implementing concepts of OOPs using Java, Data types and Variables, Operators, Control structures, classes, declaring objects, access control, Inheritance, Polymorphism, Abstract classes, Interfaces, Packages. Arrays: Basics, One - & Multi- dimensional.	10
II	Exception handling: Built-in,checked and unchecked Exceptions, Using try and catch, throw, throws, finally clauses, multiple catch clauses, Multithreaded programming: Java thread model, creating threads, thread priorities & synchronization.	8
III	Java I/O: Stream classes, Byte Stream & Character Streams: Input stream, Output stream, FileInputstream, FileOutputstream Generic Programming:generic classes, generic methods	8
IV	Java Collections Framework: Introduction, Collections Framework hierarchy, List, Set, Map Interface and their implementing classes and methods, Iterator/ListIterator, Utility classes. Introduction To Swing: Hierarchy Of Java Swing Classes,Swing GUI Components, Related Packages, Swing Control Classes & Methods, Handling Events in Swing GUI	8

REFFERENCES BOOKS:	
	1. Core Java, Volume I — Fundamentals (9th Edition), Cay S.Horstmann, Gary Cornell,Prentice Hall
	2. Effective Java,Second Edition, Joshua Bloch, Addison-Wesley Educational Publishers Inc
	3. S. Chavan “Programming in Java” Shroff Pub.
	4. Java Generics and Collections, by Maurice Naftalin, Philip Wadler, O'Reilly Media, Inc.

	Suggested Practical List
	The sample list of programs is given below. This list can be used as a guideline but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes. 1. Write, debug and execute simple JAVA programs that demonstrate programming logic by making use of various control statements . 2. Programs to Demonstrate the understanding and application of classes and objects to real world problems 3. Programs that Demonstrate the understanding and application of interfaces. 4. Programs to Demonstrate the understanding of built in and user defined packges 5. Programs that Demonstrate the understanding and application of Exception handling using real world problems 6. Programs that Demonstrate the understanding and application of Multi-threading using Thread Class/Runnable Interface 7. Programs that Demonstrate the understanding and application of synchronization using multi-threading. 8. Programs that Demonstrate use of streams for File handling, 9. Programs to Demonstrate the use and benefits of generic classes, generic methods, 10. Programs that Demonstrate the use of few Collection classes with real world problems 11. Programs that Demonstrate the use of Swing Control Classes & Methods in GUI application development 12. Programs that Demonstrate the use of Delegation Event model .

Course Code	**MCA20108**
Course Name	**Lab2- Data Structure and Algorithms**
Credits	**1**
Course Outcomes :	On completion of the course, the students will be able to get
	Skill of applyingdifferent data structures for solvingproblem

Sr.No.	**Contents**	**Total Hrs**
	Thesamplelistofprogramisgivenbelow.Thislistcanbeusedasguidelineforproblem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes. 1. Write a program to implement SearchingAlgorithm i) Linear Search ii) BinarySearch 2. Write a program to implement SortingAlgorithm i) Bubble Sort ii) Selection Sort iii) InsertionSort 3. Write a program toperform i) Addition of Matrix ii) Multiplication of Matrix 4. Write a program to implement Linear Linked List (Insertion & Searchingoperation) 5. Write a program to implement Stack (PUSH, POP, DISPLAYOperations) 6. Write a program to implement Queue (Insertion, Deletion) 7. Write a program to implement Tree Traversal Algorithm (Inorder, Preorder,Postorder) 8. Write a program to implement Graph using AdjacencyMatrix.	30

Course Code	**MCA20109**
Course Name	**Lab3- Operating System**
Credits	**1**
Course Outcome	On completion of the course, the students will be able to
	1. Able to understand the Basics of Linux working .
	2. Able to perform the shell scripting programs .
	3. Able to create file handling utilities by using Linux shell environment.

	Contents	**Total Hrs**
	Linux : Startup, user Accounts, linux logging in logging out, Command line, simple commands, file system and related commands, shell, pipes and redirection, sh, tcsh, networking with Linux, file system administration. The sample list of program is given below. 1. Write a shell script program to display list of user currently logged in. 2. Write a shell script program to display "HELLO WORLD". 3. Shell script program to check whether given file is a directory or not. 4. Shell script program to count number of files in a Directory. 5. Create directory, write contents on that and Copy to a suitable location in your home directory. 6. Use a pipeline and command substitution to set the length of a line in file to a variable. 7. Write a grep/egrep script to find the number of words character, words and lines in a file. 8. Write a shell script for firewall configuration using iptables. 9. Study and write a shell script for samba server for file sharing 10. Write a shell script for editing grub menu in ubuntulinux 11. To simulate First Come First Serve & Shortest Job First process scheduling algorithm 12. To simulate Shortest Job First process scheduling algorithm 13. To simulate Preemptive Shortest Job First process scheduling algorithm 14. To implement Round Robin Process scheduling Algorithm 15. To implement Priority Based Process scheduling Algorithm 16. To simulate paging technique of memory management. 17. To simulate segmentation technique of memory management. 18. To implement the FIFO page replacement policy 19. To implement FCFS Disk Scheduling algorithm 20. To implement SCAN Disk Scheduling algorithm	10

Course Code	**MCA20110**
Course Name	**Lab4- Mathematics & Statistical Techniques**
Credits	**1**
Course Outcomes :	**Students will be able to solve the problems of Mathematics and Statistical Techniques using programming logic.**

	Contents	Total Hrs
	The following list can be used as guidelines for creating problem statements but the scope of the laboratory should not be limited to this list. Aim of the list to inform about minimum expected outcomes. Use C/C++/Java language to develop the Programs OR implement the same Mathematical and Statistical Calculations using Data Analytic tools SAS/ R ProgrammingLanguages. 1. Problem on Linearalgebra. 2. Problem on ProbabilityTheory. 3. Problem on Permutations &Combinations. 4. Problem onDerivatives. 5. Problem on graphical & diagrammaticrepresentation. 6. Problem on measures of Central Tendency ordisperssion. 7. Problem on moments, measures of Skewness andKurtosis. 8. Problem on computation of correlation co-efficient for bivariatedata. 9. Problem on Fitting of linear & nonlinear regression lines or computation of rank correlationco-efficient. 10. Problems on timeseries	30

SEMESTER II

Course Code	**MCA20201**
Course Name	**Client Server Computing**
Credits	**4**
Course Outcomes:	On completion of this course, student will be able to:
	1. Acquire knowledge of Server-Side programing by implementing Servlet and JSP.
	2. Acquire the knowledge of J2EE architecture, MVC Architecture.
	3. Distinguish Web Server, Web Container and Application Server
	4. Understand and write the deployment descriptor and enterprise application deployment.
	5. Design and implement components like: Session, Java Beans, JSTL, Tag Extensions.
	6. Gain knowledge of frameworks such as Struts Architecture and Hibernate Architecture
	7. Distinguish JDBC and Hibernate. Design and Develop various application by Integrating any of Servlets, JSPs, Database, Struts,hibernateafteranalyzing requirements and evaluating existing system.
	Pre-requisite of course: Knowledge of Core Java

Units	Contents	Total Hrs
I	**Java Database Connectivity:** JDBC Concepts, JDBC API, Driver Manager, Connection,Statement,PreparedStatement, CallableStatementand ResultSet classeswith relevant methods, Types of ResultSets.Handling queries, inserts, deletes and updates to database.Displaying the query results. Stored Procedures.	10
II	**Servlets in Java:** Servlet structure & lifecycle. Servlet A P I basics, various classes & interfaces. Servlet requirements, writing. Running of Servlets, Concepts ofCookies, Servlets & cookies. Session managementwith ServletAPI. Server side includes and request forwarding.Servlet chaining. Jdbc Servlets	10

III	**Introduction to JSP:** Simple JSP concepts, Environment set up for JSP, Life cycle of a JSP, Elements involved with development of JSP: Scripting Elements,Directives, Implicit Objects. Java beans: Concept of Beans, Properties, Bean instances & serialization, Bean Scopes, Writing Beans, Deploying a bean, JDBC bean. Jsp Actions, Using a bean in a JSP. Java StandardTagLibrary(JSTL/AdvancedJSP):Typesoftags,coreandSQLtags in detail.	10
IV	**Introduction to Javascript:**What is Javascript?, Values, Types and Operators, Expressions and statements, control flow statements, Functions, Arrow Functions, HTTP and Forms, Event handling, data structures, objects	10
V	**Introduction to Hibernate:** Why Hibernate?, Architecture of Hibernate, Hibernate Query language,Hibernate O/R Mapping,Setting up the Development Environment ,Creating Database TableWriting-> Hibernate Configuration File, JavaBean, and Hibernate Mapping File, Developing Controller Component,Developing view Component.	10
VI	**Introduction to Struts:**Explaining MVC 2 Design Pattern for Struts 2 ,The Need for Struts 2,Processing Request in Struts 2, Struts 2 Architecture,,Actions in Struts 2, Interceptors, OGNL Support,PerformingValidation in Struts 2, Internationalizing Struts 2 Applications, Implementing Plugins in Struts 2,Integrating Struts 2 with Hibernate	10

Textbook :	
	1 Java Server Programming Java EE 7 (J2EE 1.7) Black Book(2014),. KogentLearning SolutionsInc. Core Servlets and Java Server Pages: Core Technologies by Marty Hall and Larry Brown,Java 2 Platform Enterprise Edition series, PrenticeHall

Reference Books :	
	1) 1 Java EE cookbook, Elder Moraes,Packt Publishing Limited (9 April 2018) **Reference URLs**: www.docs.oracle.com www.tutorialspoint.com www.javatpoint.com

Course Code	**MCA20202**
Course Name	**Artificial Intelligence & Applications**
Credits	**4**
Course Outcomes:	On completion of the course, the students will be able to
	1. Adopt an approach in view of Problem solving with AI.
	2. Identify and apply suitable 'Intelligent Agents for various AIapplications.
	3. Identify knowledge statement and represent it.
	4. Empower students for path planning of a robotic system.
	5. To develop and survey embedded systems applications usingmachine learning

Units	Contents	Total Hrs
I	**Introduction to Artificial Intelligence:** What is an AI,Introduction of Intelligent systems, The Foundations of Artificial Intelligence, Applications of A.I. Problem solving with AI, AImodels, **Intelligent Agents:** Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programswork.	10
II	**Knowledge, Reasoning, and Planning**: Knowledge based agents,The Wumpus World, Logic, propositional logic, Representation of knowledge using rules, Predicate logic, Unication and lifting, inference in FOL,Forward Chaining, Backward Chaining, Resolution, Logic Programming. Planning problem, Planning, Algorithms for Planning as State-Space Search, Planning Graphs, simple planning agent, planning languages, blocks world problem, goal stackplanning.	10
III	**Logical Agents:** Knowledge representation structures: Frames, semantic net, Scripts, Logic: Prepositional Logic, Prepositional Theorem Proving, Inference and proofs, Proof by resolution, Conjunctive normal form, Horn clauses and definite clauses, Syntax and Semantics of First-Order Logic, Symbols and interpretations, Knowledge Engineering in First-Order Logic, Unification, Resolution, and Introduction to logic programming (PROLOG).	10
IV	**Problem Decomposition and Planning:** Problem Decomposition: Goal Trees, Rule Based Systems, Rule Based Expert Systems. Planning: STRIPS, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning, A Unified Framework for Planning. Constraint Satisfaction : N-Queens,Constraint Propagation, Scene Labeling, Higher order and Directional Consistencies, Backtracking and Look ahead Strategies.	10
V	**Natural Language Processing and Robotics:** **Natural Language Processing:** Language Models, Steps in NLP, Syntactic Analysis (Parsing), Semantic interpretation, Discourse and pragmatic Processing, Text Classification. Discourse and pragmatic Processing, Implementation aspects of Syntactic Analysis(Parsing). **Robotics:** Fundamentals, path Planning for Point Robot, Sensing and mapping for Point Robot, Mobile Robot Hardware, Non Visual Sensors like: Contact Sensors, Inertial Sensors, Infrared Sensors, Sonar, Radar, laser Rangefinders, Biological Sensing.	10
VI	**Machine Learning:** Machine Learning Concepts, methods and models, Supervised Learning, unsupervised and semi-supervised, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Artificial Neural Networks, Non-parametric Models, Support Vector Machines.	10

Textbook:	
	1. Artificial Intelligence: A Modern Approach by Peter andNorvig. 2. Stuart Russell and Peter Norvig (1995), Artificial Intelligence: A Modern Approach," Third edition,Pearson.

Reference Books:	
	1. Shai Shalev-Shwartz, Shai Ben-David: Understanding Machine Learning from Theory to algorithms, Cambridge UniversityPress 2. Michael Jenkin, Gregory, “Computational Principals of Mobile Robotics”, Cambridge UniversityPress. 3. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair,TMH 4. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India). 5. Artificial Intelligence and Intelligent Systems by Padhy, Oxford UniversityPress.

Course Code	**MCA20203**
Course Name	**Advance Data Base Management Systems**
Credits	**4**
Course Outcomes:	On completion of the course, the students will be able to
	1. Describe the fundamental elements of relational database management systems
	2. Apply the SQL queries on database for intended output.
	3. Analyze the database and remove the redundancy.
	4. Explain basic database storage structures and access techniques
	5. Ensure accuracy and integrity using transaction properties.
	6. Apply the concepts of database for data analytics, big data, parallel and distributed databases.

Units	Contents	Total Hrs
I	Database System Applications, Purpose of Database System, View of Data, Database Languages, Database Design, Database Engine, Database and Application Architecture, Database Users and Administrators, Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, The Relational Algebra.	10
II	Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database, Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Index Definition in SQL, Authorization, Accessing SQL from a Programming Language, Functions and Procedures, Triggers	10
III	Database Design Using the E-R Model: Overview of the Design Process, The Entity-Relationship Model, Complex Attributes, Mapping Cardinalities, Primary Key, Removing Redundant Attributes in Entity Sets, Reducing E-R Diagrams to Relational Schemas, Extended E-R Features, Entity-Relationship Design Issues RelationalDatabaseDesign:Featuresof GoodRelationalDesigns, Decomposition Using Functional Dependencies, Normal Forms, Functional-DependencyTheory,AlgorithmsforDecompositionUsingFunctionalDependencies, Decomposition Using Multivalued Dependencies,More Normal forms	10
IV	Physical Storage Systems: Overview of Physical Storage Media, Storage Interfaces, Magnetic Disks, Flash Memory, RAID, Disk-Block Access Data Storage Structures: Database Storage Architecture, File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer, Column-Oriented Storage, Storage Organization in Main-Memory Databases Indexing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B+-Tree Extensions, Hash Indices, Multiple-Key Access, Creation of Indices, Write-Optimized Index Structures, Bitmap Indices	10
V	Transactions: Transaction Concept, Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Concurrency Control: Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Insert Operations, Delete Operations, and Predicate Reads, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes, Snapshot Isolation Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with Loss of Non-Volatile Storage, High Availability Using Remote Backup Systems, Early Lock Release and Logical Undo Operations, ARIES	10

VI	Database-System Architectures: Overview, Centralized Database Systems, Server System Architectures, Parallel Systems, Distributed Systems, Transaction Processing in Parallel and Distributed Systems, Cloud-Based Services Parallel and Distributed Storage: Overview, Data Partitioning, Dealing with Skew in Partitioning, Replication, Parallel Indexing, Distributed File Systems, Parallel Key-Value Stores Big Data & Analytics: Motivation, Big Data Storage Systems, Overview of Analytics, Data Warehousing, Online Analytical Processing, Data Mining	10

Textbook :	
	Silberschatz, Korth, Sudarshan : Database System Concepts , McGraw Hill, 7th Edition

Reference Books :	
	1. Raghu Ramkrishnan :Database System(TMH) 2. C.J.Date : Database System, 7th ed,.(PearsonEducation) 3. Connolly &Begg, : Database System, Low Price Ed. (PearsonEducation) 4. Navathe&Elmarsi , Fundamentals of Database Systems. 4/e (PearsonEducation).

Course Code	**MCA20204**
Course Name	**Software Engineering**
Credits	**4**
Course Outcomes :	On completion of the course, the students will be able to
	1. Recognize evolving role of software project management.
	2. Understand and estimate cost for software project.
	3. Identify &analyze aspect in s/w to manage time, process & resources effectively with quality concept.
	4. Estimate software productivity using metrics and indicator & identify important issues for planning a project
	5. Judge different testing techniques used to test software.
	6. Evaluate the role of user and software teams.

Units	Contents	Total Hrs
I	**Evolving role of Software**. Software crises & myths. Software engineering. Software process & process models : Linear sequential, prototyping, RAD, Evolutionary Product & Process. Project management concepts : People, Product, Process, Project. W5HH principle, critical practice.	10
II	**Measures, Metrics & Indicators**. Metrics in process & project domains-software measurement, Metrics for software quality, small organization. Software projects Planning : Scope, resources, estimation, decomposition technique, Tools. Software risks : identification, risk projection, refinement & RMMM plan.	10
III	**Project Scheduling :**Concepts. Peoples Efforts. Task set, Task network. Scheduling. EV analysis, Project Plan. Software quality concepts. SQ Assurance, Software reviews, technical reviews, software reliability, ISO 900 L, SQA Plan. SCM process. Version control. SCM standard.	10
IV	**System Engineering:** Hierarchy, Business Process & Product engineering : Overviews. Requirement engineering, System modeling. Requirement analysis. Analysis principles. Software prototyping. Specification. Design Process. Design Principles & Concepts. Effective modular design. Design model &documentation.	10
V	**Software architecture :**Data Design, Architectural styles, Requirement mapping. Transform & Transaction mappings. User- interface design : Golden Rule. UTD, Task analysis &modlling, ID activities, Tools, design evaluation. Component level design : Structure programming, Comparison of design notation	10
VI	**Software Testing Fundamentals** ; test case design, Whitebox testing. Basis path, control structure-, Blackbox-Testing, & for specialized environments. Strategic approach to S/W testing. Unit testing, integration testing, validation testing, system testing. Debugging. Technical metrics for software.	10

Textbook :	
	Pressman Roger. S. : Software Engineering, A Practitioner's Approach TMH.

Reference Books :	
	1. Somerville : Software Engineering (Addison-Wesley)(5/e) 2. Fairly R. : Software Engineering (McGrawHill) 3. Davis A. : Principles of Software Development (McGrawHill) 4. Shooman, M.L. : Software Engineering(McGraw-Hill)

Course Code	**MCA20205**
Course Name	**ELECTIVE 1 – Computer Graphics**
Credits	**4**
Course Outcomes:	On completion of the course, the students will be able to
	1. Understand the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two dimensions.
	2. Demonstrate various algorithms for scan conversion and filling of basic objects and their comparative analysis
	3. Interpret the mathematical foundation of the concepts of computer graphics.
	4. Apply geometric transformations, viewing and clipping on graphical objects
	5. Explore solid model representation techniques and projections.
	6. Understand visible surface detection techniques and illumination models.

Units	**Contents**	**Total Hrs**
I	An overview of Computer Graphics and Graphics System : Video display devices, Raster-Scan systems, Random-Scan systems, Graphics monitors and workstations, input devices, hard copy devices, Graphics software..	10
II	Output primitives : Point and Lines, Line drawing algorithms, loading the frame buffer, line function, circle and ellipse generating algorithms, curves, parallel curves algorithms, Pixel addressing, filled-area primitives , functions, Cell array, character generation.	10
III	Attributes of output primitives : Line and curve attributes, color and grey scale levels, area fill attributes. Character attributes, bundled attributes, antialiasing.	10
IV	2-D geometric transformations : basic transformations, matrix representations, composite transformations, other transformations, transformations between coordinate systems, affine transformations, transformation functions,Raster methods for transformations. Two-Dimensional viewing : viewing coordinates, Window-toviewport coordinate transformation, viewing functions, clipping : point, line, polygon, curve, text, exterior.	10
V	Structures and hierarchical modelling : concepts, editing structures, basic modelling concepts, hierarchical modelling, GUI and interactive input methods : the user dialogue, input of graphical data, functions, initial values for input device parameters, interactive picture - construction techniques, virtual reality environments	10
VI	Three dimensional concepts : display methods, graphics, Bezier curves and surfaces, B-spline curves and surfaces, Beta-splines, three dimensional geometric and modelling transformations : translation, rotation, scaling, three dimensional viewing : viewing pipeline, viewing coordinates, projections.	10

Tex tbooks :	
	1) D. Hearn, M.P .Baker : Computer Graphics C Version, II edition (Pearson Education)
	2) Ze-Nian, Li, Mark S. Drew "Fundamentals of Multimedia" (Pearson Education)

Reference Books :	
	1.Rajan Parekh "Principles of Multimedia " (TataMcGraw-Hill) 2.F.S. Hill : Computer Graphics Using Open GL, II edition (PearsonEducation) 3.W. M. Newman & R.F. Sproul : Principles of Interactive Computer Graphics, 2/e, (McGrawHill) 4.F .S. Hill: Computer Graphics(Macmillan) 5.Harington : Computer Graphics (McGrawHill)

Course Code	**MCA20205**
Course Name	**ELECTIVE 1 – Data Security**
Credits	**4**
Course Outcomes:	On completion of the course, the students will be able to
	1. Explain different security attacks.
	2. Analyze different security issues related to operating system.
	3. Apply and understand security aspect with respect to database.
	4. Solve network threats including detection of intrusion
	5. Analyze and apply security protocols to improve the administration
	6. Summarize different issues related to computer society and attempt to solve it.

Units	**Contents**	**Total Hrs**
I	Introduction: Security- Attacks- Computer criminals- Method of defense Program Security: Secure programs- Non-malicious program errors- Viruses and other malicious code- Targeted malicious code- Controls against program threats	10
II	Operating System Security: Protected objects and methods of protection- Memory address protection- Control of access to general objects- File protection mechanism- Authentication: Authentication basics- Password- Challenge-response- Biometrics	10
III	Database Security: Security requirements- Reliability and integrity- Sensitive data- Interface, Multilevel database- Proposals for multilevel security	10
IV	Security in Networks: Threats in networks- Network security control- Firewalls- Intrusion detection systems- Secure e-mail- Networks and cryptography- Example protocols: PEMSSL- Ipsec.	10
V	Administrating Security: Security planning- Risk analysis- Organizational security policies, Physical security	10
VI	Legal and Ethical Issues in Computer Security - Protecting programs and data- Information and law- Rights of employees and employers- Software failures- Computer crime- PrivacyEthicalissuesin computer society- Case studies of ethics.	10

Textbook :	
	1. C. P. Pfleeger, and S. L. Pfleeger, Security in Computing, Pearson Education, 4th Edition, 2003 2. Matt Bishop, Computer Security: Art and Science, Pearson Education, 2003

Reference Books :	
	1. Stallings, Cryptography And Network Security: Principles and practice, 4th Edition, 2006 2. Kaufman, Perlman, Speciner, Network Security, Prentice Hall, 2nd Edition, 2003 3. Eric Maiwald, Network Security : A Beginner's Guide, TMH, 1999 4. Macro Pistoia, Java Network Security, Pearson Education, 2nd Edition, 1999 5. Whitman, Mattord, Principles of information security, Thomson, 2nd Edition,2005

Course Code	**MCA20205**
Course Name	**ELECTIVE 1 – Optimization Techniques**
Credits	**4**
Course Outcomes :	On completion of the course, the students will be able to
	1. Understand the importance of optimization of industrial process management
	2. Apply basic concepts of mathematics to formulate an optimization problem
	3. Analyze and appreciate variety of performance measures for various optimization problems

Units	Contents	Total Hrs
I	**Introduction:** Classification of problems in OR, Mathematical Modeling, **Dynamic programming problems:** Investment problem, Equipment replacement, stage coach.	10
II	**Linear Programming Problems:** Introduction, concept of linear programming model, Graphical Method, Simplex Method, Big M Method, Two phase Method. Duality Concept.	10
III	**Transportation Problem:** Introduction to transportation problem, mathematical model, types of transportation problem, Optimization techniques for transportation problem, methods to find basic solution, Northwest Corner cell Method (NWCM), Least Cost cell Method (LCM), Vogel Approximation Method (VAM). Optimizing the basic feasible solution using U-V method.	10
IV	**Assignment Problem:** Introduction, zero-one programming model for Assignment problems, type of assignment problems. **Sequencing Problem:**NJobsandTwomachinesequencingProblems,Njoband three machine sequencing problem.	10
V	**Decision Theory:** Introduction to decision theory, minimax, minimin, maximin and maximax decision procedure, Bayes decision procedure. Regret function versus loss function. **Game Theory:** minimax, maximin, pure strategies, mixed strategies & expected payoff, solution of 2 × n games, m × 2 games. Brawn's Algorithm.	10
VI	**Network Analysis:** Critical Path Method (CPM), Critical Path, Time estimates as EST, EFT, LST and LFT and Floats. Project Evaluation and Review Technique (PERT) Network, ET, TE, TL, SE, critical path, probability of completing events on schedule.	10

Textbook :	
	1. B.E Gillelt , Introduction to Operation Research TMHEdition 2. R.Panneerselvam “Operation Research”PHI. 3. Operations Research, KantiSwarup, Gupta. P. K. & Man Mohan, S. Chand & Sons.

Reference Books :	
	1. J.K. Sharma “ Operation Research” (2/e)Macmillan. 2. Tata Hamdy, “ Operations Research- An Introduction” (5/e), PHI. 3. Taha H. A. “Operation Research”Macmillan. 4. Operations Research by PK Gupta and D.S Hira. S. ChandPublication

Course Code	**MCA20207**
Credits	**1**
Course Name	**Lab 5-Client Server Computing**
Course Outcomes :	On completion of the course, the students will be able to
	1. Implement Servlets and JSP to understand Server-Side programming.
	2. Design program to understand J2EE architecture, MVC Architecture.
	3. Distinguish Web Server, Web Container and Application Server, Serialization, Internationalization
	4. Design and implement components like: Session, Java Beans, JSTL, Tag Extension and Filter.
	5. Acquire knowledge of frameworks such as Struts and Hibernate
	6. Distinguish between JDBC and Hibernate.
	7. Design and Develop various application by Integrating any of Servlets, JSPs, Database, Spring, hibernate by analyzing requirements and evaluating existing system.

	Contents	**Total Hrs**
	The sample list of programs is given below. This list can be used as a guideline but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes. (Use of JDBC) WAPTO: 1. Create a database usingJAVA 2. Create a table, IN THEDATABASE 3. Insert records in thetable 4. Update records in database table based onconditions 5. Display the records in database table based onconditions 6. Write a servlet program in Java that calls a stored procedure and displays the values returned by the storedprocedure. 7. Create login form and perform state management using Cookies, 8. Perform state management usingHttpSession 9. Create a registration form with validations usingjavascript 10. Create database of student subject-wise data and retrieve all data usingJSP 11. Study and implementHibernate 12. Study and Implement MVC usingStruts **13.** A mini project using allconcepts	**30**

Course Code	**MCA20208**
Course Name	**Lab 6-Artificial Intelligence &Applications**
Credits	**1**
Course Outcomes:	Students will be able to develop basic Artificially Intelligent, Machine Learning and Robotics Applications

	Contents	Total Hrs
	The following list can be used as guidelines for creating problem statements but the scope of the laboratory should not be limited to this list. Aim of the list to inform about minimum expected outcomes. 1. At least 6 Practical based on LISPlanguage. 2. At least 6 Practical based on PROLOGLanguage. 3. Develop chat-bot application for enquirypurpose. 4. At least 1 practical based on implementation of Natural Language Processing using any of its open sourcetools. 5. Use any one open source robot simulation software and perform at least 1program to demonstrate simulate robots (like line follower robot). 6. Practical to demonstrate the use of Machine Learning concept to classifyanytype of information based on facts as "real" or "fake".	**30**

Course Code	**MCA20209**
Course Name	**Lab 7- Elective- 1 [Computer Graphics]**
Credits	**1**
Course Outcomes:	Students will be able to apply the core concepts of computer graphics to real world problems

	Contents	Total Hrs
	Minimum Twelve practicals/experiments based on the respective syllabus, covering each of the units. The following list of can be used as guidelines for basic understanding but the scope of the laboratory should not be limited to this list. Aimof the list to inform about minimum expectedoutcomes. 1. Study various in build graphics functions in Clibrary. 2. Write a program to draw a line using DDAalgorithm. 3. Write a program to draw a line using Bresenham‘salgorithm. 4. Write a program to draw a circle using midpointalgorithm. 5. Write a program to draw a circle using Bresenham‘salgorithm. 6. Write a program to draw a rectangle using line drawingalgorithm. 7. Write a program to perform 2D Transformation on aline. 8. Write a program to perform shear transformation on arectangle. 9. Write a program to rotate a circle (alternatively inside and outside) around the circumference of anothercircle. 10. Write a program to draw a car using in build graphics functionandtranslate it from bottom left corner to right bottom corner of screen. 11. Write a program to draw balloons using in build graphics function and translate it from bottom left corner to right top corner ofscreen. 12. Write a program to draw a cube using in build library function and perform 3Dtransformations 13. Translations in x, y, zdirections 14. Rotation by angle 450 about z axis, rotation by 600 about y-axis in succession. 15. Scaling in x-direction by a factor of 2, scaling in y- direction by a factor of3. 16. Write a program to implement line clipping (Cohen Sutherland algorithm). 17. Write a program for making Beziercurve. 18. Implement polygon clipping algorithm(atleast one) 19. Program to represent a 3D object using polygon surfaces and then perform 3D transformation. 20. Program to perform projection of a 3D object on Projection Plane : Parallel and Perspective.(*)	30

Course Code	**MCA20209**
Course Name	**Lab 7- Elective- 1 [Data Security]**
Credits	**1**
Course Outcomes:	On completion of the course, the students will be able to:
	Explain different security attacks.
	Analyze different security issues related to operating system.
	Apply and understand security aspect with respect to database.
	Solve network threats including detection of intrusion
	Analyze and apply security protocols to improve the administration
	Summarize different issues related to computer society and attempt to solve it.

	Contents	**Total Hrs**
	The following list of can be used as guidelines for basic understanding but the scope of the laboratory should not be limited to this list. Aimof the list to inform about minimum expectedoutcomes. 1. Study of fundamental of Network Security 2. Study of System threat attacks - Denial of Services. 3. Study of Sniffing and Spoofing attacks. 4. Study of Techniques uses for Web Based Password Capturing. 5. Study of Different attacks causes by Virus and Trojans. 6. Study of Anti-Intrusion Technique 7. Study of Symmetric Encryption Scheme 8. Implementation of any algorithm for data encryption 9. Implementation of any Asymmetric Encryption Scheme 10. Study of IP based Authentication.	30

Course Code	**MCA20209**
Course Name	**Lab 7- Elective- 1 [Optimization Techniques]**
Credits	**1**
Course Outcomes:	Students will be able to solve the problems of Optimization Techniques using programming logic.

	Contents	**Total Hrs**
	The following list can be used as guidelines for creating problem statements but the scope of the laboratory should not be limited to this list. Aim of the list to inform about minimum expected outcomes. Use C/C++/Java language to develop the program. 1. Write a program to demonstrate the North West cornermethod. 2. Write a program to demonstrate the Least CostMethod. 3. Write a program to demonstrate Vogal's ApproximationMethod. 4. Write a program for gametheory. 5. Write a program to find optimal period of replacement. (Equipment replacementproblem). 6. Write a program to solve investmentproblem. 7. Write a program to demonstrate the Critical PathMethod. 8. Write a program to prepare the loss-regrettable. 9. Write a program to calculate PERT. Write a program to prepare the payofftable.	30

Course Code	**MCA20210**
Course Name	**Lab 8- Mini Project**
Credits	**1**
	Mini project-the student's needs to complete at the end of the semester in order to strengthen the understanding of fundamentals through effective application of the course.

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