Department of Information, Communication & Technology

Ref.No.: TIAS/DICT/MCA/2023-24/003   **Dated: 11.07.2023**

Subject: **Master of Computer Applications Course Outcomes**

MCA-COs: Reference to Scheme of Examination & Syllabus of Master of Computer Applications w.e.f. Academic Year 2020-21 onwards of Guru Gobind Singh Indraprastha University, the Department of Information, Communication & Technology of the Tecnia Institute of Advanced Studies' for it's Postgraduate program in Computer Applications i.e. MCA has following course outcomes.

Course Outcomes (COs):
The course outcomes of various courses of MCA are as under:

Master of Computer Applications		
FIRST SEMESTER		
Paper/Subject	**Course Outcome**	
MCA-101: Discrete Structures	CO1	Choose appropriate discrete structures and combinatorics for basic problems.
	CO2	Interpret and illustrate the basics of Group Theory.
	CO3	Examine and infer mathematical logic and Boolean Algebra. Evaluate applications of number theory.
	CO4	Implement and create models for computer science problems by understanding the concepts of Graph Theory.
	CO5	
MCA-103: Computer Networks	CO1	Explain the functions of each layer in the OSI reference model and TCP/IP protocol suite while illustrating the process of data encoding and multiplexing.
	CO2	Utilize the fundamentals of data communication and Networking to identify the topologies and connecting devices of networks.
	CO3	Identify and discuss the underlying concepts of IPv4 & IPv6 protocols, along with their characteristics and functionality.
	CO4	Discover the appropriate MAC layer/data link layer protocols for the given network.
	CO5	Evaluate and implement routing algorithms and multicasting
	CO6	Adapt transport and application layer protocols along with concepts of mobility and security in networks

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MCA- 105 Operating Systems with Linux	CO	Explain the structure and functions of Operating Systems along with their components, types and working.
	1	Make use of appropriate Linux commands for Memory Management, File Management and Director Management.
	CO	Analyze the performance of different Scheduling algorithms along with the policies for Concurrency and Deadlock management.
	2	
	CO	
	3	

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	CO4	Elaborate the System Calls for Process management and File Management.
MCA- 107 Database Management Systems	CO1	Explain the various database components, models, DBMS architecture and Database Security
	CO2	Apply relational database theory to construct relational algebra expression, tuple and domain relation expression for SQLqueries.
	CO3	Construct advanced SQL queries on data and apply Procedural abilities through PL/SQL
	CO4	Examine the use of normalization and functional dependency for database design.
	CO5	Appraise the concepts of transaction, concurrency control and recovery in databases.
MCA- 109 Object Oriented Programming and JAVA	CO1	Illustrate the Object-Oriented paradigm, Java language constructs and JVM internal Architecture.
	CO2	Apply the concepts of exception handling, multithreading, and collection framework
	CO3	Analyze the use of event handling and JFC based toolkit in creating GUI-based computing solutions.
	CO4	Design database enabled client-server applications using JDBC,RMI, I/O operations, network programming relevant concepts.
	CO5	Elaborate the functional programming concepts introduced in Java 8 and beyond.
MCA-161 Computer Networks Lab.	CO1	Interpret suitable Network Simulator
	CO2	Apply network configuration skills to design specific network scenarios.
	CO3	Make use of various connecting devices and LAN connectivityto build networks.
	CO4	Simulate the working and analyze the performance of various communication protocols.
	CO5	Evaluate routing in the networks and compare different routing algorithms
	CO6	Work in teams to design networks for real life scenarios by applying the concepts of all the layered architecture.
MCA-163 Operating Systems with Linux Lab.	CO1	Build the Linux operating system and configure it.
	CO2	Discover Linux commands for working with Linux Environment
	CO3	Appraise the Process Management Algorithms, Process Management system calls, Inter Process Communication and CPU Scheduling algorithms
	CO4	Create programs using systems calls for memory management and File Management in C programming, also simulate Deadlock avoidance algorithm using C

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MCA-165 Database Management Systems Lab.	CO1	Translate an information model into a relational database schema and to implement the schema using RDBMS
	CO2	Apply advanced SQL features like views, indexes synonyms, etc.for database management
	CO3	Analyze PL/SQL structures like functions, procedures, cursors and triggers for database applications.
	CO5	Examine database administration concepts like GRANT, REVOKE

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		etc. through SQL commands
	CO6	Work in teams to design solutions for real world problems/case studies by creating efficient database schema
MCA-167 Object Oriented Programming and JAVA Lab.	CO1	Apply Object-Oriented and Java language constructs for creating Java programs.
	CO2	Make use of exception handling, multithreading, and collection framework for constructing effective solutions.
	CO3	Inspect the use of event handling and JFC based toolkit for GUI-based computing solutions.
	CO4	Design database enabled client-server applications using JDBC, RMI, I/O operations, network programming and relevant concepts.
	CO5	Elaborate .the functional programming concepts introduced in Java 8 and beyond.
MCA-169 Minor Project-I	CO1	Apply acquired knowledge within the chosen technology for solution of specific problem.
	CO2	Analyze the technical aspects of the chosen project through a systematic and comprehensive approach
	CO3	Deduct plausible solution for the technical aspects of the project.
	CO4	Work as an individual or in teams to develop the technicalproject.
	CO5	Create effective reports and documentation for all project related activities and solution
SECOND SEMESTER		
MCA- 102 Data and File Structures	CO1	Recall different type of data structures.
	CO2	Explain the fundamentals of an Abstract Data Type (ADT).
	CO3	Apply linear and nonlinear data structures to solve real time problems.
	CO4	Appraise and determine the correct data structure for any given real-world problem.
	CO5	Create innovative solutions for real world problems.
MCA-104 Object Oriented Software Engineering	CO1	Illustrate system modeling and architecture using UML.
	CO2	Apply suitable iterative process model
	CO3	Analyze requirements with use cases.
	CO4	Create domain models for analysis phase
	CO5	Create innovative solutions for real world problems.
	CO6	Design object solutions with patterns and architectural layers

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MCA-106 Python Programming	CO1	Demonstrate knowledge of programming constructs in python.
	CO2	Illustrate string handling methods user defined functions in python.
	CO3	Apply data structure primitives like lists,
	CO4	Inspect file handling and object- oriented programming techniques.
	CO5	Evaluate and visualize the data using appropriate pythonlibraries.
	CO6	Develop python applications with database connectivity operations.
MCA- 108	CO1	Apply EER concepts and normalization for specific cases.

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Advanced Database Management Systems	CO2	Make use of query processing, query optimization and advanced transaction processing for specific problem scenarios
	CO3	Analyze object-oriented paradigm in database design alongwith OODBMS and ORDBMS
	CO4	Evaluate various concurrency control mechanisms and recovery techniques for Distributed Databases
	CO5	Appraise advanced database models and their applications
	CO6	Design and create appropriate NoSQL Databases for specific applications
MCA-110 Data Warehousing and Data Mining	CO1	Relate to Data warehouse principles, components and architectures.
	CO2	Demonstrate the necessity of data pre-processing for mining applications.
	CO3	Apply suitable data mining techniques to solve specific real world problems.
	CO4	Compare and evaluate different data warehousing models
MCA-112 Mobile ApplicationsDesign and Development	CO1	Relate to Android OS architecture and application components
	CO2	Make use of appropriate activities and intents in Android app development
	CO3	Model GUI application design in Android using action controls,fragments and views
	CO4	Analyze Android data storage mechanism and APIs
	CO5	Appraise iOS technology stack for mobile app development
	CO6	Design iOS applications using Swift language constructs
MCA-114 Full Stack Development	CO1	Relate the basics of Javascript (JS) and React JS
	CO2	Apply the concepts of props and Sate Management in React JS
	CO3	Examine Redux and Router with React JS
	CO4	Appraise Node JS environment and modular development
	CO5	Develop full stack applications using MongoDB
MCA-116 Web Technologies	CO1	Relate the fundamentals of Internet, Protocols, WWW, Webservers with HTML tags, commands of CSS and Java Script
	CO2	Build Dynamic Web Applications applying the concept of HTML, CSS and JavaScript
	CO3	Examine the working of Basic ASP, NET Web Forms (Server Controls, Validation Controls, User controls, ADO.NET, Caching, state management), AJAX and jQuery.
	CO4	Appraise ASP.Net Web Forms and ASP.NET MVC
	CO5	Create an Interactive Web Application using ASP.NET Forms, ASP.NET MVC BTL6

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MCA- 118 Theory of Computations	CO1	Relate to the basics of Finite State Machines.
	CO2	Explain grammar and establish equivalence between grammar, languages and pushdown automata.
	CO3	Solve the computational model for a given language
	CO4	Analyze Finite Automata for different regular expression and languages.
	CO5	Estimate the optimal computing time of the given problem
	CO6	Analyse and evaluate the decidability of the various computational problems using programming skills.
MCA-120	CO1	Identify the fundamentals of software testing and differentiate

Software Testing	it from debugging.
	CO2 Apply knowledge of prioritization, and technical and logical dependencies, to schedule test execution for a given set of test cases during development and regression testing.
	CO3 Appraise test tools, object-oriented software testing according to their purpose and the test activities they support.
	CO4 Develop test cases for given problem with respect to structural and functional testing techniques.
	CO5 Adapt in a cross-functional Agile team to discuss principles and basic practices of Agile software development.
MCA-122 Microprocessors	CO1 Recall various features of microprocessor, memory and I/0 devices.
	CO2 Illustrate 8086 microprocessor architecture and define its bus organization including control signals.
	CO3 Apply the concepts of memory and I/0 interfacing to 8086 processor
	CO4 Explain and outline the features of advance microprocessors.
	CO5 Understand 8086 processor addressing modes, outline classification of different instructions and functions of each instruction and write programs in assembly language using 8086 instructions.
MCA- 124 Embedded Systems	CO1 Recall Embedded system, architecture and the design process of an Embedded Systems.
	CO2 Explain working of different memory devices and memory management techniques.
	CO3 Identify Interrupt and interfacing of firmware with I/O and memory.
	CO4 Discover basics of operating system and its types along with different task synchronization techniques.
	CO5 Appraise RTOS, memory interface, and communication interfaces.
MCA-126 Information Security	CO1 Recall varied risks related to information security
	CO2 Identify threats, vulnerabilities and countermeasures to prevent attacks on information
	CO3 Apply risk and IT security guidelines on software security, database security, network security and computer security audit on various types of industries
	CO4 Inspect appropriate security requirements for proper control and security from worms, Trojans, viruses etc.
	CO5 Create user identification and authentication methods

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MCA- 128 Digital Marketing	CO1	Interpret Digital Marketing preliminaries.
	CO2	Build effective Digital Marketing strategies for different products and services.
	CO3	Make appropriate use of varied Digital Marketing Platforms like Email, Facebook, Twitter, YouTube, Pinterest, etc. as per given scenario.
	CO4	Apply and analyze the concept of Search Engine Optimization (SEO), SEM and Mobile Marketing to given scenarios.
	CO5	Analyze specific trends using Google Analytics

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	CO6	Create effective Display Ads and Search Engine Advertising
MCA-130 Management Information System	CO1	Explain the usage of Information systems in Business and their importance.
	CO2	Identify the techniques of strategic design for Emerging IT Infrastructure.
	CO3	Construct the required Information Systems in an ethical way
	CO4	Appraise the Business Applications of Information Systems
MCA-132 Management Principles and Organizational Behaviour	CO1	Recall the significance of individual differences and people skillsfor becoming effective, responsible and ethical managers
	CO2	Explain the power of groups in influencing organizational efficacy, and develop the ability to work in teams
	CO3	Understand interpersonal processes and apply strategies to enhance one's effectiveness
	CO4	Discover effective communication channels and leadership structures that can help reinforce desired organizational culture
	CO5	Develop leadership and creative problem solving among students
MCA-134 Finance and Accounting	CO1	Recall the purpose and principles of accounting.
	CO2	Explain the mechanics of accounting equation to understandthe inter-linkages among various financial statements.
	CO3	Build journal, leger and trial balance and understand their importance.
	CO4	Analyze financial statements and generate the reports for purpose of decision making.
	CO5	Create inventory accounts and financial statements.
	CO6	Elaborate the financial system, functions of various participants and types of operations to apply knowledge in that area.
MCA-162 Data and File Structures Lab.	CO1	Illustrate basic data structures- arrays and linked lists.
	CO2	Build stacks and queues using arrays and linked lists.
	CO3	Discover sparse matrix, polynomial arithmetic, searching and sorting techniques and their applications.
	CO4	Appraise binary search tree to perform efficient search operations.
	CO5	Examine and implement graph algorithms.
	CO6	Develop an application making extensive use of binary files.
MCA-164 Object Oriented Software Engineering Lab.	CO1	Apply object-oriented software engineering concepts to aproject.
	CO2	Build design model diagrams for design phase.
	CO3	Analyze and construct models and diagrams in analysis phase.
	CO4	Appraise an advanced CASE tool.
	CO5	Design and deploy a project suitably.
	CO6	Work in teams to design practical solutions for real life case studies using UML.

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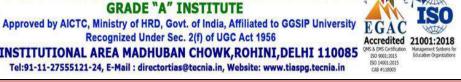| MCA-166 Python Programming Lab. | CO1 | Demonstrate program creation in Python through usage of appropriate constructs and OOPs concepts |
	CO2	Apply the concepts of data structures and string functions in python program.
	CO3	Apply the concepts of file handling and exception handling.
	CO4	Evaluate and visualize the data using appropriate python

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		libraries.
	CO5	Develop GUI based applications with database connectivity in Python
MCA- 168 Advanced Database Management Systems Lab. (Lab. Based on CoreElective -1)	CO1	Illustrate the concepts of ER and EER Model to design databases.
	CO2	Apply the basics of various NoSQL database types.
	CO3	Identify basic MongoDb commands to build specific NoSQL databases.
	CO4	Analyze XML Attributes to create databases using nested queries and joins using Xquery queries.
	CO5	Work in teams to develop complete NoSQL/Object-Oriented/Distributed database to support backend of any applications program.
MCA-168 Data Warehousing and Data Mining Lab. (Lab based on Core Elective - I)	CO1	Demonstrate various OLAP operation on multi-dimensional data.
	CO2	Apply different data transformation techniques to deal withnoisy data
	CO3	Apply data mining algorithms on real time data.
	CO4	Assess most appropriate data mining algorithm for a given situation
MCA-168 Mobile Applications Design and Development Lab. (Lab. based on Core Elective -1)	CO1	Interpret case studies for Android app development.
	CO2	Utilize the concepts of activities and intents Android app development case studies
	CO3	Make use of Android Web, Networking and Telephony APls inAndroid app development
	CO4	Discover GUI based Android applications using action controls,fragments and views
	CO5	Create interactive applications on iOS platform using iOS SDKand Swift
	CO6	Work in teams to construct iOS-based solutions using Swift language for real life case studies
MCA-168 Full Stack. Development Lab. (Lab. based on Core Elective -1)	CO1	Apply concepts of DOM creation and rendering using React.jsCO2 Make use of Node.js process model in given case studies
	CO3	Construct REST APls for cross platform application developmentCO4 Create full stack applications using Angular.js and React.js
	CO5	Develop applications using Node.js and MongoDB connectivity
MCA-168 Web Technologies Lab. (Lab. based on Core Elective - I)	CO1	Build Websites using HTML, CSS, Javascript primitives.
	CO2	Construct secure ASP.NET Web application using Web Server Controls.
	CO3	Appraise jQuery to build ASP.NET AJAX application.
	CO4	Work in teams to create interactive ASP.NET based Web FormsMVC based applications along with jQuery and AJAX.

MCA- 168 Theory of Computations Lab. (Lab. based on Core Elective -1)	CO1	Understand and demonstrate various finite machines usingtools like JFLAP.
	CO2	Model language recognizers using appropriate programming skills.
	CO3	Analyze varied abstract models in computing to recognize the language.

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	CO4	Appraise the simulation of Finite Automata using appropriate programming skills.
	CO5	Design the Context Free Grammar for a given language.
MCA-168 Software Testin gLab. (Lab. based on Core Elective -1)	CO1	Plan and apply test driven development within the context of a software development application.
	CO2	Discover specific and measurable test cases and suites to ensure coverage and traceability to requirements through appropriate tools.
	CO3	Appraise and prioritize the test cases for the specific software.
	CO4	Evaluate problem reporting techniques, metrics, and testing status reports to communicate testing results to colleagues, mangers, and end users.
	CO5	Adapt in a team to design a live case study on a software product through appropriate agile methodology.
MCA-168 Microprocessors Lab. (Lab. based on Core Elective - I)	CO1	Demonstrate the skills/abilities for writing an assembly program in an assembler.
	CO2	Experiment with various arithmetic operations on the 8086 microprocessor.
	CO3	Examine troubleshooting mechanisms of electronic hardware.
	CO4	Evaluate wired serial communication at chip level.
	CO5	Elaborate interfacing of various I/O devices
MCA-168 Embedded Systems Lab. (Lab. based on Core Elective - I)	CO1	Demonstrate hardware and software design requirements of embedded systems.
	CO2	Apply specifications of embedded systems on suitable simulators.
	CO3	Discover the challenges of Embedded Systems.
	CO4	Evaluate and analyze the requirements of Embedded Systems, related software architectures and tool chain for Embedded Systems.
	CO5	Elaborate the current trends in Embedded Systems.
MCA-168 Information Security Lab. (Lab. based on Core Elective - I)	CO1	Demonstrate the risks related to information in various situations.
	CO2	Apply security measures for any system software.
	CO3	Build cryptographic measures and PKI implementations.
	CO4	Identify application level and security challenges and issues.
	CO5	Analyze different types of security threats & attacks.
	CO6	Develop user identification and authentication techniques for specific systems.

MCA-170 Minor Project - II	CO1	Apply acquired knowledge within the chosen technology for solution of specific real world problem.
	CO2	Analyze the technical aspects of the chosen project through a systematic and comprehensive approach.
	CO3	Deduct plausible solution for the technical aspects of the project.
	CO4	Work as an individual or in teams to develop the technicalproject.
	CO5	Create effective reports and documentation for all project related activities and solutions.

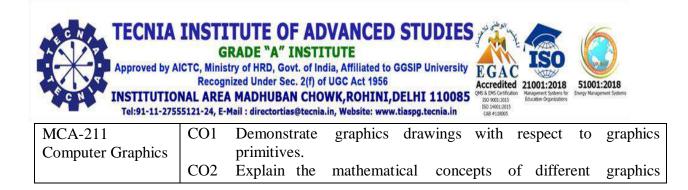# TECNIA INSTITUTE OF ADVANCED STUDIES
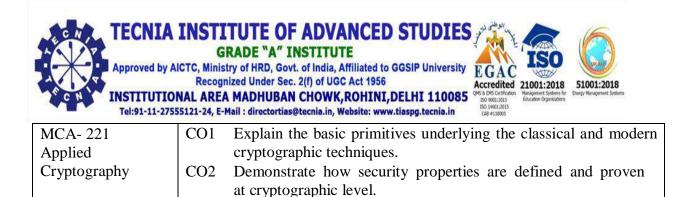### GRADE "A" INSTITUTE
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THIRD SEMESTER		
MCA- 201 Design and Analysis of Algorithms	CO1	Demonstrate P and NP complexity classes of the problem.
	CO2	Apply the concepts of asymptotic notations to analyze the complexities of various algorithms.
	CO3	Analyze and evaluate the searching, sorting and tree-based algorithms.
	CO4	Design efficient solutions using various algorithms for given problems.
	CO5	Develop innovative solutions for real-world problems using different paradigms.
MCA-203 Artificial Intelligence and Machine Learning	CO1	Define the meaning of Intelligence and recall various models for knowledge representation and reasoning within an AI problem domain.
	CO2	Summarize varied learning algorithms and model selection.
	CO3	Apply the concept of learning trends and patterns from data to build an appreciation for what is involved in learning from data.
	CO4	Analyze and apply a variety of learning algorithms to data.
	CO5	Appraise AI algorithms and assess their performance. Follow standards and ethical practices.
	CO6	Develop a strong foundation for a wide variety of state of the art Machine Learning algorithms.
MCA-205 Statistics and Data Analytics	CO1	Explain fundamental concepts and terminologies of statistics and data analytics.
	CO2	Experiment with various measures of central tendency, dispersion, shape and their implication.
	CO3	Apply probability and probability distribution primitives.
	CO4	Examine hypothesis testing an use inferential statistics- T, F, Z and Chi Square Test.
	CO5	Assess analysis of variance for specific cases.
MCA- 207 Enterprise Computing with JAVA	CO1	Model Java EE architectural components, Servlet creation and session management for web applications.
	CO2	Inspect the fundamentals of Java Server Pages (JSP) and Struts for web-based applications.
	CO3	Appraise Hibernate Framework of JEE and apply constructs of Object Relational Mapping
	CO4	Elaborate principles of Dependency Injection and its applications in JEE
	CO5	Design applications based on spring Boot and Spring AOP.
MCA-209 Natural Language eProcessing	CO1	Relate to the existing NLP systems and determine the advantages and disadvantages of these systems.
	CO2	Demonstrate the skills of solving specific NLP tasks, as well as running experiments on textual data.
	CO3	Apply Natural Language Processing (NLP) knowledge to some of its application.
	CO4	Assess and apply the available tools of NLP on various case studies.

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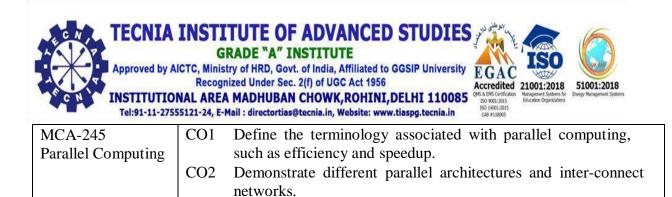| MCA-211 Computer Graphics | CO1 | Demonstrate graphics drawings with respect to graphics primitives. |
| | CO2 | Explain the mathematical concepts of different graphics |

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		algorithms.
	CO3	Apply 2D & 3D transformation concepts to represent images with different dimensions and shapes.
	CO4	Analyze and evaluate the concepts of projections and shading methods to obtain realistic images.
	CO5	Develop scenes with different clipping methods and transform it to graphics display device.
	CO6	Develop interactive applications using different computer graphics algorithms and animation effects.
MCA-213 Wireless Sensor Networks	CO1	Explain the underlying technology and architecture of a Wireless sensor network.
	CO2	Analyse the different variants of Operating systems in wireless sensor networks.
	CO3	Examine the various types of protocols in MAC layer, networklayer and transport layer.
	CO4	Evaluate real world problems using appropriate sensor devices.
	CO5	Design different applications for network management.
MCA-215 Software Project Management	CO1	Illustrate project scheduling within time and budget
	CO2	Identify ethical issues related to software project management
	CO3	Apply the model-based software architectures.
	CO4	Analyse how a project can be monitored, controlled and assessed.
	CO5	Evaluate risk associated with project development, and design policies to reduce risk.
	CO6	Develop an efficient project to reduce rework and labour-intensiveness.
MCA-217 Advanced Computer Architecture	CO1	Explain micro-architectural design of processors.
	CO2	Identify the meaning of Parallel Processing, its applications and associated hardware technologies.
	CO3	Distinguish between the different parallel architectures and compare their performance relative to various parameters.
	CO4	Explain and evaluate the performance of different ILP methods, pipelining design/approach for a given set of instructions.
	CO5	Evaluate the performance of pipelining and non-pipelining environment in a processor.
	CO6	Assess cache and memory related issues in multi-processors, and parallel programing.
MCA-219 Distributed Systems	CO1	Explain the real life applications, architecture and model of Distribute Systems
	CO2	Analyze fundamentals of Distributed Operating Systems and its concepts like synchronization, mutual exclusion, deadlocks and shared memory
	CO3	Determine Cloud, Fog and Edge Computing, and apply adequate patterns for user-interaction with connected-objects.
	CO4	Analyze, design and implement Distributed Databases.

| MCA- 221 Applied Cryptography | CO1 | Explain the basic primitives underlying the classical and modern cryptographic techniques. |
| | CO2 | Demonstrate how security properties are defined and proven at cryptographic level. |

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	CO3	Identify common attacks and crypto graphical techniques to prevent them.
	CO4	Analyze and apply appropriate cryptographic techniques to security engineer the problem at hand.
MCA- 223 Cloud Computing	CO1	Identify the importance of Cloud Computing Paradigm, Cloud Security & Load Configurations.
	CO2	Model and apply the concepts of Virtualization and Security in the cloud computing environment.
	CO3	Analyze the concept of Data Centres with Cloud Computing and examine the Use cases of various Cloud Computing Titans.
	CO4	Design & Appraise Cloud Computing based VMS and weigh the advantages & disadvantages of various proprietary platforms along with available best practices.
MCA-225 e-Business Systems	CO1	Define the concepts of e-business and e- commerce and the related information technology and web-based tools.
	CO2	Identify Security aspects of e-business-online threats, securities protocols and understand and apply cryptographic applications for securing thee-businesses and data privacy.
	CO3	Examine various e-business models, revenue models, electronic payment systems and electronic fund transfers.
	CO4	Create effective strategies for e-business and mobile commerce while adapting to the emerging trends in e-business.
MCA-227 Web Intelligence and Big Data	CO1	Explain the fundamentals of web intelligence and big data.
	CO2	Understand issues and apply text and Image pre-processing techniques to specific cases
	CO3	Analyse the key issues in big data management and itsassociated applications.
	CO4	Adapt Hadoop and related big data technologies such as Map Reduce, Pig and Hive in the context of big data management.
MCA-229 Flutter and Dart	CO1	Demonstrate the basic primitives in Flutter and Dart framework
	CO2	Model native platform code using Flutter and Dart
	CO3	Examine the use of widgets and user interactions in application development
	CO4	Evaluate application development using the concepts of animation and interactive widgets
	CO5	Construct flutter and dart applications using customized layouts and service interactions
MCA-231 Service Oriented Architecture	CO1	Explain Service Oriented Architecture; Service Oriented Application, Big Data, Cloud and Containers.
	CO2	Apply XML in Service Oriented based Solutions for a given problem.
	CO3	Analyze the architecture of Service Oriented solution for any given specific problem.
	CO4	Assess Microservices based solution with other approaches.

MCA-233 Multimedia Technologies	CO1	Explain the technical aspects of multimedia systems.
	CO2	Apply various file formats of audio, video and text media in different applications.
	CO3	Analyze the QoS parameters of various multimedia applications through internet.

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	CO4	Evaluate different types of multimedia compression methods.
	CO5	Design interactive multimedia software applications using animations.
	CO6	Develop real-time multimedia applications using different multimedia components. .
MCA-235 Internet of Things	CO1	Explain the architecture of Internet of Things.
	CO2	Demonstrate the different enabling technologies for IoTs
	CO3	Apply Python Programming skills to develop loT application.CO4 Analyze the architecture of Arduino and Raspberry Pi
	CO5	Create Small loT Application using Sensors
MCA-237 Soft Computing	CO1	Demonstrate the techniques of soft computing and their role in problem solving
	CO2	Apply various soft computing techniques in order to solve problems effectively and efficiently.
	CO3	Construct neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
	CO4	Analyze Fuzzy logic and neural networks primitives like fuzzy sets, fuzzy logic and heuristics based on human experience.
	CO5	Assess the current research problems and research methods in Soft Computing Techniques.
MCA-239 Software QualityManagement	CO1	Identify software quality and the varied models and approaches aimed at realising software quality in varied software development environments.
	CO2	Discover software quality aspects and participants by improving different phases of software development.
	CO3	Analyze fundamental concepts of CASE Tools and quality metrics for specific software cases.
	CO4	Appraise varied SQA standards and costs and challenges associated with Software Quality.
MCA- 241 Digital Image Processing	CO1	Relate to the digital image processing primitives and thedifferent types of images and their application areas.
	CO2	Explain the image formation process, and the filtering techniques for image enhancement.
	CO3	Apply appropriate image processing algorithms in both the spatial and frequency domain.
	CO4	Analyze types of noise and the techniques useful to remove the noise from the degraded images.
	CO5	Assess image segmentation and compression techniques for various image processing applications.
MCA- 243 Compiler Design	CO1	Recall different language translation tools.
	CO2	Explain the Importance of code optimization.
	CO3	Identify compiler generation tools and techniques.
	CO4	Construct compiler and its applications.
	CO5	Design a compiler for a simple programming language.

MCA-245 Parallel Computing	CO1	Define the terminology associated with parallel computing, such as efficiency and speedup.
	CO2	Demonstrate different parallel architectures and inter-connect networks.

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	CO3	Identify the challenges in efficient implementation of large-scale parallel applications.
	CO4	Analyze the hardware and software challenges in parallelism.
	CO5	Assess different parallel programming models, and algorithms.
MCA-247 Numerical and Scientific Computing	CO1	Recall finite precision computation.
	CO2	Demonstrate understanding of common numerical methods used to obtain approximate solutions to otherwise intractable mathematical problems.
	CO3	Apply Numerical analysis which has enormous applications in the field of Science and some fields of Engineering.
	CO4	Examine numerical methods for various mathematicaloperations and tasks.
	CO5	Analyze and evaluate the accuracy of common numerical methods.
	CO6	Assess calculation and interpretation of errors in numerical method.
MCA-249 Research Methodology	CO1	Identify how Research is done in Computer Science to improve Individual Research Productivity.
	CO2	Discover the types of Experiments and Measurements possible in Research
	CO3	Analyze the fundamental concepts of Sampling and Data Analysis.
	CO4	Develop appropriate Technical Writing Skills.
MCA-251 Operational Research	CO1	Demonstrate linear programming problems and appreciate their limitations.
	CO2	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
	CO3	Solve different queuing situations and find the optimal solutions using models for different situations.
	CO4	Apply these techniques constructively to make effective business decisions.
	CO5	Examine different models of queuing theory and game theory.
	CO6	Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications.
MCA-253 Cyber Security and Cyber Laws	CO1	Demonstrate computer technologies, digital evidence collection, and reporting in forensic acquisition.
	CO2	Apply strategies of using information as a weapon and a target.
	CO3	Identify the principles of offensive and defensive information warfare for a given context.
	CO4	Analyze the social, legal and ethical implications of informationwarfare.
	CO5	Appraise key terms and concepts in cyber law, intellectual property and cybercrimes, trademarks, domain theft and Cyber Forensics

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| MCA-255 e-Content Development | CO1 | Relate to the meaning and standards of e- learning and e-content. |
| | CO2 | Demonstrate instructional content designing and standardized |

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		course designing with e- content designing
	CO3	Apply digital media for development.
	CO4	Examine Content Management systems (CMS) and Learning Management Systems (LMS).
	CO5	Evaluate various authoring and publishing tools fore-content design and presentation.
	CO6	Elaborate innovative practices in the design & development of e-content.
MCA- 261 Design and Analysis of Algorithms Lab.	CO1	Apply logical thinking to build solutions for given problems.
	CO2	Evaluate correctness & efficiency of algorithms using inductiveproofs and invariants.
	C03	Design and perform parameter-based analysis of the searching, sorting and tree-based algorithms.
	C04	Create test optimal solutions for various and problems.
MCA-263 Artificial Intelligence and Machine Learnin gLab.	CO1	Apply heuristic search based algorithms to solve different puzzles.
	CO2	Identify reduction techniques on large-datasets and reducetheir dimensionality.
	CO3	Analyze the datasets for bias and apply appropriate regression techniques.
	CO4	Evaluate the learning techniques for classification.
	CO5	Implement the knowledge of inferences rules to design the knowledge base.
	CO6	Create a domain specific intelligent application.
MCA- 265 Statistics and Data Analytics Lab. (Lab. based on Core Elective - II)	CO1	Identify various measures like Central tendency, Measures of Dispersion, Measures of shape etc.
	CO2	Analyze Probability Distribution on specific cases.
	CO3	Assess hypothesis testing and apply inferential statistics- t, F, Z and Chi Square Test to specific cases
	CO4	Deduct Correlation and Regression on specific problem.
	CO5	Elaborate Statistical and Data analytics techniques on real time data (case study)
MCA-265 Computing with JAVA Lab. (Lab. based on Core Elective - II) Enterprise	CO1	Model Java EE architectural components, Servlet and session management for web applications.
	CO2	Examine Java Server Pages (JSP) and Struts for web-based applications.
	CO3	Appraise Hibernate Framework of JEE and apply Object Relational Mapping to specific cases
	CO4	Elaborate principles of Dependency Injection and its application in JEE.
	CO5	Design applications based on Spring Boot and Spring AOP.
MCA-265 Natural Languag eProcessing Lab. (Lab. Based on CoreElective - II)	CO1	Apply lemmatization primitives using python.
	CO2	Analyze Lexical analysis on various text corpuses.
	CO3	Assess the text classification algorithms on text and speech tagging.
	CO4	Create an NLP model for analyzing the text documents.

MCA-265		CO1	Demonstrate basic objects using graphic primitives.
Compute	Graphics	CO2	Experiment with scan-conversion and clipping algorithms.

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Lab. (Lab. based on Core Elective-II)	CO3	Apply transformation operations to images and generate animated sequences.
	CO4	Implement projections and hidden surface removal algorithmsand analyze their role in architectural drawings.
	CO5	Create interactive applications with se of animation and shading effects.
MCA-265 Wireless Sensor Networks Lab. (Lab. Based on CoreElective-II)	CO1	Build a Wireless Sensor Network using appropriate simulator.
	CO2	Analyze the transmission between different sensor nodes and find throughput of network under different scenarios.
	CO3	Examine the different types of clustering protocols to analyze the topology.
	CO4	Evaluate different routing algorithms.
	CO5	Appraise the energy efficiency of different networks.
	CO6	Elaborate data storage and data dissemination techniques on different networks.
MCA-265 Software Project Management Lab. (I ab. based on Core Elective-II)	CO1	Construct Proposal for software project.
	CO2	Examine and schedule the working progress and budget of the project.
	CO3	Analyse and assess the Risk associated with the project.
	CO4	Estimate the resources for project development.
	CO5	Create a novel solution of project for a specific problem.
MCA-265 Advanced Computer Architecture Lab. (Lab. based on CoreElective-II)	CO1	Demonstratep parallelism in hardware/ software with appropriate tools.
	CO2	Apply memory organization and mapping techniques to specific problems.
	CO3	Examine the architectural features of advanced processors for different problems.
	CO4	Evaluate the performance of different pipelined processors.
MCA-265 Distributed Systems Lab (Lab. based on Core Elective - II)	CO1	Model the applications based on client-server architecture, threads and CORBA in distributed systems.
	CO2	Experiment to implement Remote method invocation in distributed systems.
	CO3	Examine distributed algorithms for different primitives likeshared memory, mutual exclusion and deadlock detection.
	CO4	Compose a development environment and deploy an applocally on Cloud.
	CO5	Analyze techniques to implement distributed databases and create tables to demonstrate data fragmentation.
MCA-265 Applied Cryptography Lab. (Lab. based on Core Elective - II)	CO1	Demonstrate the classical and modern cryptographic primitives.
	CO2	Experiment with security properties at the cryptographic level
	CO3	Analyze common attacks and cryptographic techniques to prevent them
	CO4	Adapt appropriate cryptographic techniques to security engineer the problem at hand

MCA- 265	CO1	Demonstrate the cloud platform on an appropriate tool.
Cloud	CO2	Apply virtualization in clouds
ComputingLab	CO3	Distinguish between at least two cloud-based platforms.
(Lab. based on Core	CO4	Choose and implement best security practices of cloud.

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51001:2018
Energy Management Systems

Elective-II)	CO5	Create automation on load balancing in cloud.
MCA-265 e-Business Systems Lab. (Lab. based on Core Elective - II)	CO1 CO3 CO4 CO5	Model an appropriate Business model for a proposed website Distinguish varied online payment methods Assess varied e-commerce software's Create an e-commerce website and compare it with similar existing websites
MCA-267 Web Intelligence and Big Data Lab. (Lab. based on Core Elective - Ill)	CO1 CO2 CO3 CO4	Construct specific data sets on Hadoop. Examine Web Scrapping/Crawling on suitable datasets. Evaluate the characteristics of NoSQL databases and implement Big Data concepts. Compile machine learning libraries and mathematical and statistical tools with modern technologies like Hadoop and Map Reduce.
MCA-267 Flutter and Dart Lab. (Lab. based on CoreElective-Ill)	CO1 CO2 CO3 CO4 CO5	Construct applications with Flutter and Dart primitives. Experiment with native platform code development on givencase studies. Analyze case studies to discover interactive widget-based solutions. Design animated solutions using flutter and dart. Create service based custom applications using flutter and dart.
MCA-267 Service Oriented Architecture Lab. (Lab. based on Core Elective - Ill)	CO1 CO2 CO3 CO4	Build XML document with appropriate SOAP Services. Discover customized Web Services and REST Services for appropriate cases. Appraise Microservices using Spring Boot and Honeycomb. Design and implement the Microservices and deploy them using a Container based systems.
MCA-267 Multimedia Technologies Lab. (Lab. based on Core Elective - Ill)	CO1 CO2 CO4 CO5 CO6	Demonstrate modeling of 2D and 3D graphical scenes using Open Graphics Library suits. Apply various delivery methods including streaming.CO3 Analyse audio and text compression algorithms. Examine video compression algorithms. Create 2D animation applications using appropriate multimedia tools: Develop customized multimedia projects using different components.
MCA-267 Internet of Things Lab. (Lab based on CoreElective-Ill)	CO1 CO2 CO3 CO4 CO5	Demonstrate IoT based application components. Build loT Protocols at each layer. Analyze IoT Physical devices through appropriate programminglanguage. Assess Sensor Interfacing through Embedded boards. Create small IoT Applications using available communication APIs.

MCA-267 Soft Computing Lab. (Lab. Based on CoreElective-Ill)	CO1	Demonstrate the basic of De-Morgan's Law, Union and Intersection operations in suitable tool.
	CO2	Apply FIS Editor and use Fuzzy toolbox to map temperature scale for anti-lock brakes.
	CO3	Construct AND-NOT function and XOR Function using

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		McCulloch-Pitts neural net by suitable program.
	CO4	Create and view custom neural networks by defining topology, transfer function, configure network, train net and calculate neuron output.
	CO5	Implement Genetic Algorithm and develop quality solutions to optimization and search problems by relying on biological inspired operator.
MCA-267 Software Quality Management Lab. (Lab. based on CoreElective-Ill)	CO1	Build software quality assurance plans through appropriate tools (IBM RUP/Star UML).
	CO2	Apply quality assurance tools and techniques.
	CO3	Examine software quality plans through checklists for a specific software system.
	CO4	Appraise runtime assurances and requirements monitoring,
	CO5	Formulate a common software process model and tailor it for increased quality.
	CO6	Work in teams to design a software quality assurance plan for a specific software system case.
MCA-267 Digital Image Processing Lab (Lab. based on CoreElective-Ill)	CO1	Demonstrate basic tool usage to explore digital image formats and their processing.
	CO3	Experiment with basic image processing operations on the images.
	CO4	Analyze the image enhancement technique for the improvement of pictorial information for human perception, vision and understanding.
	CO5	Assess complex frequency domain filtering and apply this knowledge to remove different types of noises from an image.
	CO6	Build data compression techniques and test them on images for efficient storage.
MCA-267 Compiler DesignLab (Lab. based on Core Elective - Ill)	CO1	Apply the knowledge of the LEX tool & YACC tool to develop ascanner & parser.
	CO2	Experiment with Intermediate Code Generation in a compiler.
	CO3	Examine the knowledge of patterns, tokens & regular expressions for solving problems.
	CO4	Inspect programs for solving complex problems in a compiler.
	CO5	Assess the available tools and technologies for writing a compiler.
MCA-267 Parallel ComputingLab (Lab. based on Core Elective - Ill)	CO1	Explain and outline the impact of synchronization issues, latency and bandwidth on the efficiency and effectiveness of parallel computing applications.
	CO2	Demonstrate the requirements of parallel systems and critically evaluate the strengths and weaknesses of parallel computing models.
	CO3	Model different parallel computing paradigms including memory passing, memory sharing, data- parallel and various other approaches.
	CO4	Develop appropriate solutions to real-life parallel computing problems and issues

MCA-267 Numerical and	CO1	Identify properties for numerical methods and mathematical models by using the analysis methods.

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Scientific Computing Lab. (Lab. Based on CoreElective - Ill)	CO2	Construct an algorithm by structuring and dividing a computational problem into sub-problems and formulating an algorithm.
	CO3	Analyze various numerical methods and implement them in problem solving.
	CO4	Assess the limitations, advantages, and disadvantages of different numerical methods.
MCA-269 Minor Project - Ill	CO1	Apply acquired knowledge within the chosen technology for solution of specific problem.
	CO2	Analyze the technical aspects of the chosen project through a systematic and comprehensive approach.
	CO3	Deduct plausible solution for the technical aspects of the project.
	CO4	Work as an individual or in teams to develop the technicalproject.
	CO5	Create effective reports and documentation for all project related activities and solutions.
FOURTH SEMESTER		
MCA-202 Dissertation (Major Project)	CO1	Apply techniques, skills and modern computing tools necessary for project development.
	CO2	Apply team-skills, ethics and professional attitude in professional endeavour.
	CO3	Model overall project management through sustainable practices.
	CO4	Adapt technological changes and futuristic challenges of the contemporary world.
	CO5	Create technical documents and reports.

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