SCHEME OF EXAMINATION

&

DETAILED SYLLABUS

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

For

MASTER OF COMPUTER APPLICATIONS (MCA) DEGREE

(02 Years)

under the aegis of

University School of Information, Communication and Technology offered at Affiliated Institutes of University

from A.S. 2025-26

onwards

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

SECTOR 16C, DWARKA, NEW DELHI

Master of Computer Applications (MCA)

Programme Education Objectives (PEO):
It is envisioned that the graduates passing out MCA degree, will achieve the following objectives and accomplishments, in a span of 05 – 10 years time, after having passed the MCA degree:-

PEO	Detailed Statement of the PEO
PEO1	Exhibit professional competencies and knowledge for being a successful technocrat.
PEO2	Adopt creative and innovative practices to solve real-life complex problems.
PEO3	Be a lifelong learner and contribute effectively to the betterment of the society.
PEO4	Be effective and inspiring leader for fellow professionals and face the challenges of the rapidly changing multi-dimensional, contemporary world.

Programme Outcomes (POs):
It is envisioned that the graduates passing out MCA degree, will be able to possess following Graduate Attributes and demonstrate related competencies:-

PO #	GA Theme	Detailed Statement of the PO
PO1	Computational Knowledge (**CK**)	Demonstrate competencies in fundamentals of computing, computing specialization, mathematics and domain knowledge suitable for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
PO2	Problem Analysis (**PA**)	Identify, formulate and analyze complex real-life problems in order to arrive at computationally viable conclusions using fundamentals of mathematics, computer sciences, management and relevant domain disciplines.
PO3	Design / Development of Solutions (**DDS**)	Design efficient solutions for complex, real-world problems to design systems, components or processes that meet the specifications with suitable consideration to public health, safety, cultural, societal and environmental considerations.
PO4	Conduct Investigations of Complex Computing Problems (**CICP**)	Ability to research, analyze and investigate complex computing problems through design of experiments, analysis and interpretation of data and synthesis of the information to arrive at valid conclusions.
PO5	Modern Tool Usage (**MTU**)	Create, select, adapt and apply appropriate technologies and tools to a wide range of computational activities while understanding their limitations

PO #	GA Theme	Detailed Statement of the PO
PO6	Professional Ethics (**PE**)	Ability to perform professional practices in an ethical way, keeping in the mind cyber regulations & laws, responsibilities and norms of professional computing practices.
PO7	Life-long Learning (**LLL**)	Ability to engage in independent learning for continuous self-development as a computing professional.
PO8	Project Management and Finance (**PMF**)	Ability to apply knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
PO9	Communication Efficacy (**CE**)	Ability to effectively communicate with the technical community and with the society at large about *complex* computing activities by being able to understand and write effective reports, design documentation, make effective presentations with the capability of giving and taking clear instructions.
PO10	Societal and Environmental Concern (**SEC**)	Ability to recognize and assess societal, environmental, health, safety, legal and cultural issues within local and global contexts and the consequential responsibilities applicable to professional computing practices.
PO11	Individual and Team Work (**I&T**)	Ability to work in multi-disciplinary team collaboration both as a member and leader, as per need.
PO12	Innovation and Entrepreneurship (**I&E**)	Ability to apply innovation to track a suitable opportunity to create value and wealth for the betterment of the individual and society at large.

Master of Computer Applications

FIRST SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
	MCA-101	Discrete Structures	3	1	4
	MCA-103	Computer Networks	3	-	3
	MCA-105	Operating Systems with Linux	3	-	3
	MCA-107	Database Management Systems	3	-	3
	MCA-109	Object Oriented Programming and JAVA	3	-	3
Practical & Project					
	MCA-161	Computer Networks Lab.	0	2	1
	MCA-163	Operating Systems with Linux Lab.	0	2	1
	MCA-165	Database Management Systems Lab.	0	2	1
	MCA-167	Object Oriented Programming and JAVA Lab.	0	2	1
	MCA-169	Minor Project – I	0	6	3
NUES*					
	MCA-171	Professional Proficiency – I (It is suggested to have Personality Development and Communication Skills Course)	0	2	1
Total			**15**	**17**	**24**

*** Non-University Examination System (NUES)**

Master of Computer Applications

SECOND SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
	MCA-102	Data and File Structures	3	-	3
	MCA-104	Object Oriented Software Engineering	3	-	3
	MCA-106	Python Programming	3	-	3
Core Elective - I *(Choose any One)*					
	MCA-108	Advanced Database Management Systems	3	1	4
	MCA-110	Data Warehousing and Data Mining			
	MCA-112	Mobile Applications Design and Development			
	MCA-114	Full Stack Development			
	MCA-116	Web Technologies			
	MCA-118	Theory of Computations			
	MCA-120	Software Testing			
	MCA-122	Microprocessors			
	MCA-124	Embedded System			
	MCA-126	Information Security			
Open Elective - I *(Choose any One)*					
	MCA-128	Digital Marketing	3	1	4
	MCA-130	Management Information System			
	MCA-132	Management Principles and Organizational Behavior			
	MCA-134	Finance and Accounting			
Practical & Project					
	MCA-162	Data and File Structures Lab.	0	2	1
	MCA-164	Object Oriented Software Engineering Lab.	0	2	1
	MCA-166	Python Programming Lab.	0	2	1
	MCA-168	Lab. based on Core Elective - I	0	2	1
	MCA-170	Minor Project – II	0	6	3
NUES*					
	MCA-172	Environment Science (NUES)	2	0	2
	MCA-174	Professional Proficiency – II (It is suggested to have Technical Paper Writing Course)	0	2	1
Total			**17**	**18**	**27**

*** Non-University Examination System (NUES)**

Master of Computer Applications

THIRD SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
	MCA-201	Design and Analysis of Algorithms	3	1	4
	MCA-203	Artificial Intelligence and Machine Learning	3	-	3
Core Elective - II *(Choose any One)*					
	MCA-205	Statistics and Data Analytics	3	-	3
	MCA-207	Enterprise Computing with JAVA			
	MCA-209	Natural Language Processing			
	MCA-211	Computer Graphics			
	MCA-213	Wireless Sensor Networks			
	MCA-215	Software Project Management			
	MCA-217	Advanced Computer Architecture			
	MCA-219	Distributed Systems			
	MCA-221	Applied Cryptography			
	MCA-223	Cloud Computing			
	MCA-225	e-Business Systems			
Core Elective - III *(Choose any One)*					
	MCA-227	Web Intelligence and Big Data	3	-	3
	MCA-229	Flutter and Dart			
	MCA-231	Service Oriented Architecture			
	MCA-233	Multimedia Technologies			
	MCA-235	Internet of Things			
	MCA-237	Soft Computing			
	MCA-239	Software Quality Management			
	MCA-241	Digital Image Processing			
	MCA-243	Compiler Design			
	MCA-245	Parallel Computing			
	MCA-247	Numerical and Scientific Computing			
Open Elective - II *(Choose any One)*					
	MCA-249	Research Methodology	3	-	3
	MCA-251	Operational Research			
	MCA-253	Cyber Security and Cyber Laws			
	MCA-255	e-Content Development			
Practical & Project					
	MCA-261	Design and Analysis of Algorithms Lab.	0	2	1
	MCA-263	Artificial Intelligence and Machine Learning Lab.	0	2	1
	MCA-265	Lab. based on Core Elective - II	0	2	1
	MCA-267	Lab. based on Core Elective - III	0	2	1
	MCA-269	Minor Project – III	0	6	3

NUES*					
	MCA-271	Entrepreneurship Mindset (NUES)	3	0	3
	MCA-273	Professional Proficiency – III (It is suggested to have IPR, Human Values and Professional Ethics Course)	0	2	1
Total			**18**	**17**	**27**

*** Non-University Examination System (NUES)**

Master of Computer Applications

FOURTH SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
	MCA-202	Dissertation (Major Project)	-	-	17
NUES*					
	MCA-272	One MOOC Course (from SWAYAM Platform) (NUES)	-	-	2
	MCA-274	Professional Proficiency – IV (Seminar and Progress Report)	-	-	3
		Total	**-**	**-**	**22**

*** Non-University Examination System (NUES)**

Important Notes:

1. As mandated by the statutory bodies, every student shall be given 03 weeks induction training in the beginning of the first semester. Detailed guidelines for the same shall be finalized through Programme Co-ordination Committee.
2. Institutions shall also be required to facilitate the non-computer science students for successfully completing the Bridge Courses from MOOC platform. If required, Institution may also conduct make-up classes or tutorial sessions for such students.
3. In order to conduct classes for Electives (Core or Open), there must be a minimum of 20 students in that Elective. However, if the numbers of students are less than 20 in any of the Electives (Core or Open), the elective course may still be offered but no classes will be held and the students shall be required to successfully complete that course from the MOOC using SAWAYAM or other similar platforms. In that case, students shall be required to obtain prior approval of the Programme Co-ordination Committee for undertaking any course(s) from the MOOC platforms. Requirement of attendance, to such students, shall be waived off based upon the document of having completed the course from MOOC platforms. MCA-272 shall also be completed from the MOOC using SAWAYAM or other similar platforms, as detailed above. However, students shall be required to appear for the examinations conducted by the Institution as teachers' continuous evaluation to earn these credits. The MOOC course should have at least 30 hours of teaching. No direct credit transfer shall be allowed based upon the Certificate of having completed these electives courses from the MOOC platforms.
4. Detailed modalities of all the NUES Papers and MCA-202 (Dissertation) related guidelines for assessment and evaluation shall be followed as approved by the Programme Co-ordination Committee. The dissertation should be oriented towards socially relevant projects.
5. The total number of the credits of the MCA programme = **100**.
6. Each student shall be required to appear for examinations in all courses. However, for the award of the degree a student shall be required to earn the minimum of **90** credits.
7. Evaluation of Bridge Courses shall be based in line with NUES mechanism. Institutions shall send these marks to the University as NUES Course, based upon the final MOOC Certificate. Detailed guidelines shall be approved by the Programme Co-ordination Committee.
8. The programme of study shall be governed by Ordinance 11 of the University.
9. Passing Marks shall be 40 out of 100 marks for every paper.

Master of Computer Applications

BRIDGE COURSE DETAILS

FOR

NON-COMPUTER SCIENCE STUDENTS JOINING THE MCA PROGRAMME

Students from the non-computer Science background joining the MCA Programme will have to pass the following 05 papers from the MOOC using SWAYAM platform, in semester-wise order, as defined by the Programme Co-ordination Committee (considering the pre-requisites of different courses in different semesters) but, not later than the end of the 04th Semester. Final Degree shall be awarded only after completion of the following 05 papers:-

Paper Code	Paper Name	Reference of MOOC (on SAWAYAM) Course
BCMCA-001	Fundamentals of Computer Systems	**Course Title:** CIT-001: Fundamentals of Computer Systems **By:** Shri. Mangala Prasad Mishra **Coordinated By:** IGNOU **Course Duration:** 08 Weeks **Link:** https://swayam.gov.in/nd2_nou20_cs03/preview
BCMCA-002	Computer Architecture and Organization	**Course Title:** Computer Architecture and Organization **By:** Prof. Indranil Sengupta, Prof. Kamalika Datta **Coordinated By:** IIT, Kharagpur **Course Duration:** 12 Weeks **Link:** https://swayam.gov.in/nd1_noc20_cs64/preview
BCMCA-003	Introduction to Programming in C	**Course Title:** Introduction to Programming in C (106104128) **By:** Prof. Satyadev Nandakumar **Coordinated By:** IIT, Kanpur **Course Duration:** 08 Weeks **Link:** https://swayam.gov.in/nd1_noc20_cs91/preview
BCMCA-004	An Introduction to Programming through C++	**Course Title:** An Introduction to Programming through C++ (106101208) **By:** Prof. Abhiram Ranade **Coordinated By:** IIT, Bombay **Course Duration:** 12 Weeks **Link:** https://nptel.ac.in/content/syllabus_pdf/106101208.pdf
BCMCA-005	Software Engineering	**Course Title:** Software Engineering **By:** Prof. Rajib Mall **Coordinated By:** IIT, Kharagpur **Course Duration:** 12 Weeks **Link:** https://swayam.gov.in/nd1_noc20_cs68/preview

Notes:

1. In case of un-availability of any of the above mentioned courses from the MOOC (on SWAYAM platform), the same course(s) may be completed from any other Govt. approved platform, with prior approval from the Programme Co-ordination Committee.
2. The list of non-computer science background students in every admitted batch shall be communicated by the admitting institutions by 4th week of starting of academic session to the examination division of the university.
3. Students with BCA/B.Sc.(Computer Science/Information Technology) or equivalent (to be decided by the sub-committee of the program co-ordination committee, at undergraduate level shall be considered as computer science background. All other students shall be considered as non-computer science students.
4. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA.

Discrete Structures

Course Code: **MCA-101**
Course Name: **Discrete Structures**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Familiarization of basic mathematical structures and combinatorics
2. Understanding and ability to apply mathematical logic and Boolean Algebra
3. Understanding and application of number theory and elementary Group Theory
4. Application and construction of graphs in providing solutions of Computer Science problems

PRE-REQUISITES:

Basic knowledge of Mathematics.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Choose appropriate discrete structures and combinatorics for basic problems.	BTL1	PO1, PO2, PO3
CO2	Interpret and illustrate the basics of Group Theory.	BTL2	PO1, PO2, PO3,PO4
CO3	Examine and infer mathematical logic and Boolean Algebra.	BTL4	PO1, PO2,PO3, PO4, PO7
CO4	Evaluate applications of number theory.	BTL5	PO1, PO2, PO3, PO4
CO5	Implement and create models for computer science problems by understanding the concepts of Graph Theory.	BTL6	PO1, PO2, PO3, PO4, PO7, PO11

UNIT – I

Chapter / Book Reference: TB1 [Chapters 2, 4, 5, 6, 7];

No. of Hours: 11 **TB2 [Chapters 2, 3]; TB3 [Chapter 4, 7, 8, 10, 11]**

Sets Theory Concepts: Sets, Subsets, Power Set, Multi-sets, Operations on Sets, Algebra of sets, Principle of Inclusion and Exclusion; Cartesian Product, Relations, Types of Relations, Equivalence Relation, Partial Order Relation, Closure of Relation; Function, Properties of Functions, One-one Function, Many-one Function, Onto function, Composition of a Function, Invertible Function.

Combinatorics: Permutation, Combination, Combination with Unlimited Repetition, Pigeonhole Principle.

Recurrence Relations: Definition, Solution of Linear First-order Recurrence Relations with Constant Coefficients (Homogeneous and Non-homogeneous).

UNIT – II

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1, 4, 5, 10];**
TB2 [Chapters 1, 4]; TB3 [Chapters 2, 3, 9]

Formal logic: Statement, Symbolic Representation, Tautologies, Fallacy, Operations on Logic, Logically Equivalence, Algebra of Propositions, Arguments and Validity, Rules of Inference for Propositional Logic, Normal Forms.

Methods of Proofs: Direct Proof, Indirect Proof, Proof by Contradiction, Proof by Exhaustive Cases, Principle of Mathematical Induction, Principle of Complete Induction.

Lattices: Poset, Lattice, Sublattices, Types of Lattices - Bounded Lattice, Distributive Lattice, Complemented Lattice; Isomorphic Lattices.

Boolean Algebra: Definition, Subalgebra, Boolean Function, Boolean Expressions, Minimization of Boolean Function, K-Map.

UNIT – III

No. of Hours: 11 **Chapter / Book Reference: TB1 [Chapters 3, 11]; TB2 [Chapters 3, 6];**
TB3 [Chapters 6, 12, 20]

Number Theory: Primes, Division Algorithm, Greatest Common Divisor (GCD), LCM, Euclidean Algorithm, Fundamental Theorem of Arithmetic, Congruences, Linear Congruence equations, Chinese-Remainder Theorem, Euler Phi function, Fermat's Little Theorem, Applications of Congruences – ISBN, UPC, Introduction to Cryptography.

Group Theory: Definition, Groups as Symmetries, Subgroups, Cosets, Cyclic Group, Normal Subgroups, Quotient Group, Lagrange's Theorem, Homomorphism, Permutation Group.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 8]; TB2 [Chapter 5];**
TB3 [Chapters 14, 15]

Graph Theory: Graphs, Types of Graphs, Degree of a Vertex, Subgraphs and Isomorphic Graphs, Representation of Graphs, Operations of Graphs, Walks and Paths, Connectivity, Weighted Graphs, Euler Graph, Fluery's Algorithm, Hamiltonian Graph, Cut-Vertices and Cut-Edges, Planar Graphs, Euler's formula, Graph Colouring - Vertex Colouring, Edge Colouring, Chromatic Number and Chromatic Polynomial, Welch-Powell Algorithm, Four Colour Conjecture, Five Colour Theorem (with proof).

TEXT BOOKS:

TB1. Kenneth H. Rosen, “Discrete Mathematics & its Applications: With Combinatorics and Graph Theory”, McGraw Hill, 7th Edition, 2017.
TB2. J. P. Tremblay and R. Manohar, “Discrete Mathematical Structures with Applications to Computer Science”, McGraw Hill, 1st Edition, 2001.
TB3. Swapan Kumar Sarkar, “A Textbook of Discrete Mathematics”, S. Chand Publishing, 9th Edition, 2019.

REFERENCE BOOKS:

RB1. Kolman, Busby and Ross, “Discrete Mathematical Structures”, Pearson, 10th Edition, 2015.
RB2. D. S. Malik and M. K. Sen, “Discrete Mathematics: Theory and Applications”, Cengage, 1st Edition, 2012.
RB3. C. L. Liu, D. P. Mohapatra, “Elements of Discrete Mathematics”, McGraw Hill, 4th Edition, 2012.
RB4. S. Santha, “Discrete Mathematics with Combinatorics and Graph Theory”, Cengage, 1st Edition, 2009.
RB5. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, PHI, 1st Edition (1979), 24th Indian Print, 2003.

Computer Networks

Course Code: **MCA-103**
Course Name: **Computer Networks**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Understand basics, topologies and working mechanism of wired and wireless computer networks.
2. Analyze the features and operations of protocols of OSI reference model & TCP/IP protocol suite.
3. Design, calculate, and apply routing mechanisms for IPv4 & IPv6
4. Identify the networking requirements for an organization and select & propose appropriate architecture and technologies.
5. Work on Network addressing, design and implementation.

PRE-REQUISITES:

1. Basic Networking concepts
2. Basic Operating System Concepts

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
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.	BTL2	PO1, PO2, PO3, PO7
CO2	Utilize the fundamentals of data communication and networking to identify the topologies and connecting devices of networks.	BTL3	PO1, PO2, PO3, PO7, PO10
CO3	Identify and discuss the underlying concepts of IPv4 & IPv6 protocols, along with their characteristics and functionality.	BTL3	PO1, PO2, PO3, PO4

CO4	Discover the appropriate MAC layer/ data link layer protocols for the given network.	BTL4	PO1, PO2, PO3, PO4, PO7
CO5	Evaluate and implement routing algorithms and multicasting.	BTL5	PO1, PO2, PO3, PO4, PO11
CO6	Adapt transport and application layer protocols along with concepts of mobility and security in networks.	BTL6	PO1, PO2, PO3, PO4, PO6, PO7, PO8

UNIT – I

No. of Hours: 11 Chapter/Book Reference: TB1 [Chapters 3,4,5,6,7,8]; TB2 [Chapters 2,3]; TB3 [Chapters 1,2]

Introductory Concepts: Goals and Applications of Computer Networks, OSI reference model, TCP/IP protocol suite, networks topology & design. Networking Devices (Hub, Bridge, Switch & router). **Physical Layer**: The functions of Physical Layer, Guided Transmission Media, Wireless Transmission media, Communication Satellites, Digital Signal Encoding Formats, Digital to analog Modulation, Digitization – Sampling Theorem, PCM, DM, Analog to digital Modulation, The Mobile Telephone System, Multiplexing.

UNIT – II

No. of Hours: 11 Chapter / Book Reference: TB1 [Chapters 9,10,11, 12, 13, 14, 15, 16, 17]; TB3 [Chapter 3]

The Data Link Layer: Data Link Layer introduction, Error Detection and Correction, Flow Control Protocols, Error Control protocols.

Medium access sub-layer: Channel allocation problem, ALOHA Protocols, Carrier Sense Multiple Access Protocols, CSMA with Collision Detection, Collision free protocols, Ethernet, wireless LANs, Blue Tooth, Wi-Fi.

UNIT – III

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapters 18-22]; TB2 [Chapters [4-7]; TB3 [Chapter 5]

Network Layer: Functions of network layer, **IPv4**: Classful & classless addressing, Routing algorithms, IP packet format, **IPv6**: addressing, neighbor discovery, address auto configuration **Mobile IP**: Mobility in networks, IP Multicasting (Source based tree & Group shared tree).

UNIT – IV

No. of Hours: 10 Chapter/ Book Reference: TB1 [Chapters 23- 26, 30-32]; TB2 [Chapters 13-15]; TB3 [Chapters 6-7]

Transport Layer: Transport layer functions, Transport layer protocols, UDP, TCP, connection management, flow control, error control and congestion control.

Application Layer: DNS, Electronic Mail, www, firewalls, Concept of public & private keys.

TEXT BOOKS:

TB1. Behrouz A. Forouzan, “Data Communication and Networking”, TMH, 5th Edition, 2017.

TB2. Behrouz A. Forouzan, “TCP/IP Protocol Suite”, Tata Mc Grew Hill, 4th Edition, 2009.

TB3. A. S. Tanenbaum, “Computer Networks”, Pearson, 5th Edition, 2013.

REFERENCE BOOKS:

RB1. Douglas E. Comer, "Computer Networks and Internet", Pearson, 6th Edition, 2018.
RB2. Douglas E. Comer, "Internetworking with TCP/IP", Pearson, 6th Edition, 2015.
RB3. S. Keshav, "An Engineering Approach to Computer Networking", Pearson, 1st Edition, 2002.
RB4. Kevin R Fall and W. Richard Stevens, "TCP/IP illustrated, Volume 1: The Protocols", Addison Wesley, 2nd Edition, 2011.
RB5. W. Stallings, "Data and Computer Communication", Macmillan Press, 8th Edition, 2016

Operating Systems with Linux

Course Code: **MCA- 105**
Course Name: **Operating Systems with Linux**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Understand the basic components of Operating Systems and their interactions.
2. Select the policies for Process Management, Memory Management and Deadlock Management.
3. Understand the basics of File, Device and Disk Storage Management.

PRE-REQUISITES:
1. Fundamentals of Computer Systems
2. Introduction to Programming

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the structure and functions of Operating Systems along with their components, types and working.	BTL2	PO1, PO2, PO5, PO6
CO2	Make use of appropriate Linux commands for Memory Management, File Management and Directory Management.	BTL3	PO1,PO2, PO3, PO4, PO5, PO6
CO3	Analyze the performance of different Scheduling algorithms along with the policies for Concurrency and Deadlock management.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6 PO7, PO8, PO9
CO4	Elaborate the System Calls for Process management and File Management.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9

Unit –I

No. of Hours: 11 Chapter/Book Reference: TB1 [Chapter 1, 2, 3]; TB2 [Chapter 2, 3]; TB4 [Chapter 1]

Operating System: Concept, Components of Operating System, Operating System Operations, Protection and Security. Computing Environment. **Abstract View of OS**: User view, System View, Operating System Services, **System Calls:** Concept, types of System Calls. **Computer System Architecture**: Single-Processor Systems, Multiprocessor Systems. **Types of Operating systems:** Batch Operating System, Multi-Programmed Operating System, Time-Shared Operating System, Real Time Operating System, Distributed Operating Systems.
Process Management: Process Concept**,** Operation on Processes, Cooperating Processes, Inter-Process Communication, Threads.
Linux Operating System: Introduction to Linux OS, Basic Commands of Linux OS.

UNIT-II

No. of Hours: 11 Chapter / Book Reference: TB1 [Chapter 5, 6]; TB2 [Chapter 9]; TB3 [Chapter-7, 15]

Process Synchronization: Introduction, The Critical-Section Problem with solution, Bakery Algorithm, Synchronization hardware, Semaphores, Semaphores Implementation, Classical Problems of Synchronization with algorithms, Critical Regions, Monitors.
CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling algorithms**,** Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling.
Linux Operating System: Process Management Commands and System Calls.

UNIT-III

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapter 7, 8, 9]; TB3 [Chapter 15]

Deadlock: System Models, Deadlock Characterization, Resource Allocation Graph, Deadlock Prevention, Avoidance, Detection and Recovery, Banker's algorithm.
Memory Management: **Main Memory**: Contiguous Memory Allocation, Fragmentation, Paging, And Segmentation. **Virtual Memory:** Demand Paging, Page Replacement, Page replacement algorithm, Allocation of frames, Thrashing.
Linux Operating System: Memory Management Commands and System Calls.

UNIT-IV

No. of Hours: 10 Chapter / Book Reference: TB1[Chapter 9, 10, 11, 12]; TB2 [Chapter 5, 11]; TB3[Chapter 3, 7]

File, Devices and Secondary Storage Management: File-System Interface: Concepts, Access Methods, Directory and Disk Structure. File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management. **Devices:** Types of devices, Channels and Control Unit, Multiple Paths, Block Multiplexing. **Secondary Storage**: Mass-Storage Structure, Disk Structure, Disk Scheduling Algorithms, Disk Management, RAID structure of disk.
Linux Operating System: File Management Commands and System Calls.

TEXT BOOKS:

TB1. Silberschatz, Galvin, Greg, "Operating System Concepts", Wiley and Sons, 9th Edition, 2015.
TB2. Sumitabha Das, "Unix concept and Programming", McGraw Hill education, 4th Edition, 2015.

TB3. W. Richard Stevens Stephen A. Rago" Advanced Programming in the UNIX® Environment", Addison-Wesley, 3rd Edition, 2013.
TB4. Milan Milenkovic, "Operating Systems Concepts and Design", Tata McGraw-Hill, 2nd Edition, 1995.

REFERENCE BOOKS:

RB1. Godbole, Achyut, "Operating System", McGraw-Hill Education, 2nd Edition, 2005.
RB2. William Stallings, "Operating System: Internals and Design Principles", Person, 9th Edition, 2018.
RB3. A. S. Tanenbaum, "Modern Operating Systems ", Pearson, 3rd Edition, 2007.
RB4. Kenneth H. Rosenet al, "UNIX: The Complete Reference", McGraw-Hill/Osborne, 6th Edition, 2017.
RB5. Dhanjay M. Dhamdhere, "Operating System A concept based approach", Tata McGraw-Hill, 2nd Edition, 2006.
RB6. Madnick E. and Donovan J., "Operating Systems", Tata McGraw Hill, 2001.

Database Management Systems

Course Code: **MCA- 107**
Course Name: **Database Management Systems**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Develop a broad understanding of database concepts and database management system software, data models, schemas and instances, data constraints, relational algebra and calculus.
2. Acquire Knowledge to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.
3. Be able to write SQL and PL/SQL commands to create and manipulate database objects.
4. Be able to discuss importance of normalization and improve the database design by applying various normal forms.
5. Get in depth knowledge of concurrency control mechanisms, transaction management techniques and database security.

PRE-REQUISITES:
1. Elementary Maths (Sets, Relations)
2. Computer fundamentals related to memory organization such as primary memory, secondary memory etc.
3. Knowledge of basic data structures.
4. Basic knowledge of data storage and file management system.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the various database components, models, DBMS architecture and Database Security	BTL2	PO1, PO2, PO3

CO2	Apply relational database theory to construct relational algebra expression, tuple and domain relation expression for SQL queries.	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Construct advanced SQL queries on data and apply Procedural abilities through PL/SQL.	BTL4	PO1, PO2, PO3, PO4, PO5
CO4	Examine the use of normalization and functional dependency for database design.	BTL4	PO1, PO2, PO3, PO4, PO6, PO11, PO12
CO5	Appraise the concepts of transaction, concurrency control and recovery in databases.	BTL5	PO1, PO2, PO3, PO4, PO6, PO8,PO10, PO11, PO12

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-4]; TB2 [Chapters 1-2]**

Basic concepts: Database & database users, characteristics of the database, database systems, concepts and architecture, Data Models, Schemas & Instances, DBMS architecture & data independence, Overview of hierarchical, Network & Relational Data Base Management Systems.

Data Modelling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, Concepts of keys, Extended ER model – Generalization, Specialization, Aggregation, ER diagram to tables Mapping.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 5, 6, 8, 9]; TB2 [Chapters 3-5]; TB3 [Chapters 7-11]**

Relational Model: Relational data model, **Relational integrity constraints:** Entity Integrity, Referential integrity, Domain Constraints, Key constraints. **Relational Algebra, Relational calculus:** Tuple Relational Calculus and domain Relational calculus.

Introduction on SQL: SQL commands and types: DML, DDL, DCL, TCL. SQL Datatypes and literals, Operators in SQL. **Database Objects**: Table, View, Sequence, Index, Synonym, Queries. **Advanced SQL:** Functions: Single Row Functions, Aggregate functions, Sub queries, Join Operations. **Set Operations**: Unions, Intersection, Minus.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 10, 11]; TB2 [Chapters 7, 9]; TB3 [Chapters 15, 16, 18]**

Normalization: Functional dependencies, Normal forms- 1NF, 2NF, 3NF, BCNF, join dependencies and multi-valued dependencies.

PL/SQL Programming: Introduction to PL/SQL, Structure of PL/SQL Block, PL/SQL language: Operators, Control Structure, Cursors, Triggers, Procedures and functions.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 17-20, 23]; TB2 [Chapters 6, 15-17]**

Transaction processing concept: Transaction system, Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log-based recovery, checkpoints, deadlock handling.
Concurrency control techniques: Concurrency control, locking techniques, time stamp ordering, granularity of data items, recovery from catastrophic failures.
Concepts of object-oriented database management systems, Distributed Data Base Management Systems, overview of Database Security Concepts.

TEXT BOOKS:

TB1. Elmsari and Navathe, "Fundamentals of Database Systems", Pearson Education, 7th Edition, 2016.
TB2. Korth, Silberschatz, "Fundamentals of Database System Concepts", TMH, 6th Edition, 2010.
TB3. Ivan Bayross, "SQL, PL/SQL the Programming language of Oracle", BPB Publications, 2010.

REFERENCE BOOKS:

RB1. Ullman J. D., "Principals of Database Systems", Galgotia Publications, 2nd Edition, 1999.
RB2. C.J.Date, A. Kannan, S. Swamynathan "An Introduction to Database Systems", Pearson Education, 8th Edition, 2006.
RB3. Desai B., "An Introduction to Database Concepts", Galgotia Publications, New Delhi.
RB4. Shio Kumar Singh, "Databases Systems Concepts, Design and Applications", Pearson Publication, 2nd Edition, 2011.
RB5. Rajiv Chopra, "Database Management System (DBMS) - A Practical Approach", S. Chand & Company Pvt. Ltd., 4th Edition, 2014.

Object Oriented Programming and JAVA

Course Code: **MCA- 109**
Course Name: **Object Oriented Programming and JAVA**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Learn how to implement Object Oriented concepts through Java.
2. Identify and apply the Java thread model to program Java applications.
3. Understand the basics of the Collection Framework.
4. Understand and apply the basics of Java 8 Constructs
5. Implement JDBC,RMI and related concepts.

PRE-REQUISITES:
Programming Fundamentals and Object Orientation Concepts

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Illustrate the Object-Oriented paradigm, Java language constructs and JVM internal architecture.	BTL2	PO1, PO2, PO3
CO2	Apply the concepts of exception handling, multithreading, and collection framework.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO3	Analyze the use of event handling and JFC based toolkit in creating GUI-based computing solutions.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10
CO4	Design database enabled client-server applications using JDBC, RMI, I/O operations, network programming and relevant concepts.	BTL6	PO1,PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10

CO5	Elaborate the functional programming concepts introduced in Java 8 and beyond.	BTL6	PO1, PO3, PO4, PO5, PO6, PO7, PO10, PO11, PO12

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1-9, 12, 16, 17]; TB2 [Chapters 1-10]**

OOP Paradigm: Comparison of programming paradigms, Characteristics of Object-Oriented Programming Languages, Object-based programming languages

Java Fundamentals: Brief History of Java, Structure of a Java program, Importance and features of Java, Introduction to JVM and its architecture including set of instructions. Overview of JVM Programming. Internal and detailed explanation of a valid .class file format. Instrumentation of a .class file, Bytecode engineering libraries, Overview of class loaders and Sandbox model of security. Basic language construct of Java-including keywords, constants, variables, operators, looping and decision-making construct

Implementation of OOPs concepts in Java: Objects, Classes and their implementation, Encapsulation, Data Abstraction, Inheritance, Polymorphism, Dynamic Binding, Message Passing, default parameter values, using reference variables with function

Arrays and String: creating an array, one and two-dimensional arrays, String arrays and methods, Classes: String and String Buffer classes, Wrapper classes: Basics types, using super, multilevel hierarchy abstract and final classes, Object class, packages and interfaces, access protection, extending interfaces, packages

UNIT – II

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 10-11, 18, 22,28]; TB2[Chapters 11, 15-16, 18]**

Exception Handling: Fundamentals exception types, caught and uncaught exceptions, throw, throws, built in exceptions, custom exceptions

Multithreaded Programming: Multithreading basics, Happens-before ordering, Java Thread Model: priorities, synchronization, messaging, thread class, Runnable interface, inter-thread communication, suspending, resuming, and stopping threads.

The Collection Framework: The Collection Interface, Collection Architecture in Java, Collection Classes, traversing Collections, working with Maps & Sets

Networking fundamentals: networking classes and interfaces, using java.net package, TCP/IP, and Data-gram Programming

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 24-27, 31-33]; TB2[Chapters 12-13]**

Anonymous Classes and Inner classes in Java: Core concept and its implementation and types of anonymous classes, nested and inner classes, and their implementation

Event Handling: Different Mechanism, the Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter and Inner Classes, working with windows, Graphics and Text, using AWT controls, Layout managers and menus, handling Images, animation, sound and video.

Swing: Introduction to JFC (Java Foundation Classes), features of Swing, comparison with AWT, Advanced Control

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 13-15, 20, 29-30]; TB2 [Chapters 14, 18]

JDBC: Introduction to DBMS & RDBMS, DBC API, JDBC Application Architecture, Obtaining a Connection, JDBC Models: Two Tier and Three Tier Model, Result Set, Prepared Statement, Callable Statement.

Input/output Programming: Basics, Streams, Byte and Character Stream, predefined streams, Reading and writing from console and files.

Java 8 Concepts: Default and Functional Interfaces, Lambda Expression, Java stream API and Pipelines, Try with Resources, Java 8 Memory optimization.

RMI (Remote Method Invocation): Introduction, Steps in creating a Remote Object, Generating Stub & Skeleton, RMI Architecture, RMI packages.

TEXT BOOKS:

TB1. Herbert Schildt, "Java - The Complete Reference", Oracle Press, 9th Edition, 2014.

TB2. Kathy Sierra and BertBates, "Head First Java", O'Reilly Publications, 2nd Edition, 2005.

REFERENCE BOOKS:

RB1. E. Balaguruswamy, "Programming with Java", Tata McGraw Hill, 4th Edition, 2009.

RB2. Cay Horstmann, "Computing Concepts with Java 2 Essentials", John Wiley & Sons, 2nd Edition, 1999.

RB3. Decker and Hirshfield, "Programming Java: An Introduction to Programming using JAVA", Vikas Publication, 2nd Edition, 2000.

RB4. N. P. Gopalan and J. Akilandeswari, "Web Technology - A Developers' Perspective", PHI, 2nd Edition, 2014.

RB5. Eric Jendrock, Jennfer Ball and Debbei Carson, "The Java #EE5 Tutorial", Pearson, 3rd Edition, 2007.

RB6. Daniel Liang, "Introduction to Java Programming", Pearson, 7th Edition, 2010.

RB7. Bill Vanners, "Inside Java Virtual Machine", Tata McGraw Hill, 2nd Edition, 2000.

RB8. Shelley Powers, "Dynamic Web Publishing", Techmedia, 2nd Edition, 1997.

Computer Networks Lab.

Course Code: **MCA-161**
Course Name: **Computer Networks Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop the working expertise of the following:-

1. Operating principles of computer networking and acquire practical notions of various communication protocols.
2. Analysing the network routing algorithms and a practical approach to Ethernet/Internet networking.
3. Implementing the concept of data transfer between nodes.
4. Assembling of networks, and experimenting to understand the layered architecture
5. Evaluating the challenges in building networks for organizations.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Interpret suitable Network Simulator	BTL2	PO1, PO2, PO3, PO4,PO5
CO2	Apply network configuration skills to design specific network scenarios.	BTL3	PO1,PO2, PO3,PO4, PO5, PO7
CO3	Make use of various connecting devices and LAN connectivity to build networks.	BTL3	PO1, PO2,PO3, PO4, PO5, PO7, PO11
CO4	Simulate the working and analyze the performance of various communication protocols.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10
CO5	Evaluate routing in the networks and compare different routing algorithms	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO6	Work in teams to design networks for real life scenarios by applying the concepts of all the layered architecture.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO11, PO12

Operating Systems with Linux Lab.

Course Code: **MCA- 163**
Course Name: **Operating Systems with Linux Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop the working expertise of the following:-

1. Perform Linux Operating System Installation.
2. Implement the policies of Process Management, Inter process communication and Memory Management
3. Apply the basics of File Management, Device and Disk Storage Management

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Build the Linux operating system and configure it.	BTL3	PO1, PO2, PO3, PO4, PO5
CO2	Discover Linux commands for working with Linux Environment	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO3	Appraise the Process Management algorithms, Process Management system calls, Inter Process Communication and CPU Scheduling algorithms	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10
CO4	Create programs using systems calls for memory management and File Management in C programming, also simulate Deadlock avoidance algorithm using C.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Database Management Systems Lab.

Course Code: **MCA-165**
Course Name: **Database Management Systems Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop the working expertise of the following:-

1. Working expertise of DDL and DML commands with their application on solving real time problems.
2. Ability to apply filters using where clause and nested queries, integrity constraints at table level and column level and to use built-in functions including numeric, character and date functions.
3. Adequate knowledge to fetch data from multiple tables using different types of JOIN operations.
4. Knowledge of the generic structure of PL/SQL programs based on different PL/SQL control structures – Triggers, Cursors, Functions & Procedures and to apply transaction management concepts using Save point, Rollback and Commit statements.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to: -

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Translate an information model into a relational database schema and to implement the schema using RDBMS	BTL2	PO1, PO2, PO3, PO5, PO6
CO2	Apply advanced SQL features like views, indexes, synonyms, etc. for database management	BTL3	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Analyze PL/SQL structures like functions, procedures, cursors and triggers for database applications.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Examine database administration concepts like GRANT, REVOKE etc. through SQL commands.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO6	Work in teams to design solutions for real world problems/case studies by creating efficient database schema.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Object Oriented Programming and JAVA Lab.

Course Code: **MCA-167**
Course Name: **Object Oriented Programming and JAVA Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of Object-Oriented concepts in Java. Learners will be able to construct Java based computing solutions on real world case studies implementing concepts studied in theory.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO#	Detailed Statement of the CO	BT Level	Mapping to PO#
CO1	Apply Object-Oriented and Java language constructs for creating Java programs.	BTL3	PO1, PO2, PO3,PO4, PO5, PO7, PO10
CO2	Make use of exception handling, multithreading, and collection framework for constructing effective solutions.	BTL3	PO1, PO2, PO3, PO4, PO6,PO10, PO11
CO3	Inspect the use of event handling and JFC based toolkit for GUI-based computing solutions.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10, PO11
CO4	Design database enabled client-server applications using JDBC, RMI, I/O operations, network programming and relevant concepts.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO11
CO5	Elaborate the functional programming concepts introduced in Java 8 and beyond.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10, PO11, PO12

Minor Project – I

Course Code: **MCA-169**
Course Name: **Minor Project – I**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of solving complex computing problems through project based learning approach using real world case studies by implementing the concepts studied in the theory courses of this semester.

COURSE OUTCOMES (CO):
After completion of this course, the learners will be able to:-

CO#	Detailed Statement of the CO	BT Level	Mapping to PO#
CO1	Apply acquired knowledge within the chosen technology for solution of specific problem.	BTL3	PO1, PO2, PO3, PO4
CO2	Analyze the technical aspects of the chosen project through a systematic and comprehensive approach.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Deduct plausible solution for the technical aspects of the project.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO4	Work as an individual or in teams to develop the technical project.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10, PO11, PO12
CO5	Create effective reports and documentation for all project related activities and solutions.	BTL6	PO11

Professional Proficiency – I

Course Code: **MCA-171**
Course Name: **Professional Proficiency – I**

Objective and Structure of this Course:
General Proficiency (under NUES Scheme) is aimed to impart value added modules to students, based upon the changing requirements of the industry, from time to time. This innovative practice makes the scheme open and adaptive to the changing requirements of the industry, by keeping inbuilt flexibility of introducing any value added module based upon industry input, from time to time. The required decision of the value added module and related assessment guidelines shall be finalized by the Programme Co-ordination Committee, before start of the semester. Its COs and required mapping shall be done by the Programme Co-ordination Committee, after finalizing the value added module to be offered under this course. There shall not be any external examination of the University for this course. The performance of the candidates should continuously be evaluated by an internal committee, at the College level, as per the guidelines of the Programme Coordination Committee.

Suggestion:
It is suggested to have Personality Development and Communication Skills Course in first semester under Professional Proficiency - I. However, the final decision shall be taken by the Programme Coordination Committee, before start of the semester.

Data and File Structures

Course Code: **MCA- 102**

Course Name: **Data and File Structures**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Familiarization of fundamentals of data and file structures and their operations like, insertion, deletion, searching and sorting
2. Understanding and implementation of data structures like arrays, linked lists, stacks, queues, trees, graphs and files
3. Identification of a suitable data structure to model data used in real world applications

PRE-REQUISITES:

1. Discrete Structures
2. Programming Skills

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall different type of data structures.	BTL1	PO1
CO2	Explain the fundamentals of an Abstract Data Type (ADT).	BTL2	PO1, PO2
CO3	Apply linear and nonlinear data structures to solve real time problems.	BTL3	PO1, PO2, PO3, PO4, PO6, PO10
CO4	Appraise and determine the correct data structure for any given real-world problem.	BTL5	PO1, PO2, PO3, PO4, PO6, PO10, PO11
CO5	Create innovative solutions for real world problems.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6,

			PO7, PO10, PO11

UNIT – I

No. of Hours: 14 Chapter / Book Reference: TB1 [Chapters 1-4,7]; TB2 [Chapters 3, 7]

Introduction to Linear Data Structures:
Introduction and Classification of Data Structures, Abstract Data Types.
Arrays: Single Dimension, Multi Dimensions, Memory Representation, Address Calculation, Sparse Matrices- Types, Representation and Operations, Linear and Binary Search, Selection Sort, Bubble Sort, Insertion Sort, Radix Sort, Merge Sort, Shell Sort.
Linked List: Dynamic Memory versus Static Memory Allocation, Types and Operations- Singly Linked List, Doubly Linked List, Header Linked List, Circular Linked List, Applications- Polynomial Arithmetic**.**
Stacks and Queues: Introduction and Implementation, Types of Queues and Applications, Multi Stacks and Multi Queues, Applications of Stacks- Need, Evaluation and Conversion between Polish and Reverse Polish Notations, Quick Sort, Recursion.

UNIT – II

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapter 5]; TB2 [Chapters 4, 6]

Non Linear Data Structures: Trees
Trees: Notations & Terminologies, Binary Trees, Binary Search Trees and Basic Operations, Tree Traversals (Recursive and Stack Based non-Recursive), Threaded Binary Tree, Tree Sort, Tries.
AVL Trees: Properties, Operations- Insertion and Deletion.
M- Way Trees: General Concept, B Trees , B+ Trees and B* Trees.
Heaps: Structural Properties, Heapify, Heap Sort, Priority Queue Implementation.

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 6]; TB2 [Chapter 9]

Non-Linear Data Structures: Graphs
Representation of Graphs: Adjacency Matrix and Linked Representation.
Graph Traversals: Breadth First Search, Depth First Search, Connected Components.
Spanning Trees: MST Algorithms - Kruskal's Algorithm, Prim's Algorithm.
Shortest Path Algorithms: Single Source and All Pairs- Dijkstra's Algorithm, Floyd-Warshall Algorithm, Topological Sort.
Case Studies: Dynamic Graphs, Social Network Graphs and Sparse Graphs.

UNIT – IV

No. of Hours: 9 Chapter / Book Reference: TB1 [Chapters 8, 10]; TB2 [Chapter 5]; TB3 [Chapters 4, 10-16]

Hashing and File Structures:
Hashing: Hash Table, Hash Functions, Collision Resolution- Chaining and Open Addressing.
File Organization: Sequential, Index Sequential, Relative. Operations- Creating, Updating, and Retrieving from Sequential Files, Handling Sequential Files in C language, Seeking, Positioning, Reading and Writing Binary Files in C.
External Sorting: Merging Ordered Files and Unordered Files, Natural Merge, Balanced Merge, K-Way and Polyphase Merge.

TEXT BOOKS:

TB1. E. Horowitz and S. Sahni, "Fundamentals of Data Structures in C". Universities Press, Second edition, 2008.

TB2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education India, Fourth Edition, 2014.

TB3. Mary E. S. Loomis, "Data Management and File Structure", PHI, Second Edition, 2009.

REFERENCE BOOKS:

RB1. Y. Langsam, M. J. Augenstein and A.M. Tanenebaum, "Data Structures using C and C++", Pearson Education India, 2nd Edition, 2015.

RB2. Alfred V. Aho, John E. Hopcroft and D. Ullman, "Data Structures and Algorithms", Addison-Wesley, 1st Edition, 2002.

RB3. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Cengage Learning, 2nd Edition, 2004.

RB4. D. Malhotra and N. Malhotra, "Data Structures and Program Design using C", Laxmi Publications, Indian adapted edition from Mercury Learning and Information, USA, 1st Edition, 2018.

RB5. Schaum's Outline Series, "Data Structure", TMH, Special Indian Ed., 17th Reprint, 2014.

RB6. D. Samanta, "Classic Data Structures", PHI, 2nd Edition, 2009.

Object Oriented Software Engineering

Course Code: **MCA-104**
Course Name: **Object Oriented Software Engineering**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. To understand the iterative implementation of software projects.
2. To analyze projects using use case modeling tools.
3. To develop solutions for real life cases using design models and patterns.
4. To understand and implement project design requirements for user interface, data layer and system controls.
5. To apply modern case tools to develop solutions.

PRE-REQUISITES:
1. Software Engineering Concepts
2. Object Oriented Programming Concepts

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Illustrate system modeling and architecture using UML	BTL2	PO1, PO2, PO3, PO7
CO2	Apply suitable iterative process model	BTL 3	PO1, PO2, PO3, PO4, PO7, PO11
CO3	Analyze requirements with use cases.	BTL 4	PO1, PO2, PO3, PO4, PO6, PO7, PO10
CO4	Appraise analysis and design artifacts	BTL 5	PO1 ,PO2, PO3, PO4, PO7, PO11
CO5	Create domain models for analysis phase	BTL 6	PO1, PO2, PO3, PO4, PO7, PO11
CO6	Design object solutions with patterns and architectural layers	BTL 6	PO1, PO2, PO3, PO4, PO7, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB3 [Chapter 6]; TB2 [Chapter 2]

Object Oriented Concepts: Review of Objects and Classes. Links and association, Generalization and specialization, Inheritance, Grouping concepts, aggregation, composition, abstracts classes, Polymorphism, Metadata, Constraints, Reuse.

Object Oriented Methodologies: Introduction to Rational Unified Process, Comparison of Traditional Lifecycle Model vs Object Oriented lifecycle model.

UML: Origin of UML, 4+1 view architecture of UML

Architecture: Introduction, System development is model building, model architecture, requirements model, analysis model, the design model, the implementation model, test model.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 3]; TB3 [Chapters 7]

Project Management and Inception Phase: Project Management, the unified process and the inception phase, Project Monitoring and Control.

Analysis: Introduction, the requirements model, the analysis model – use cases and domain classes, use case modelling and Detailed Requirements.

UML: Use case model, Activity Diagram, System sequence Diagrams, Object Diagrams, Domain Class Model Diagrams.

UNIT – III

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapter 8-10]; TB2 [Chapters 8, 12]

Construction: Introduction, the design model, block design, working with construction. Use case realization: the design discipline within UP iterations.

Designing the Subsystem: Mapping design to code, Designing the data access layer, UI interfaces and system interfaces.

Reusable Design Patterns: Importance of design patterns, Basic design patterns – Singleton, Multiton, Iterator, Adapter, Observer.

UML: Communication Diagrams, Design Class Diagram, State Transition Diagram, Package Diagram, Component Diagram and Deployment Diagram.

UNIT – IV

No. of Hours: 8 Chapter / Book Reference: TB2 [Chapter 13]; TB3 [Chapter 12]

Object Oriented Testing Techniques: Testing Terminology, Types of test, Automatic Tests, Testing Strategies.

Agile Process: Agile Manifesto, Agile Principles, Introduction to Extreme Programming, Scrum, Lean processes. Case Studies.

TEXT BOOKS:

TB1. John W. Satzinger, Robert B. Jackson and Stephen D. Burd, “Object Oriented Analysis and Design with Unified Process”, Cengage Learning, 1st Edition, 2014.

TB2. Mike O’Docherty, “Object Oriented Analysis and Design”, Wiley, 1st Edition, 2013.

TB3. Ivar Jacobson, Magnus Christerson, Patrick Jonsson and Gunar Overgaard, “Object Oriented Software Engineering-Use Case Driven Approach”, Pearson, 7th Impression, 2009.

REFERENCE BOOKS:

RB1. Grady Booch, James Rumbaugh, Ivar Jacobson, "The UML User Guide", Pearson, 2nd Edition, 2008.

RB2. Craig Larman, "Applying UML and Patterns – An Introduction to Object-Oriented Analysis and Design and Iterative Development", Pearson, 3rd Edition, 2016.

RB3. Martin C Robert and Martin Micah, "Agile Principles, Patterns, and Practices in C#", Pearson, 1st Edition, 2007.

RB4. Yogesh Singh and Ruchika Malhotra, "Object Oriented Software Engineering", PHI, 1st Edition, 2012.

RB5. Mahesh P. Matha, "Object Oriented Analysis and Design using UML", PHI, 1st Edition, 2008.

RB6. Michael Blaha and James Rumbaugh, "Object Oriented Modelling and Design with UML", Pearson, 2nd Edition, 2013.

Python Programming

Course Code: **MCA-106**
Course Name: **Python Programming**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Master the fundamentals of writing Python scripts
2. Understand decision-making and functions in python
3. Interpret Object-oriented programming features in python
4. Gain knowledge of data structures in python
5. Explore GUI programming and database operations in python

PRE-REQUISITES:
Problem Solving Skills

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO#
CO1	Demonstrate knowledge of basic programming constructs in python.	BTL2	PO1, PO2, PO3, PO5
CO2	Illustrate string handling methods and user defined functions in python.	BTL2	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Apply data structure primitives like lists, tuples, sets and dictionaries.	BTL3	PO1, PO2, PO3, PO4, PO5, PO10
CO4	Inspect file handling and object- oriented programming techniques.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Evaluate and visualize the data using appropriate python libraries.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10, PO11
CO6	Develop python applications with database connectivity operations.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 Chapter/Book Reference: TB1 [Chapter 5]; TB3 [Chapters 1-6, 15]

Conceptual Introduction: History, Features and Future of Python, Installation, Interactive Shell, Program Structure, Identifiers, Keywords, Escape Sequences, Data-Types, Variables, Assignments, Immutable Variables, Operators and Operands, Precedence of Operators, Type-Conversion Functions, Short-circuit vs. Lazy Evaluation ,Input and Output Functions, Comments, Command-Line arguments.
Control Flow: Conditional Statements: if, if-else, if-elif-else, Nested Conditionals, Loops: for, while, break, and continue statements.
Functions: Defining, Calling and Types of Functions, Arguments and Return Values, Formal vs. Actual Arguments, Scope and Lifetime, Keyword Arguments, Default Arguments, Decorators, Iterators and Generators, Recursion.
Modules: Importing Modules, Math and Random Module, Packages and Composition.

UNIT – II

No. of Hours: 11 **Chapter/Book Reference: TB2 [Chapters 5, 18]; TB3[Chapters 3, 10, 11, 13, 14]**

String Manipulations: Basic functions of Strings, Subscript Operator, Indexing, Slicing and Immutable Strings.
Data Structures: Lists, Tuples, and Dictionaries, Basic List Operations, List Slicing, List Methods, Cloning Lists, Mutability, Searching and Sorting Lists, Tuples: Tuple Assignment, Tuple as Return Value, Dictionary Literals, Adding and Removing Items, Accessing and Replacing Values, Traversing Dictionaries, Sorting Dictionaries, Dictionary Operations, Sets Operations.
File Handling: Text Files-Writing and Reading Operations, Creating and Reading a Formatted File, Manipulating Files and Directories, Closing Files.

UNIT – III

No. of Hours: 12 **Chapter/Book Reference: TB3 [Chapters 7, 8, 12,13]**

Object Oriented Programming: Classes, Objects, Attributes and Methods, Access Specifiers, Constructors, Static Methods, Data Hiding, Inheritance, Polymorphism, Operator Overloading, Abstract Classes.
Threads: Multi-Threading, Life-Cycle of a Thread, Synchronization using Locks and Semaphores.
Exception Handling: Exception Class Hierarchy, Except clause, Try, Finally clause, User-Defined Exceptions, Assertions.

UNIT – IV

No. of Hours: 12 **Chapter/Book Reference: TB1 [Chapters 11-12]; TB3 [Chapters 9, 16-23]**

Advanced Python: Lambda and List Comprehensions, Map, Reduce and Filter Functions
NumPy Library: Introduction to NumPy, Creation of One-Dimensional Arrays, Reshaping of an Array, Element-wise Operations, Aggregate Operations, Array Indexing, Array Slicing, Insert Row/Columns, Append Row/Columns, Array Manipulation Operations, Multi-Dimensional Arrays.
Pandas Library: Data Preparation and Pre-Processing, Series, Querying a Series, Data-Frames, DataFrame Indexing and Loading, Querying a Data Frame, Indexing Data Frames, Missing Values.

Data Visualization: Graphs in Python: Bar charts, Pie-charts, Scatter plots, Multiple plots, Subplots, Legends, Changing figure Size, Styling plots using Matplotlib Library.
GUI Programming: Creating User-interface, GUI Widgets with Tkinter, Creating Layouts, Check Box, Radio Buttons, List Box, Menus, Menus Options, Dialog Boxes
Database Access: Database Connectivity Operations: Create, Insert, Select, Delete, Drop, Update, Joins.

TEXT BOOKS:

TB1. Budd T A, "Exploring Python", McGraw-Hill Education, 1st Edition, 2011.
TB2. Mark Lutz, "Learning Python", O'Reilly, 4th Edition, 2013.
TB3. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, 1st Edition, 2013.

REFERENCE BOOKS:

RB1. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, 1st Edition, 2011.
RB2. Allen Downey, "Think Python: How to Think Like a Computer Scientist", O'Reilly, 2nd Edition, 2015.
RB3. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, 1st Edition, 2017.
RB4. Joel Grus, "Data Science from Scratch", O'Reilly, 2nd Edition, 2019.
RB5. Tony Gaddis, "Starting out with Python", Pearson, 3rd Edition, 2014.

Advanced Database Management Systems

Course Code: **MCA- 108**
Course Name: **Advanced Database Management Systems**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Expertise related to EER concepts, normalization, query processing & optimization and transaction processing.
2. Fair knowledge about implementation of NoSQL databases and its applications, structure and storage of XML data.
3. Fundamental knowledge of Big data and its applications, client server architecture and emerging database models and applications and other advanced data models like multimedia and web databases.
4. Knowledge of Object-Oriented databases and concurrency control techniques, database recovery techniques in distributed databases.

PRE-REQUISITES:
1. Data Base Management systems
2. Basics of Object-Oriented Concepts
3. Working knowledge of SQL/PL-SQL

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply EER concepts and normalization for specific cases.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11
CO2	Make use of query processing, query optimization and advanced transaction processing for specific problem scenarios.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Analyze object-oriented paradigm in database design along with OODBMS and ORDBMS	BTL4	PO1, PO2, PO3, PO4, PO6, PO10

CO4	Evaluate various concurrency control mechanisms and recovery techniques for Distributed Databases	BTL5	PO1, PO2, PO3, PO4, PO6, PO10
CO5	Appraise advanced database models and their applications	BTL5	PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10
CO6	Design and create appropriate NoSQL Databases for specific applications	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters – 3, 4, 10, 11, 15]; TB2 [Chapters - 6, 7, 9, 13, 14]; TB3 [Chapters – 2, 3, 12, 15 ,19]**

Relational Databases: Integrity Constraints revisited, ER and Extended ER diagram, Comparison between DBMS, RDBMS, OODBMS, Distributed and Centralized DB, Functional Dependency and Normalization (1NF, 2NF, 3NF, BCNF, 4NF and 5NF).

Query Processing and Optimization: Relational Algebra, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Transformation of Relational Expressions, Indexing and Query Optimization.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter- 10]; TB4 [Chapters - 1, 2, 3]**

NoSQL Databases: Defining NoSQL databases, functions of NoSQL, Categories of NoSQL, implementing it on CouchDB (Creating a Database and Storing Data, Nesting Data, Retrieving Data, Querying Data, Defining Views, Using Reduce Function to Reduce Data), overview of other NoSQL databases (MongoDb), Introduction to Big Data and applications.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters - 20]; TB2 [Chapter- 9]; TB3 [Chapter - 23]**

Object Oriented DBMS: Overview of object-oriented paradigm, OODBMS architectural approaches, Object identity, procedures and encapsulation, Object oriented data model: relationship, identifiers, Basic OODBMS terminology, Inheritance, Basic interface and class structure, Type hierarchies and inheritance, Type extents and persistent programming languages, OODBMS storage issues, Comparison of OODBMS and OORDBMS.

XML: Structure of XML data, storage of XML data, XML applications.

UNIT – IV

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapter- 25]; TB2 [Chapter – 19, 24, 25]; TB3 [Chapters - 22]**

Distributed Databases: Introduction of Distributed Databases and its features, DDBMS architectures, Homogeneous and Heterogeneous databases, Distributed data storage, Distributed transactions, Commit protocols, Availability, Concurrency control & recovery in distributed databases, Distributed query processing: Query Transformation.

Advanced Transaction Processing: Real time transaction systems, long duration transaction, and nested transaction.

Overview of Advanced Database Models: Multimedia database, Deductive databases, Semantic databases, Spatial databases, Mobile databases and web database.

TEXT BOOKS:

TB1. Elmarsi, Navathe, Somayajulu, Gupta, "Fundamentals of Database Systems", Pearson Education, 7th Edition, 2016.
TB2. Silberscatz, Korth, Sudarshan, "Database System Concepts", Mcgraw Hill, 7th Edition, 2019.
TB3. R. Ramakrishnan, "Database Management Systems", McGraw Hill International, 3rd Edition, 1998.
TB4. Banker, Bakkum,Verch, Gerrett, Hawkins, "Mongodb in Action", Manning Publication, 2nd Edition, 2016.

REFERENCE BOOKS:

RB1. Date, Kannan, Swaminathan, "An Introduction to Database Systems", Pearson Education, 8th Edition 2007.
RB2. Singh S. K., "Database System Concepts, Design and Application", Pearson Education, 2006.
RB3. D. Maier, "The Theory of Relational Databases", Computer Science Press, Rokville, Maryland, 1993.
RB4. Bernstein, Lewis, Panigrahi,"Database Systems an application oriented system", Pearson Publications, 2nd Edition, 2008.

Data Warehousing and Data Mining

Course Code: **MCA-110**
Course Name: **Data Warehousing and Data Mining**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Principles of Data Warehousing and Data Mining.
2. Architecture of Data Warehouse.
3. Various Data pre-processing Methods.
4. Data Mining techniques.

PRE-REQUISITES:
1. Information System Concepts
2. Database Management System

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate to Data warehouse principles, components and architectures	BTL1	PO1, PO2, PO3
CO2	Demonstrate the necessity of data pre-processing for mining applications	BTL2	PO1, PO2, PO3, PO4
CO3	Apply suitable data mining techniques to solve specific real world problems	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10
CO4	Compare and evaluate different data warehousing models	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB2 [Chapters 1, 2, 10, 11 & 15]**

Data Warehouse and OLAP Technology: Data warehouse definition, Difference between Database System and Data Warehouse, Need for data warehousing, Basic building blocks

of Data warehouse, Data Warehouse Models, Metadata in the data warehouse, Data Warehouse Architecture, Dimension and Fact Tables. Multidimensional Data Model: Star, Snowflake, Constellation. Data Cube and OLAP operation, OLAP Server (ROLAP, MOLAP and HOLAP). OLAP based Case Study.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-3]

Introduction to Data Mining: Data Mining-Definition & Functionalities, Applications of Data Mining, Issues in Data Mining, Data Mining Primitives, KDD Process, OLAP VS Data Mining.

Data Pre-Processing: Data Objects and Attributes, Inconsistent Data, Need for Data Pre-Processing, Data Pre-processing Techniques: Cleaning, Integration, Transformation, Reduction.

UNIT – III

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapters 6,8,9]

Introduction to Data Mining Approaches: Supervised and Unsupervised Learning

Classification: Applications of classification and prediction. Issues regarding Classification and prediction, Classification methods: Decision tree induction, Naïve Bayesian Classification, Classification by Back propagation, Model Evaluation.

Association Rule Mining: Application of Association Rule Mining, Frequent Item sets, Mining Association rules from Transactional Databases using Apriori and FP Growth, finding relevant rule using Support, Confidence and Lift ratio.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 10, 12]

Cluster Analysis: Applications of Clustering, Types of clustering methods: Partitioning, Hierarchical and Density Based, Evaluation of Clusters.

Outlier Analysis: Types of outliers, Challenges of Outlier Detection, Outlier Detection Methods.

TEXT BOOKS:

TB1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Elsevier, 3rd Edition, 2011.

TB2. Paul Raj Poonia, “Fundamentals of Data Warehousing”, John Wiley & Sons, 2nd Edition, 2003.

REFERENCE BOOKS:

RB1. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.

RB2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2nd Edition, 2007.

RB3. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw Hill, 10th Reprint, 2007.

RB4. K. P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

Mobile Applications Design and Development

Course Code: **MCA-112**

Course Name**: Mobile Applications Design and Development**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Design scripts to meet given interface requirements.
2. Use variables, properties and other code elements appropriately to implement the code design.
3. Devise, carry out and evaluate functional test strategies of mobile design.
4. Implement and evaluate techniques for the installation of mobile applications and delivery via various channels.

PRE-REQUISITES:

1. Basic Programming skill
2. Basic knowledge of web applications

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate to Android OS architecture and application components	BTL1	PO1, PO2, PO3
CO2	Make use of appropriate activities and intents in Android app development	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Model GUI application design in Android using action controls, fragments and views	BTL3	PO1, PO2, PO3, PO5, PO7, PO11

CO4	Analyze Android data storage mechanism and APIs	BTL4	PO2, PO3, PO4, PO5, PO7, PO9
CO5	Appraise iOS technology stack for mobile app development	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO11
CO6	Design iOS applications using Swift language constructs	BTL6	PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO11, PO12

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters: 1-6]**

Android Systems: Introduction to Mobile devices and applications, Open Handset Alliance (OHA), Overview of Android OS and architecture, installing android studio, understanding the android build system.

Introduction to Android Application Components: Activity, service, content provider and broadcast received, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

Activities and Intents: Declaring and starting a new activity, switching between activities, passing data and returning value from activity, state of activity, storing persistent activity data, understanding activity life cycle, Types of intents, intent filter, context, data sharing using intent.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapters: 2-6, 8, 10]**

Android User Interface: Basic android UI, android layouts, view attributes, button, text view and edit text, spinner, check box, radio button, date and time pickers, scroll view, switch and toggle, image view, drawable, styles and themes, UI events and event listeners, animations, notifications, progress dialog, Action bar, tool bar, menus and pop ups, Floating action button, Tab based UI, Fragment, Types of Fragment, Fragment Life cycle, communication between fragment and activity, add, replaced remove fragment, Listview, material design, recyclerview.

UNIT – III

No. of Hours: 12 **Chapter / Book Reference: TB2 [Chapters: 7, 12-14]; TB3 [Chapters: 1-4]**

Android Storage: Using Android Data and Storage APIs, Managing data using SQLite, Sharing Data between Applications with Content Providers

Android APIs: Multimedia, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, android location based services

Introduction to iOS Technology Stack: iOS architecture, StoryBoard, features of Xcode, components of iOS SDK, view controller, AppDelegate, Single page application

Introduction to Swift: datatypes, variables, flow control statements, different operators, Typecasting using as operator. Collections and functions in swift, classes and structures, inheritance, closure and enumerations.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters: 5-7 & 9-12]**

User Interactions: Controls, gesture organizers, touching views, layouts, concepts of Bounds and frame, Navbar and Navbar button, Toolbar and Toolbar buttons, Timers, Container view, Table and navigation, Core Location and Mapkit, using Google Maps in iOS. Sensors in iOS

Data Persistence: Core Data framework for storing persistent data, CRUD operations.

TEXT BOOKS:

TB1. Meier Reto and Ian Lake, "Professional Android", Wrox, 4th Edition, 2018.

TB2. Rick Boyer, "Android 9 Development Cookbook", Packt Publishing Limited, 3rd Edition, 2018.

TB3. Craig Grummitt, "iOS Development with Swift", Manning publications, 4th Edition, 2017.

REFERENCE BOOKS:

RB1. Dawn Griffiths and David Griffiths, "Head First Android Development: A Brain-Friendly Guide", O'Reilly, 2nd Edition, 2017.

RB2. Bill Phillips, Chris Stewart, Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", Big Nerd Ranch Guides, 4th Edition, 2019.

RB3. Mark Wickham, "Practical Android: 14 Complete Projection Advanced Techniques and Approaches", Apress, 1st Edition, 2018.

RB4. Matt Newburg, "iOS 13 Programming Fundamentals with Swift: Swift, Xcode, and Cocoa Basics", O'Reilly, 1st Edition, 2019.

RB5. Wallace Wang, "Beginning iPhone Development with Swift 5: Exploring the iOS SDK", Apress, 5th Edition, 2019.

RB6. Matt Newburg, "Programming iOS 13: Dive Deep into Views, View Controllers, and Frameworks", O'Reilly, 1st Edition, 2019.

Full Stack Development

Course Code: **MCA-114**

Course Name: **Full Stack Development**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. The core concepts of both the frontend and backend programming.
2. The latest web development technologies.
3. Maintaining data using NoSQL data bases.
4. Complete web application development process.

PRE-REQUISITES:

1. HTML 5, CSS 3
2. JavaScript

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate the basics of Javascript (JS) and ReactJS	BTL1	PO1, PO2, PO3
CO2	Apply the concepts of props and State Management in React JS	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Examine Redux and Router with React JS	BTL4	PO1, PO2, PO3, PO4, PO6, PO7, PO10
CO4	Appraise Node JS environment and modular development	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10

CO5	Develop full stack applications using MongoDB	BTL6	PO1,PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB3 [Chapters: 1, 2, 4, 5, 6]**

Introduction to React: Definition of React, Obstacles and Roadblocks, React library, React Developer tools, Introduction to ES6, Declaring variables in ES6, Arrow Functions, ES6 Objects and Arrays, ES6 modules, Introduction to AJAX, Functions in AJAX.
Pure React: Page setup, virtual DOM, React Element, React DOM, Constructing Elements with Data, React Components, DOM Rendering, First React Application using Create React App, React with JSX, React Element as JSX.
Props, State and Component Tree: Property Validation, Validating Props with createClass, Default Props, ES6 Classes and stateless functional components, React state management, State within the component tree, state vs props, Forms in React.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters: 7, 8, 9, 11]; TB4 [Chapters: 1, 2, 3, 5]**

Enhancing Components: Component Lifecycle, JavaScript library integration, Higher-Order Components, Managing state outside the react, Introduction to Flux
Redux and Router: State, Actions, Reducers, The Store, Middleware, React Redux, React Router, Incorporating the router, Nesting Router, Router parameters
JSON: Introduction, Syntax, Data types, Objects, Schema
REST API: Introduction, WRML, REST API Design, Identifier Design with URIs, Interaction Design with HTTP, Representation Design, Caching, Security

UNIT – III

No. of Hours: 12 **Chapter / Book Reference: TB2 [Chapters: 2-6]**

Introduction to Angular: Angular architecture; introduction to components, component interaction and styles; templates, interpolation and directives; forms, user input, form validations; data binding and pipes; retrieving data using HTTP; Angular modules
Node.js: Introduction, Features, Node.js Process Model
Environment Setup: Local Environment Setup, The Node.js Runtime, Installation of Node.js
Node.js Modules: Functions, Buffer, Module, Modules Types
Node Package Manager: Installing Modules using NPM, Global vs Local Installation, Attributes of Package.js on, Updating packages, Mobile-first paradigm, Using twitter bootstrap on the notes application, Flexbox and CSS Grids

File System: Synchronous vs Asynchronous, File operations
Web Module: Creating Web Server, Web Application Architecture, Sending Requests, Handling http requests

Express Framework: Overview, Installing Express, Request / Response Method, Cookies Management

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters: 11-15]**

MongoDB: Introduction to NoSQL, Understanding MongoDB datatypes, Building MongoDB Environment (premise and cloud based), Administering Databases and User accounts, Configuring Access Control, Managing Collections, connecting to MongoDB from Node.js, Accessing and Manipulating Databases and Collections, Manipulating MongoDB documents from Node.js, Understanding Query objects, sorting and limiting result sets

TEXT BOOKS:

TB1. D. Brad, B. Dayley and C. Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", Addison-Wesley Professional, 2nd Edition, 2017.

TB2. D. Herron, "Node.js Web Development", Packt Publishing, 2nd Edition, 2018.

TB3. A. Banks and E. Porcello, "Learning React: Functional Web Development with React and Redux", O'Reilly, 1st Edition, 2017.

TB4. M. Masse, "REST API – Design Rulebook", O'Reilly, 1st Edition, 2011.

REFERENCE BOOKS:

RB1. S. Pasquali and K. Faaborg, "Mastering Node.js", Packt Publishing Limited, 2nd Edition, 2017.

RB2. T. Dyl and K. Przeorski, "Mastering Full Stack React Web Development", Packt Publishing Limited, 1st Edition, 2017.

RB3. C.J. Ihrig and A Bretz, "Full Stack JavaScript Development with MEAN", SitePoint, 1st Edition, 2015.

RB4. E.W.I. Koroliova, "MERN Quick Start Guide: Build web applications with MongoDB, Express.js, React, and Node", Packt Publishing Limited, 1st Edition, 2018.

Web Technologies

Course Code: **MCA-116**
Course Name: **Web Technologies**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Concept of HTML, CSS and JavaScript
2. .NET Architecture and C#.NET Basics
3. Creating Web Application using ASP.NET Web Forms, jQuery and AJAX
4. Creating Web Application using ASP.NET MVC, jQuery and AJAX

PRE-REQUISITES:

1. Object-Orientated Programming
2. Computer Networks
3. Database Management System

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate the fundamentals of Internet, Protocols, WWW, Webservers with HTML tags, commands of CSS and Java Script	BTL1	PO1, PO2, PO3, PO5
CO2	Build Dynamic Web Applications applying the concept of HTML, CSS and JavaScript	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO3	Examine the working of Basic ASP.NET Web Forms (Server Controls, Validation Controls, User controls, ADO.NET, Caching, state management), AJAX and jQuery.	BTL4	PO1, PO2, PO3, PO5, PO6, PO7, PO9
CO4	Appraise ASP.Net Web Forms and ASP.NET MVC	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9

CO5	Create an Interactive Web Application using ASP.NET Forms, ASP.NET MVC	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO11, PO12

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-4]**

Overview of Internet: Evolution of Internet, Concept of Internet and WWW, Introduction to TCP/IP.

HTML: HTML Elements, Semantic Elements, HTML Forms.

CSS: Introduction, Selectors, Styling**:** Borders, Background, Text Effects, Text, Fonts, Transitions, Transforms, Animation, Multiple Columns, User Interface and CSS Filters.

Web Servers: System Architecture, Configuring and Accessing IIS Web Servers, HTTP Protocol-Request and Response.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 6-13]; TB3 [Chapter 1]

JavaScript: Introduction, Operators, Conditional Statement, Looping Statement, Functions in JavaScript, JavaScript and Objects, Commonly used objects in JavaScript, the DOM and web browser environments, forms and validations.

DHTML: Combining HTML, CSS and JavaScript, Events and Buttons, Controlling the browser.

.NET Framework: Understand the .NET platform, Components of .NET Framework: CLI, CTS, CLS, CLR and CLI, Understand the assembly.

UNIT – III

No. of Hours: 12 **Chapter / Book Reference: TB3 [Chapters 2, 3, 6, 10, 11]; TB4 [Chapters 3-8,19-21]**

Basics of C#: Language Fundamentals, Reference and Value Types, Access Modifiers, Properties, Indexers, Arrays, Inheritance and Polymorphism.

Working with ASP.NET Web Forms: Building ASP.NET Page, Using ASP.NET Web Server Controls, User-Controls: Creating user controls and interacting with User Controls, Performing Form Validation with Validation Control, ASP.NET State Management, Caching in ASP.NET Application, Application Tracking and Error Handling, Authentication, Authorization.

Working with ADO.NET*:* Introduction to ADO.NET, Working with Data-Bound Controls, Concepts of XML Data Binding, Encrypting Data over the Network.

UNIT – IV

No. of Hours: 12 **Chapter / Book Reference: TB4 [Chapters 22-25]**

AJAX: Understanding the need for Ajax, ASP.NET Ajax, Client Side Technologies, Server- Side Technologies, Building ASP.NET Ajax applications.

jQuery: Introduction, Selecting Elements, Modifying Elements, Event Handling, jQuery UI

Working with ASP.NET MVC: Introduction to MVC, Comparison ASP.NET web form application and ASP.NET MVC, MVC Architecture, Developing interactive web applications.

TEXT BOOKS:

TB1. Ivan Bay Ross, “HTML, DHTML, Java script, Perl CGI”, BPB Publication, 4th Revised Edition, 2010.
TB2. Paul Deitel, Harvey Deitel, Abbey Deitel, ”Internet & World Wide Web: How to Program”, Pearson, 5th Edition, 2018.
TB3. Herbert Schildt, “C# 4.0 The Complete Reference”, McGraw-Hill Education, 1st Edition, 2010.
TB4. Jason N. Gaylord, Christian Wenz, Pranav Rastogy, Todd Miranda, Scott Hanselman, “Professional ASP.NET 4.5 in C# and VB”, Wrox Publication, 1st Edition, 2013.

REFERENCE BOOKS:

RB1. James L Mohler and Jon Duff, “Designing Interactive Web Sites”, Delmar Thomson Learning, 1st Edition, 2000.
RB2. John Pollock , ”JavaScript: A Beginner's Guide”, TMH, 5th Edition, 2020.
RB3. Stephen Walther, Kevin Hoffman, Nate Dudek, “ASP.NET 4.0 Unleashed”, Pearson Education, 1st Edition, 2010.
RB4. Jess Chadwick, Todd Snyder, Hrusikesh Panda ,“Programming ASP.NET MVC 4”, O'Reilly Media, 1st Edition, 2012.
RB5. Christian Wenz ,“Programming ASP.NET AJAX- Build rich, Web 2.0 Style UI with ASP.NET AJAX”, O'Reilly Media, 1st Edition, 2007.

Theory of Computations

Course Code: **MCA- 118**
Course Name: **Theory of Computations**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Expressing problems as testing membership in a language
2. Designing a capable mathematical model of computation to decide/recognize a language
3. Distinguishing the relative capabilities of different models of computation
4. Understanding what is decidable and what is not
5. Classifying the languages based on space-complexity and time-complexity of the model

PRE-REQUISITES:
1. Discrete Structures
2. Knowledge of writing formal mathematical proofs

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate to the basics of Finite State Machines.	BTL1	PO1, PO2
CO2	Explain grammar and establish equivalence between grammar, languages and pushdown automata.	BTL2	PO1, PO2, PO3
CO3	Solve the computational model for a given language	BTL3	PO1, PO2, PO3, PO4
CO4	Analyze Finite Automata for different regular expressions and languages.	BTL4	PO1, PO2, PO3, PO4
CO5	Estimate the optimal computing time of the given problem.	BTL5	PO1, PO2, PO3, PO4, PO7
CO6	Analyse and evaluate the decidability of the various computational problems using programming skills	BTL5	PO1, PO2, PO3, PO4, PO5

UNIT – I

No. of Hours: 14 Chapter/Book Reference: TB1 [Chapters 1-4]; TB3 [Chapters 2-4]

Introduction to Automata and Regular Language: Overview of Theoretical Computer Science, Applications of Theory of Computer Science, Introduction: Alphabets, Strings and Languages, Notion of formal language; Finite State Machines. Finite Automata: Deterministic Finite Automata (DFA), Non- Deterministic Finite Automata (NFA), €-Closure, Regular Language, Equivalence of DFAs and NFAs, Minimization of Finite Automata, Mealy and Moore Machines. Regular Expressions, Various Identities of Regular Expressions, Kleen's Theorem, Equivalence of Regular Expressions and DFAs, Arden's Theorem (Without Proof), Closure Properties of Regular Languages, Pumping Lemma for Regular Languages, Non-Regular Languages. Introduction to JFLAP, Construction of DFA and NFA using JFLAP.

UNIT – II

No. of Hours:12 Chapter / Book Reference: TB1 [Chapters 5-8]

Context Free Language and Pushdown Automata: Grammar, Context Free Grammar, Left Most and Right Most Derivation, Derivation Tree, Ambiguity, Ambiguous Grammar, Removal of Ambiguity, Simplification of Grammar, Normal Forms: Chomsky Normal Form and Greibach Normal Form. Context Free Language, Pushdown Automata (deterministic and nondeterministic), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma for CFLs, Non- Context Free Languages.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 9-11]; TB3 [Chapter 5]

Turing Machines and Computability Theory: Definition of Turing Machine, Recursive and Recursively Enumerable Languages and their Closure Properties. Extensions of Turing Machines: Multi-tape Turing Machines, Multidimensional Tapes, Non – deterministic Turing Machines, Universal Turing Machine, Equivalence of Various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Post Correspondence Problem, Modified Post Correspondence Problem, Reducibility. Chomsky Classification.

UNIT – IV

No. of Hours: 08 Chapter / Book Reference: TB2 [Chapters 7, 8, 10]

Complexity Theory: Time and Space Measure, Time Complexity, DTIME(t(n)), NTIME(t(n)), Polynomial Verifier, Complexity Classes, P and NP, Space Complexity, PSPACE, Savitch Theorem, L, NL, Probabilistic Computation.

TEXT BOOKS:

TB1. Peter Linz, "Introduction to Formal Languages and Automata", Narosa, 6th Edition, 2016.

TB2. Michael Sipser, "The Introduction to Theory of Computation", Cengage Learning, 3rd Edition, 2016.

TB3. Hopcroft, Motwani, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 3rd Edition, 2015.

REFERENCE BOOKS:

RB1. Dexter C. Kozen, **"**Automata and Computability" Springer, Reprint 2002, 3rd Edition, 1999.
RB2. Harry R. Lewis, C H Papadimitriou**, "**Elements of Theory of Computation*",* PHI, 2nd Edition, 1998.
RB3. Susan H. Rodger, "JFLAP: An Interactive Formal Languages and Automata Package*"*, Jones & Bartlett, 1st Edition, 2006.
RB4. J. C. Martin, "Introduction to Language and the Theory of Computation*"*, TMH*,* 3rd Edition, 2007.
RB5. Wanye Goddard **"**Introducing the Theory of Computation" Student Edition, Jones and Bartlett, 1st Edition, 2010.
RB6. Vivek Kulkarni, **"**Theory of Computation**"**, Oxford University Press, 1st Edition, 2013.

Software Testing

Course Code: **MCA-120**
Course Name: **Software Testing**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to applying testing in an appropriate manner to any software under test. It shall enable the learners to get acquainted to the industry perspective and practices towards testing of software. The course shall cover the following topics:

1. Core Software Testing Concepts
2. Testing at the unit, module, subsystem and system levels
3. The testing process
4. Manual and automated techniques for generating and validating test data
5. Test-Driven Development
6. Testing Best Practices

PRE-REQUISITES:

1. Fundamentals of Software Engineering
2. Basics syntax and semantics of programming languages
3. Fundamentals of Discrete Math (Sets, Graphs, logic and Grammar)

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Identify the fundamentals of software testing and differentiate it from debugging.	BTL3	PO1, PO2,PO3, PO6
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.	BTL3	PO1,PO2, PO3, PO4, PO6, PO7
CO3	Appraise test tools, object-oriented software testing according to their purpose and the test activities they support.	BTL5	PO1, PO2, PO5, PO6, PO7, PO10

CO4	Develop test cases for given problem with respect to structural and functional testing techniques.	BTL6	PO1, PO2, PO3, PO4, PO6, PO7
CO5	Adapt in a cross-functional Agile team to discuss principles and basic practices of Agile software development.	BTL6	PO1, PO2, PO3, PO4, PO6, PO7, PO10

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1, 13,14]

Fundamentals of Testing: What is Testing?, Objectives of Testing, Testing and Debugging, Why is testing necessary?, Errors, Defects, Failures, Test Plan, Test Case, Principles of Testing, The Test Process, The Psychology of Testing, Limitations of Testing.

Testing through the Software Development Lifecycle: Software Development and Software Testing, Test Levels: Component Testing, Integration Testing, System Testing, Acceptance Testing

Static Testing: Fundamentals, Work Products that can be examined by static testing, Benefits

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 5-9]

Test Types: Overview of various testing types

Functional Testing: Equivalence Partitioning, Boundary Value Analysis, Decision Table Testing, State Transition Testing, Deriving test cases from Use Cases

Structural Testing: Identification of Independent Paths: Control Flow Graph, DD-Paths, Cyclomatic Complexity, Graph Matrix, Control Flow Testing, Data Flow Testing, Slice Based Testing, Mutation testing

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 14, 23]

Test Management: Test Manager and Tester, Purpose and Content of a Test Plan, Test Strategy and Test Approach, Entry and Exit Criteria, Test Execution Schedule, Test Estimation Techniques (metrics-based and expert-based), purpose and content of test report, Best Practices of Software Testing

Configuration Management: Risks and Testing, Product and Project Risks, Risk-based testing and Product Quality, Priority Category Schemes and Risk Analysis

Defect Management: Overview of Defect and Defect Report

Regression Testing: Overview, Regression versus Development Testing, Regression Test Case Selection

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 11, 15, 18, 19]

Test Driven Development: Overview, Automated Test Execution, Pros and Cons.

Object-Oriented Testing: Issues in Testing Object-Oriented Software, Overview of Object-Oriented Unit, Integration and System Testing

Agile Testing: Fundamentals of Agile Software Development, Agile Software Development Approaches (Extreme Programming, Scrum, Test Driven Development), Agile Model-Driven Development, Traditional Testing versus Agile Testing, Roles and Skills of Tester in Agile Teams, Exploratory Testing and Agile Testing

TEXT BOOKS:

TB1. Jorgensen, P., "Software Testing - A Craftsman's Approach", CRC Press: Boca Raton FL, 4th Edition, 2014.
TB2. Beizer, B., "Software Testing Techniques", Van Nostrand Reinhold: Boston MA, 2nd Edition, 1990.
TB3. Paul Ammann and Jeff Offutt, "Introduction to Software Testing", Cambridge University Press, 2nd Edition, 2016.

REFERENCE BOOKS:

RB1. Myers, G., "The Art of Software Testing", John Wiley & Sons: New York NY, 3rd Edition, 2011.
RB2. Crispin, L. and Gregory, J., "Agile Testing", Pearson Education: Boston MA, 1st Edition, 2008.
RB3. William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, Van Nostrand Reinhold, New York, 2nd Edition, 1995.
RB4. John Watkins, Simon Mills, "Testing IT: An Off-the-Shelf Software Testing Process", Cambridge University Press, 2nd Edition, 2011.
RB5. James Whittaker, Jason Arbon, Jeff Carollo, "How Google Tests Software", Addison-Wesley, 1st Edition, 2012.

Microprocessors

Course Code: **MCA-122**
Course Name: **Microprocessors**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to gain experience related to the following:-
1. Features of microprocessor systems and specifically with the basic 16-bit (8086) processor, its architecture, internal organization and their functions.
2. Processor instruction set.
3. Low-level Assembly language programming.
4. Interfacing external peripheral devices with the processors.
5. Advance processors including RISC based processors.

PRE-REQUISITES:
1. Basics of electronics, Transistors, Flip-Flops, Registers.
2. Digital System Fundamentals
3. Assembly language programming

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall various features of microprocessor, memory and I/O devices.	BTL1	PO1, PO2
CO2	Illustrate 8086 microprocessor architecture and define its bus organization including control signals.	BTL2	PO1, PO2, PO3, PO4
CO3	Apply the concepts of memory and I/O interfacing to 8086 processor.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Explain and outline the features of advance microprocessors.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Understand 8086 processor addressing modes, outline classification of different instructions and	BTL6	PO1, PO2,PO3, PO4, PO5, PO6

	functions of each instruction and write programs in assembly language using 8086 instructions.		PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-3]**

Introduction: Evolution of microprocessors and microcontrollers, Overview of Microcomputer Systems: Hardware – Software, Addresses – General Operation of a Computer – Microprocessors in Digital System Design.

8086 Architecture: Pin assignments, CPU Architecture – Internal Operation, Addressing modes – Instruction Formats, instruction set and assembly language programming.

Assembler Language Programming: Assembler Instruction Format – Data Transfer Instructions, Arithmetic Instructions, Branch Instructions: Conditional Branch Instructions - Unconditional Branch Instructions, Loop Instructions, Logical Instructions – Shift and Rotate Instructions, Directives and Operators.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 9-10]**

Memory System Design & I/O Interfacing: Interfacing SRAM, ROM and DRAM to 8086, Address decoding & Timing, I/O Mapped I/O, Memory Mapped I/O, Handshaking Signals.

Peripheral I/O devices and their Interfacing: Types of Serial Communication Interfaces: Asynchronous Communication – Synchronous Communication – Physical Communication Standards – 8251A USART, 8255A Programmable Peripheral Interface, Programmable **Timers and Event Counters:** Intel's 8254 Programmable Interval Timer, 8257 Programmable DMA Controllers, 8259 Programmable Interrupt Controller. Interfacing 8086 with, LED display interfacing, 8253 programmable interval timer, 8279 Programmable keyboard/Display Controller.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapters 16-18]**

Advanced Microprocessors: Brief Introduction to Architecture of 80186, 80286, 80386, 80486, 8087 and Pentium architecture.

The 80386: Introduction, Operating Modes, Processor Model, Programming Model.

The 80486: Introduction, Processor Model, Programming Model.

The Pentium: Introduction, Processor Model, Programming Model, The Pentium Evolves, The Pentium MMX.

The P6 Processors: Introduction, Overview, Processor Model, New Architectural Features.

ARM Processor: Architecture features, Logical block diagram of ARM7 architecture.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters 2, 4, 5 & 11]; TB4 [Chapters 2, 4, 9, 10, 11]**

8051 Microcontrollers: Architecture of 8051, Signals, Operational features, Memory and I/O addressing, Interrupts, Instruction set, Applications.

The AVR RISC Microcontroller Architecture: Introduction, AVR Family architecture, Register File, The ALU. Memory access and Instruction execution. I/O memory. EEPROM. I/O ports. Timers. UART. Interrupt Structure.

TEXT BOOKS:

TB1. Yu-Cheng Liu, Glenn A Gibson, "Microcomputer Systems: The 8086/8088 Family: Architecture, Programming, and Design", PHI Learning, 2nd Edition, 2009.

TB2. Barry B Brey, "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Architecture, Programming and Interfacing", Pearson Prentice Hall, 8th Edition, 2009.

TB3. Muhammad Ali Mazidi, Mazidi and McKinley, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson India, 2nd Edition, 2007.

TB4. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, "The AVR Microcontroller and Embedded System using Assembly and C", Pearson, 1st Edition, 2013.

REFERENCE BOOKS:

RB1. Douglas V Hall, "Microprocessors and Interfacing", McGraw-Hill Book Company, 2nd Edition, 2005.

RB2. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC", Cengage Learning, 1st Edition, 2007.

Embedded Systems

Course Code: **MCA- 124**
Course Name: **Embedded Systems**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Acquire knowledge of basic structure and function of embedded systems.
2. Learn process to design embedded Systems.
3. Understand operating system concepts, its types and choosing RTOS.
4. Learn interfacing of embedded system with peripherals and memory devices.

PRE-REQUISITES:
1. Microprocessor & Microcontroller concepts.
2. Operating system concepts.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO
CO1	Recall Embedded system, architecture and the design process of an Embedded Systems.	BTL1	PO1, PO2
CO2	Explain working of different memory devices and memory management techniques.	BTL2	PO1, PO2, PO3
CO3	Identify Interrupt and interfacing of firmware with I/O and memory.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Discover basics of operating system and its types alongwith different task synchronization techniques.	BTL4	PO1, PO2, PO3, PO4, PO6, PO10
CO5	Appraise RTOS, memory interface, and communication interfaces.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapters 1-2]; TB2 [Chapter 1]

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems vs General Computing Systems, Purpose of Embedded Systems, Concept of Real Time Embedded Systems, Design process of an Embedded Systems, Architecture of Embedded Systems, RISC and CISC Instruction set architecture, General Purpose and Domain Specific Processors.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 2]; TB2 [Chapter 2]

Memory System Architecture: Concept of Cache & Virtual Memory, Memory management, I/O Subsystem - Interrupt driven I/O, DMA, Busy-wait I/O, Co-processors and Hardware Accelerators, Concept of Pipelining, Memory Devices – RAM, ROM, EEPROM, Flash Memory, DRAM.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 3-4]; TB2 [Chapters 8-9]

Embedded Firmware and Interfacing: Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, I/O devices and its Interfacing, Memory Interfacing, Embedded Firmware Design Approaches, Onboard and External Communication Interfaces.

UNIT – IV

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapters 7-8]; TB2 [Chapter 10]

Real Time Embedded Systems: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and multitasking, Task Schedule, Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization.

TEXT BOOKS:

TB1. Raj Kamal, “Embedded Systems”, TMH, 2nd Edition, 2006.
TB2. Shibu K.V, “Introduction to Embedded Systems”, Mc Graw Hill, 2nd Edition, 2017.

REFERENCE BOOKS:

RB1. Tammy Noergaard, “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier Publisher, 2nd Edition, 2012.
RB2. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley, 2nd Edition, 2003.
RB3. Lyla, “Embedded Systems”, Pearson, 1st Edition, 2013.

Information Security

Course Code: **MCA-126**
Course Name: **Information Security**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Various technical and management aspects of information security
2. Security requirements within an organization
3. Threats, malware through the analysis of worms, viruses, Trojans
4. Make students aware of the various technologies to implement appropriate security measures within an organization

PRE-REQUISITES:
1. Fundamentals of computer system.
2. Basics information systems and security.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall varied risks related to information security	BTL1	PO1, PO2
CO2	Identify threats, vulnerabilities and countermeasures to prevent attacks on information	BTL3	PO1, PO2, PO3, PO4, PO6, PO10
CO3	Apply risk and IT security guidelines on software security, database security, network security and computer security audit on various types of industries	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Inspect appropriate security requirements for proper control and security from worms, Trojans, viruses etc.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Create user identification and authentication methods	BTL6	PO1, PO2, PO3, PO4, PO5, PO6,

			PO7, PO8, PO9, PO10, PO11

Unit – I

No. of Hours: 10 Chapter/ Book Reference: TB1 [Chapters 1-3]; TB2 [Chapter 1]

Introduction to Information Security: Definition, Availability, Confidentiality, Accuracy, Integrity and Authenticity.

Security Threats: Vulnerabilities, Threats, Attacks and Countermeasures, Secure Software Development.

Ethical Issues in Information Security: Law and Ethics in Information Security, International Law and Legal bodies, Ethics and Information Security, Codes of Ethics.

UNIT – II

No. of Hours: 12 Chapter/ Book Reference: TB1 [Chapters 4-5]; TB2 [Chapter 9]

Managing IT Risk: Introduction, Risk Management, Risk Identification, Risk Assessment, Risk Control Strategies, Risk Control Strategy, Quantitative and Qualitative Risk Control.

Security Plan: Concept, Information Security Planning and Governance, Policies, Standards, Practices, Information Security with ISO, NIST Models, Security Education, Training and Awareness.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 6-7]; TB2 [Chapters 10, 12]

Security Technologies: Access Control: Identification, Authentication, Authorization and Accountability, Firewalls: Processing modes, Structure, Architecture, Configuring, Remote User Connections, Access and Authentication.

Security Technology: Prevention System, Intrusion Detection: Intrusion Detection and Prevention System, Operating System Fundamentals and Security Tools, Biometrics Access Controls.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 9, 10, 12]

Implementing Information Security : Remote Computing Security, Security Project Management, Technical Aspects of Implementation, Information Security Certifications.

Maintenance: Security Management Maintenance Models, Vulnerability Assessment, Introduction to Digital Forensics

TEXT BOOKS:

TB1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, CENGAGE Learning, 4th Edition, 2003.

TB2. Mark Merkow, James Breithaupt , “ Information Security : Principles and Practices”, Pearson Education, 1st Edition, 2007.

TB3. Micki Krause, Harold F. Tipton, “Information Security Management Handbook, CRC Press LLC, 6th Edition, 2004.

REFERENCE BOOKS:

RB1. Mark Rhodes, Ousley, “Information Security - The Complete Reference”, Mcgraw Hill Education, 2nd Edition, 2013.
RB2. Matt Bishop, “Computer Security Art and Science”, Pearson Education, 2nd Edition, 2002.
RB3. Charles P. Pfleeger and Shari Lawrence Pfleeger, “Security in Computing”, PHI, 4th Edition, 2006.
RB4. William Stallings, “Cryptography and Network Security: Principles and Practices”, Pearson Education, 4th Edition, 2005.
RB5. Roberta Brag, Mark Rhodes-Ousley, “Network Security - The complete Reference”, McGraw Hill Education, 2nd Edition, 2017.

Digital Marketing

Course Code: **MCA- 128**
Course Name: **Digital Marketing**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Overall understanding of Digital Marketing.
2. Various strategies involved in Marketing products and Services Digitally.
3. Understanding of Digital Marketing Platforms.
4. Techniques for Search Engine Optimization (SEO) and Mobile Marketing.
5. Develop insight on Current Trends – Digital and Social Statistics (Infographics).

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Interpret Digital Marketing preliminaries.	BTL2	PO1
CO2	Build effective Digital Marketing strategies for different products and services.	BTL3	PO1, PO2, PO3, PO8
CO3	Make appropriate use of varied Digital Marketing Platforms like Email, Facebook, Twitter, YouTube, Pinterest, etc as per given scenario.	BTL3	PO1, PO2, PO3, PO5
CO4	Apply and analyze the concept of Search Engine Optimization (SEO), SEM and Mobile Marketing to given scenarios.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Analyze specific trends using Google Analytics	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Create effective Display Ads and Search Engine Advertising	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 1]

Introduction to Digital Marketing: Evolution of Digital Marketing from traditional to modern era, Role of Internet, Current trends, Info-graphics, implications for business & society, Emergence of digital marketing as a tool, Drivers of the new marketing environment, Digital marketing strategy, P.O.E.M. framework, Digital landscape, Digital marketing plan, Digital marketing models

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 2-3]

Internet Marketing and Digital Marketing Mix: Internet Marketing, opportunities and challenges, Digital marketing framework, Digital Marketing mix, Impact of digital channels on IMC

Email Marketing: Basics of Email Marketing, Opt-in Email Permission Marketing, Online PR, Interactive Advertising, Online Partnerships, Viral Marketing, Blogs

Search Engine Advertising: Search Advertisements, Ad Placement, Ad Ranks, Creating Ad Campaigns, Campaign Report Generation

Display Marketing: Types of Display Ads, Buying Models, Programmable Digital Marketing, Analytical Tools, YouTube marketing, Trends in digital advertising

UNIT – III

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapter 4-9]

Social Media Marketing – Role of Influencer Marketing, Tools & Plan: Introduction to social media platforms, penetration & characteristics, Building a successful social media marketing strategy

Facebook Marketing: Introduction to Facebook Marketing, Creating Advertising Campaigns, Adverts, Facebook Marketing Tools

Linkedin Marketing: Introduction and Importance of Linkedin Marketing, Framing Linkedin Strategy, Lead Generation through Linkedin, Content Strategy, Analytics and Targeting

Twitter Marketing: Introduction to Twitter Marketing, how twitter Marketing is different than other forms of digital marketing, framing content strategy, Twitter Advertising Campaigns

Instagram and Snapchat: Digital Marketing Strategies through Instagram and Snapchat

Mobile Marketing: Mobile Advertising, Forms of Mobile Marketing, Features, Mobile Campaign Development, Mobile Advertising Analytics

UNIT – IV

No. of Hours: 8 Chapter / Book Reference: TB1 [Chapters 10-11]

Introduction to Search Engine Optimization (SEO): Introduction and need for SEO, How to use internet & search engines, search engine and its working pattern, On-page and off-page optimization, SEO Tactics, Introduction to Search Engine Marketing (SEM)

Web Analytics: Introduction to social media metrics**,** Google Analytics , Google AdWords, data collection for web analytics, multichannel attribution, Universal analytics, Tracking code

TEXT BOOKS:

TB1. Seema Gupta, “Digital Marketing”, Mc-Graw Hill, 8th Edition, 2018.

TB2. Ian Dodson, “The Art of Digital Marketing”, Wiley, 2017.

REFERENCE BOOKS:

RB1. Chhafey D., Ellis-Chadwick F., Johnston K. and Mayer R, “Internet Marketing: Strategy, Implementation and Practice”, Pearson Education, 2018.
RB2. Strauss, Judy and Frost, Raymond, “E-Marketing”, PHI Learning Pvt. Ltd., 2013.
RB3. Puneet Singh Bhatia, “Fundamentals of Digital Marketing”, Pearson, 2nd Edition, 2016.

Management Information System

Course Code: MCA-130
Course Name: Management Information System

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Understand the leadership role of Management Information Systems in achieving business competitive advantage through informed decision making.
2. Analyze and synthesize business information systems to facilitate evaluation of strategic alternatives.
3. Effectively communicate strategic alternatives to facilitate decision making.
4. Understand entire spectrum of issues related to managing information systems in an ethical manner.

PRE-REQUISITES:
1. General awareness of management principles.
2. IT Infrastructure.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the usage of Information systems in Business and their importance.	BTL2	PO1, PO2
CO2	Identify the techniques of strategic design for Emerging IT Infrastructure.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Construct the required Information Systems in an ethical way	BTL3	Po1, PO2, PO3, PO4, PO5, PO6, PO10, PO11, PO12
CO4	Appraise the Business Applications of Information Systems	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1, 3, 4];**

TB2 [Chapters 1-3]; TB3 [Chapters 1, 3, 7]

Organizations, Management & Information Systems: Information Systems in Business Today, How Information Systems are Transforming Business, Importance of Information Systems; Manager's view of Information Systems, Nature and scope of IS; IS characteristics and structure; Functions of Management, Managerial Role; Types of Information systems; Business – Information Technology Alignment, Business Process & Business Process Management; Competitive Advantage and SWOT Analysis; Porters' Five Forces; Ethical and Social Issues in Information Systems

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 5, 7]; TB2 [Chapters 7-9]; TB3 [Chapters 8- 11 & 16-17]**

Strategic Design and Role of Information Systems (Emerging IT Infrastructure): BYOD; Data Centres and Cloud Computing, Cloud Services Delivery Models; Enterprise Computing; Grid Computing; Green Computing; IoT, Sensor Technology, RFID; Big Data and Analytics; Data and Text Mining; Business Intelligence. Strategic Management of the Business, Strategic design of MIS, Business Strategy Implementation

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 8-9, 12- 14]; TB2 [Chapters 6, 10-12]; TB3 [Chapters 12-13, 15-16]**

Developing and Managing Information Systems: Development of Long Range Plans of MIS, Ascertaining the class of Information, Determining the Information Requirement, Development and Implementation of MIS, MIS: Development Process Model; Business Challenges; Manufacturing, Production, and Transportation Management Systems; DSS & its components; Using DSS; Sales and Marketing Systems; Accounting and Finance Systems; Human Resource Systems and Ethics; Securing Information Systems: Data Breaches and Cyber security Challenges, IT Risk Management; Mobile, App, and Cloud Security Challenges; Fraud Defenses.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 9-10]; TB2 [Chapters 3- 5]; TB3 [Chapters 5, 15, 18, 19]**

Business Applications of Information Systems: Retail Channels; E-Commerce Applications & Issues; E-Commerce Business Models; E-Business; Mobile Commerce and Applications; Social Media Strategies and Communities; Social Communities and Engagement; Social Monitoring, Metrics, and Analytics; Social Media Failures and Lessons Learned; Enterprise Systems; Enterprise Social Platforms; Enterprise Resource Planning Systems; Supply Chain Management Systems; Customer Relationship Management Systems.

TEXT BOOKS:

TB1. Kenneth C. Laudon and Jane P. Laudon, "Management Information Systems: Managing the Digital Firm", Pearson, 16th Edition, 2019.

TB2. Ramesh Behl, James A. O'Brien, George M. Marakas, "Management Information Systems", Mc Graw Hill, 11th Edition, 2019.

TB3. Rahul De, "MIS: Managing Information Systems in Business, Government and Society", Wiley, 2nd Edition, 2018.

REFERENCE BOOKS:

RB1. Turban, Volonino, Wood, Wali, “Information Technology for Management: Advancing Sustainable, Profitable Business Growth”, Wiley, 10th Edition, 2016.

RB2. Kelly Rainer, Brad Prince, Hugh Watson “Management Information Systems: Moving Business Forward”, Wiley India Edition, Wiley, 3rd Edition, 2016.

RB3. Waman S Jawadekar, “Management Information Systems – Text and Cases: A Global Digital Enterprise Perspective”, McGraw-Hill Education, 2016.

RB4. Lynda M. Applegate, Robert D. Austin, Deborah L. Soule, “Corporate Information Strategy and Management: Text and Cases”, McGraw-Hill Education, 8th Edition, 2016.

RB5. Stephen Haag, Maeve Cummings, Amy Phillips, “Management Information Systems: For the Information Age”, McGraw-Hill Education, 6th Edition, 2015.

Management Principles and Organizational Behaviour

Course Code: **MCA-132**
Course Name: **Management Principles and Organizational Behaviour**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Understanding of management and behavioral processes in the business environment.
2. Identify the Human interactions in an organization at various levels.
3. Factors driving human interactions.
4. Interpersonal interactions through applications of concepts learned to get better results in attaining specific business organizational goals.

PRE-REQUISITES:
High analytical, interpersonal, observational and communication skills.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall the significance of individual differences and people skills for becoming effective, responsible and ethical managers	BTL1	PO1, PO2
CO2	Explain the power of groups in influencing organizational efficacy, and develop the ability to work in teams	BTL2	PO1, PO2, PO3
CO3	Understand interpersonal processes and apply strategies to enhance one's effectiveness	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Discover effective communication channels and leadership structures that can help reinforce desired organizational culture	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Develop leadership and creative problem solving among students	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8,

			PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-2, 4-6]

Management: Meaning and concept of management, Nature of Management, Management as a process, Management and administration, Managerial Functions, Coordination- Definition, Relation between Co-ordination and co-operation, Role of managers, Levels of management, Managerial skills, Planning and forecasting: Definition of planning, Types of planning, Levels of planning, Range of Planning, Process, Derivative Plans, Barriers to effective planning, MBO, Definition of Business Forecasting, Techniques of Forecasting, Decision making: Definition, Types of decisions, Process, Rationality in Decision making, Bounded Rationality, Techniques of Decision Making, Organizing: Definition, Steps in Organizing, Formal and Informal Organization, Organizational Structure: Definition, Considerations in designing an organizational structure, Principles of an organization Span of control, Scalar Chain, Types of Organization, Comparison, Line and Staff Organization.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 7-8, 10-11]

Delegation and Decentralization: Meaning, definition of authority, Definition of power, concept of politics, Elements of Delegation of Authority, Principles of Delegation of Authority. Decentralization: Definition, Difference between Decentralization and Delegation. Staffing: Definition, Elements of staffing, Directing: Definition, Elements of directing, concept of Supervision, Controlling: Definition, Process, Techniques of controlling, Relation between planning and controlling Leadership – Qualities of a leader, Leadership Styles & Skills; **Behavioural Perspective and Contingency Perspective:** Path Goal Theory Transactional, Transformational and Charismatic Leadership, Trait Theory.

UNIT – III

No. of Hours: 13 Chapter/Book Reference: TB1 [Chapters 9, 12-18] TB2 [Chapter 11]

Organizational Behaviour: Historical background of OB; Emerging aspects of OB, Levels of Analysis of OB, Personality – Definition; Frameworks – MBTI and Big Five; Theories of Personality, Implications of Personality for Managers, Learning - Definition; Theories: Classical Conditioning; Operant Conditioning; Social Learning; Reinforcement Theory; Schedules of Reinforcement. Perception – Factors influencing Perception; Perception Process, Perceptual Errors and Distortion Errors, Values and Attitudes – Concept of values, Types of Values, Terminal and Instrumental values, Determinants of Values, Attitudes: Concept, Components, formation of Attitudes, Job Satisfaction, Job Involvement, Organizational Commitment, Interpersonal Relations: Transactional analysis and Johari Window, Concept of T.A, Analysis of Ego States, Types of Transactions, Johari Window, Motivation – Definition, Types, Herzberg's Two factor Theory; McCelland's Theory of Needs; Maslow's Hierarchy of Needs; Ouch's Theory, Job Enrichment and Job Enlargement, Group Dynamics and Communication – Types of Groups, Managing Culturally Diverse Groups; Stages of Groups, Informal Group, Understanding Work Teams; Evolution of Groups into Teams, Types of Teams, Building Effective Teams, Communication: Process, Formal and Informal Communication, Barriers to communication.

UNIT – IV

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapters 20-22) TB2 [Chapter 17]

Organizational Climate and Culture: Definition of Organization Climate, Significance, Factors influencing Organization climate, Definition of Organizational Culture; Elements of Organizational Culture; Managing Organizational Culture, Schein's Three Levels of Organizational Culture, Organizational Conflicts and Negotiation - Types of conflict; Attitudes towards Conflict; Hidden Conflicts in Organizations; Sources and Strategies for Managing Conflicts; Bargaining Strategies - Integrative and Distributive, Management of Organizational Change– Forces of Change and Planned Organizational Change; Approaches to Planned Change – Lewin's Force Field Analysis, Resistance to Change, Overcoming Resistance to Change, Work Stress – Types of Stress; Factors causing Stress - Personal, Organizational, Environmental; Consequences of Stress, Individual and Organizational Stress Coping strategies, Case Studies

TEXT BOOKS:

TB1. T. N. Chhabra, "Management Process and Organizational Behaviour", Sun India Publication, 3rd Edition, 2017.

TB2. S. P. Robbins, T. A. Judge & N. Vohra, "Organizational Behaviour", Pearson, 18th Edition, 2019.

TB3. C**.** B**.** Gupta, "A Textbook of Organizational Behaviour", S. Chand Publishing, 2014**.**

REFERENCE BOOKS:

RB1. S. P. Robbins, M. Coutler, &D. Decenzo, "Fundamentals of Management", Pearson, 9th Edition, 2017.

RB2. K. Singh, "Organizational Behaviour: Text and Cases", Pearson, 2nd Edition, 2013.

RB3. U. Pareek, "Understanding Organizational Behaviour", Oxford University Press, 4th Edition, 2016.

RB4. J. Greenberg, "Behavior in Organizations*",* PHI Learning, 10th Edition, 2011.

RB5. M. Parikh & R. Gupta, "Organizational Behavior", Tata McGraw Hill, 2012.

Finance and Accounting

Course Code: **MCA-134**
Course Name: **Finance and Accounting**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Preparation of primary books of account.
2. Preparation of final statements.
3. Inventory cost flow methods and valuation of closing inventory.
4. Analysis of financial statements and its reporting.
5. Understanding the scope of computer applications in Indian financial sector.

PRE-REQUISITES:

Basic Mathematical skills

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall the purpose and principles of accounting.	BTL1	PO1, PO2
CO2	Explain the mechanics of accounting equation to understand the inter-linkages among various financial statements.	BTL2	PO1, PO2, PO3
CO3	Build journal, leger and trial balance and understand their importance.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Analyze financial statements and generate the reports for purpose of decision making.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10
CO5	Create inventory accounts and financial statements.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Elaborate the financial system, functions of various participants and types of operations to apply knowledge in that area.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7,

			PO8, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-4(a)]**

Nature and purpose of Accounting; Accounting Measurement Assumptions; Generally Accepted Accounting Principles; Accounting equation; Overview of financial statements. Accounting process, double entry book-keeping and recording of transactions (Journal)

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 4(b)-5]**

Preparation of financial statements: Preparation of ledger, trial balance., Importance of suspense account. Preparation of Income statement, adjustments related to depreciation and receivables, Balance sheet.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 11,15,16]; TB2 [Part II Chapter 4]**

Inventory: Measurement of inventory by cost or net realizable value, methods of inventory valuation i.e. FIFO, LIFO, and Weighted average cost.

Analysis of Financial Statements: Common size statement analysis, Trend Analysis, Ratio analysis and its interpretation: profitability, solvency, liquidity, activity, and market capitalization ratios.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters 1,3, 9, 13,17]**

Financial System, Markets and Instruments: Introduction to Indian financial system; Participants in the financial system and their role; Working of the Financial Market-Introduction to money market and capital market instruments; Risk management in financial sector (Banks).

TEXT BOOKS:

TB1. V. Rajeskaran, R. Lalitha, “Financial Accounting”, Pearson Education, 2018.
TB2. S. N. Maheshwari, S. K. Maheswari, S. Maheswari, “Financial Accounting”, Pearson Education, 6th Revised Edition, 2018.
TB3. M. Y. Khan, “Indian Financial System”, Tata McGraw Publishing, 11th Edition, 2019.

REFERENCE BOOKS:

RB1. J. R. Monga, Girish Ahuja and Ashok Sehgal, “Financial Accounting”, Mayur Paper Back, 2019.
RB2. Jawahar Lal, Seema Srivastava, “Financial Accounting”, Himalaya Publishing House, 2015.
RB3. M. C. Shukla, T. S. Grewal and S. C. Gupta, “Advanced Accounts Vol. I” S. Chand & Co., New Delhi, 19th Edition, 2017.
RB4. P. N. Varshney, “Indian Financial System”, Sultan Chand & Sons, New Delhi, 2006.
RB5. H. R. Machiraju, “Indian Financial System”, Vikas Publishing House, 4th Edition, 2010.

Data and File Structures Lab.

Course Code: **MCA-162**

Course Name: **Data and File Structures Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop the working expertise related to the following:-

1. Implementing various data structures using a programming language.
2. Implementing different operations on data and file structures.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Illustrate basic data structures- arrays and linked lists.	BTL2	PO1, PO2
CO2	Build stacks and queues using arrays and linked lists.	BTL3	PO1, PO2, PO3
CO3	Discover sparse matrix, polynomial arithmetic, searching and sorting techniques and their applications.	BTL4	PO1, PO2, PO3, PO4
CO4	Appraise binary search tree to perform efficient search operations.	BTL4	PO1, PO2, PO3, PO4
CO5	Examine and implement graph algorithms.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Develop an application making extensive use of binary files.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Object Oriented Software Engineering Lab.

Course Code: **MCA-164**
Course Name: **Object Oriented Software Engineering Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise related to the following:-

1. Implement a real-life project using RUP.
2. Learn new case tools – Rational Rose/ Microsoft Visio/ Star UML.
3. Develop analysis model, design model and implementation model using the case tool resulting in the completion of project.
4. Ability to deploy the project.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply object-oriented software engineering concepts to a project	BTL3	PO1, PO2, PO3, PO4, PO5
CO2	Build design model diagrams for design phase.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Analyze and construct models and diagrams in analysis phase	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Appraise an advanced CASE tool	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO5	Design and deploy a project suitably.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11
CO6	Work in teams to design practical solutions for real life case studies using UML	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Python Programming Lab.

Course Code: **MCA-166**
Course Name: **Python Programming Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise related to the following:-

1. Basic programming constructs and functions in python.
2. Understand the applicability of data structures like lists, tuples, sets and dictionaries in python applications.
3. Use object-oriented programming features of python to develop applications.
4. Learn how to use exception handling in applications for error handling.
5. Design GUI based applications with database connectivity operations.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate program creation in Python through usage of appropriate constructs and OOPs concepts.	BTL2	PO1, PO2, PO3, PO4, PO5
CO2	Apply the concepts of data structures and string functions in python program.	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Apply the concepts of file handling and exception handling.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Evaluate and visualize the data using appropriate python libraries.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO5	Develop GUI based applications with database connectivity in Python.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Advanced Database Management Systems Lab.

Course Code: **MCA- 168 (Lab. based on Core Elective – I)**
Course Name: **Advanced Database Management Systems Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise related to the following:-

1. In depth knowledge of system implementation techniques using ER and EER concepts.
2. Fair knowledge of various NoSQL database types and DB principals on Couch DB. One of the goal for this laboratory is to gain familiarity with a typical MongoDB use case.
3. Conceptual background necessary to design and develop distributed database system for real life applications.
4. Working knowledge for Objects Oriented concepts with respect to Database Management Systems.
5. Research development ability of learner in databases through industry-oriented case studies.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Illustrate the concepts of ER and EER Model to design databases	BTL2	PO1, PO2, PO3, PO5
CO2	Apply the basics of various NoSQL database types	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Identify basic MongoDb commands to build specific NoSQL databases	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Analyze XML Attributes to create databases using nested queries and joins using Xquery queries	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Work in teams to develop complete NoSQL / Object-Oriented / Distributed database to support backend of any application program	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Data Warehousing and Data Mining Lab.

Course Code: **MCA-168 (Lab based on Core Elective – I)**
Course Name: **Data Warehousing and Data Mining Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of data warehouse design concepts and data mining techniques.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate various OLAP operation on multi-dimensional data	BTL2	PO1, PO2
CO2	Apply different data transformation techniques to deal with noisy data	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Apply data mining algorithms on real time data	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Assess most appropriate data mining algorithm for a given situation	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Mobile Applications Design and Development Lab.

Course Code: **MCA-168 (Lab. based on Core Elective – I)**

Course Name: **Mobile Applications Design and Development Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise related to design and development of mobile applications for android and iOS platforms.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Interpret case studies for Android app development.	BTL2	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO2	Utilize the concepts of activities and intents Android app development case studies	BTL3	PO1, PO2, PO3, PO5, PO6, PO10
CO3	Make use of Android Web, Networking and Telephony APIs in Android app development	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Discover GUI based Android applications using action controls, fragments and views	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Create interactive applications on iOS platform using iOS SDK and Swift	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO11
CO6	Work in teams to construct iOS-based solutions using Swift language for real life case studies	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Full Stack Development Lab.

Course Code: **MCA-168 (Lab. based on Core Elective – I)**

Course Name: **Full Stack Development Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of Frontend, server and Backend design and deployment for dynamic web applications.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply concepts of DOM creation and rendering using React.js	BTL3	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Make use of Node.js process model in given case studies	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Construct REST APIs for cross platform application development	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10
CO4	Create full stack applications using Angular.js and React.js	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10
CO5	Develop applications using Node.js and MongoDB connectivity	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Web Technologies Lab.

Course Code: **MCA-168 (Lab. based on Core Elective – I)**
Course Name: **Web Technologies Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of design and implementation of static and dynamic websites. Learners will also acquire project-based experiences needed for web application development. Learners will have hands on experience on the following technologies:

1. HTML, CSS and JavaScript
2. C#.NET Programming Basics
3. ASP.NET Web Forms
4. ASP.NET MVC
5. jQuery and AJAX

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Build Websities using HTML, CSS, Javascript primitives.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO2	Construct secure ASP.NET Web application using Web Server Controls.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Appraise jQuery to build ASP.NET AJAX application.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11
CO4	Work in teams to create interactive ASP.NET based Web Forms MVC based applications along with jQuery and AJAX.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Theory of Computations Lab.

Course Code: **MCA- 168 (Lab. based on Core Elective – I)**
Course Name: **Theory of Computations Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the following:-
1. Implementation of Finite Automata using tools like JFLAP
2. Construction of abstract models of computing
3. Writing programs for recognising given language using programming skills
4. Simulation of Finite Automata using programming skills

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Understand and demonstrate various finite machines using tools like JFLAP.	BTL2	PO1, PO2, PO3, PO5
CO2	Model language recognizers using appropriate programming skills.	BTL3	PO1, PO2, PO3, PO5
CO3	Analyze varied abstract models in computing to recognize the languages.	BTL4	PO1, PO2, PO3, PO4, PO6
CO4	Appraise the simulation of Finite Automata using appropriate programming skills.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Design the Context Free Grammar for a given language.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Software Testing Lab.

Course Code: **MCA-168 (Lab. based on Core Elective – I)**
Course Name: **Software Testing Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the following:-
1. Manual and Automated Testing Techniques and Tools.
2. Functional and Non-Functional Testing Test Case Creation.
3. Test-Driven Development.
4. Continuous Delivery Model and Its Impact on Testing.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Plan and apply test driven development within the context of a software development application.	BTL3	PO1, PO2, PO3, PO5, PO6, PO7, PO10
CO2	Discover specific and measurable test cases and suites to ensure coverage and traceability to requirements through appropriate tools.	BTL4	PO1, PO2, PO3, PO5, PO6, PO7, PO10
CO3	Appraise and prioritize the test cases for the specific software.	BTL5	PO1, PO2, PO3, PO5, PO6, PO7, PO10
CO4	Evaluate problem reporting techniques, metrics, and testing status reports to communicate testing results to colleagues, managers, and end users.	BTL5	PO1, PO2, PO3, PO5, PO6, PO7, PO10, PO11
CO5	Adapt in a team to design a live case study on a software product through appropriate agile methodology.	BTL6	PO1, PO2, PO3, PO5, PO6, PO7, PO10, PO11

Microprocessors Lab.

Course Code: **MCA-168 (Lab. based on Core Elective – I)**
Course Name: **Microprocessors Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise related to the following:-

1. Assembly programming of 8086.
2. Interfacing various external I/O devices to 8086 microprocessors.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate the skills/abilities for writing an assembly program in an assembler	BTL2	PO1, PO2, PO3, PO6
CO2	Experiment with various arithmetic operations on the 8086 microprocessor	BTL3	PO1, PO2, PO3, PO5
CO3	Examine troubleshooting mechanisms of electronic hardware	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Evaluate wired serial communication at chip level	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Elaborate interfacing of various I/O devices	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Embedded Systems Lab.

Course Code: **MCA-168 (Lab. based on Core Elective – I)**
Course Name: **Embedded Systems Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop the working expertise related to the following:-
1. Understand the technologies behind the embedded systems.
2. Examine and analyze the design issues of embedded systems.

PRE-REQUISITES:
1. Microprocessor & Microcontroller concepts.
2. Operating system concepts

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate hardware and software design requirements of embedded systems.	BTL2	PO1
CO2	Apply specifications of embedded systems on suitable simulators.	BTL3	PO1, PO2, PO3, PO5
CO3	Discover the challenges of Embedded Systems.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Evaluate and analyze the requirements of Embedded Systems, related software architectures and tool chain for Embedded Systems.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Elaborate the current trends in Embedded Systems	BTL6	PO1, PO2, PO3, PO4, PO6, PO7, PO9, PO10, PO11

Information Security Lab.

Course Code: **MCA-168 (Lab. based on Core Elective – I)**
Course Name: **Information Security Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise related to the following:-

1. Understand and recognize security principles.
2. Various threats to confidentiality and integrity of information.
3. Risks associated with information.

PRE-REQUISITES:

1. Basic understanding of information.
2. Basic Knowledge of MATLAB.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate the risks related to information in various situations.	BTL2	PO1, PO2
CO2	Apply security measures for any system software	BTL3	PO1, PO2, PO3
CO3	Build cryptographic measures and PKI implementations	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Identify application level and security challenges and issues.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Analyze different types of security threats & attacks	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10
CO6	Develop user identification and authentication techniques for specific systems.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Minor Project – II

Course Code: **MCA-170**
Course Name: **Minor Project – II**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of solving complex computing problems through project based learning approach using real world case studies by implementing the concepts studied in the theory courses of this semester.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO#
CO1	Apply acquired knowledge within the chosen technology for solution of specific real world problem.	BTL3	PO1, PO2, PO3, PO4
CO2	Analyze the technical aspects of the chosen project through a systematic and comprehensive approach.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Deduct plausible solution for the technical aspects of the project.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO4	Work as an individual or in teams to develop the technical project.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10, PO11, PO12
CO5	Create effective reports and documentation for all project related activities and solutions.	BTL6	PO11

Professional Proficiency – II

Course Code: **MCA-174**
Course Name: **Professional Proficiency – II**

Objective and Structure of this Course:
General Proficiency (under NUES Scheme) is aimed to impart value added modules to students, based upon the changing requirements of the industry, from time to time. This innovative practice makes the scheme open and adaptive to the changing requirements of the industry, by keeping inbuilt flexibility of introducing any value added module based upon industry input, from time to time. The required decision of the value added module and related assessment guidelines shall be finalized by the Programme Co-ordination Committee, before start of the semester. Its COs and required mapping shall be done by the Programme Co-ordination Committee, after finalizing the value added module to be offered under this course. There shall not be any external examination of the University for this course. The performance of the candidates should continuously be evaluated by an internal committee, at the College level, as per the guidelines of the Programme Coordination Committee.

Suggestion:
It is suggested to have Technical Paper Writing Course in second semester under Professional Proficiency - II. However, the final decision shall be taken by the Programme Coordination Committee, before start of the semester.

Design and Analysis of Algorithms

Course Code: **MCA- 201**
Course Name: **Design and Analysis of Algorithms**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Understand the important concepts of algorithms design and their analysis.
2. Analyze the efficiency of alternative algorithmic solutions to the problem.
3. Understand different algorithm paradigms like Divide and Conquer, Greedy, Dynamic, Backtracking and Branch and Bound.
4. Identify the appropriate data structures, algorithm design techniques and assess their impact on the performance of programs.

PRE-REQUISITES:
1. Programming Skills
2. Discrete Structures
3. Data Structures

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate P and NP complexity classes of the problem.	BTL2	PO1, PO2, PO3
CO2	Apply the concepts of asymptotic notations to analyze the complexities of various algorithms.	BTL4	PO1, PO2, PO3, PO4
CO3	Analyze and evaluate the searching, sorting and tree-based algorithms.	BTL5	PO1, PO2, PO3, PO4, PO5
CO4	Design efficient solutions using various algorithms for given problems.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Develop innovative solutions for real-world problems using different paradigms.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6,

			PO7, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 09 **Chapter/Book Reference: TB1 [Chapters 1-5]; TB2 [Chapters 0-2]; TB3 [Chapters 2, 5, 13]**

Performance Analysis of Algorithms: Algorithm Specification, Performance Analysis: Space and Time Complexity, Correctness of Algorithms, Growth of Functions, Asymptotic Notations and Types, Concept of Randomized Algorithms.

Recurrences: Substitution, Iteration, Master and Recurrence Tree method.

UNIT – II

No. of Hours: 12 **Chapter/Book Reference: TB1 [Chapters 7-9, 13, 21 28, 32]; TB2 [Chapter 2]; TB3 [Chapter 5]**

Divide and Conquer Paradigm: Problem Solving, Comparative Analysis of different Sorting and Searching Techniques, Strassen's Matrix Multiplication Method.

Sorting in linear time: Counting Sort, Bucket Sort and Radix Sort.

String Matching Concept: Naive String-Matching Algorithm, String Matching with Finite Automata, Knuth Morris Pratt Algorithm, The Rabin-Karp Algorithm.

Red Black Trees, Disjoint Set and their Implementation, Medians and Order Statistics.

UNIT – III

No. of Hours: 12 **Chapter/Book Reference: TB1 [Chapters 15-16 & 23-25]; TB2 [Chapters 4-6]; TB3 [Chapters 4, 6]**

Greedy Algorithms: General Concept, Applications, Activity Selection Problem, Fractional Knapsack problem, Job Sequencing with Deadlines, Huffman Coding, Analysis and Correctness of Prim's, Kruskal Algorithm and Dijkstra Algorithm.

Dynamic Programming: General Concept, Matrix-Chain Multiplication Problem, Longest Common Subsequence Problem, Bellman-Ford Algorithm, Analysis and Correctness of Floyd-Warshall Algorithm, Optimal Binary Search Trees, 0/1 Knapsack Problem, Network Flow Problem.

UNIT – IV

No. of Hours: 12 **Chapter/Book Reference: TB1 [Chapters 34, 35]; TB2 [Chapters 8, 9]; TB3 [Chapter 8]**

Backtracking: n-Queen's Problem, Hamiltonian Circuit Problem, Subset-Sum Problem, Graph Coloring Problem.

Branch and Bound: Assignment Problem, Travelling Salesman Problem.

Introduction to Computability, Polynomial-time Verification, NP-Completeness.

Complexity Classes: Reducibility, NP-Completeness Proof, NP-Complete & NP-Hard, Problem Classification-P, NP, NPC, NP-Hard; Circuit Satisfiability, 3SAT, Vertex Cover, Clique, Cook's Theorem.

TEXT BOOKS:

TB1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", PHI, 2nd Edition, 2006.

TB2. S. Dasgupta, C. Papadimitriou and U.Vazirani, “Algorithms”, McGraw Hill Higher Education, 1st Edition, 2017.
TB3. J. Kleinberg and E. Tardos, “Algorithm Design”, Pearson Education, 2nd Edition, 2009.

REFERENCE BOOKS:

RB1. S. Horowitz, “Fundamentals of Computer Algorithms”, University Press, 2nd Edition, 2008.
RB2. R. Panneerselvam, “Design and Analysis of Algorithms”, PHI, 2nd Edition, 2016.
RB3. T. H. Cormen, “Algorithms Unlocked”, MIT Press, 1st Edition, 2013.
RB4. S. Sridhar, “Design and Analysis of Algorithms”, Oxford University Press, 1st Edition, 2014.
RB5. R. Neapolitan and K. Naimipour, “Foundations of Algorithms”, Jones & Bartlett Publishers, 4th Edition, 2010.
RB6. A. Levitin, “Introduction to the Design and Analysis of Algorithms”, Pearson Education, 3rd Edition, 2012.

Artificial Intelligence and Machine Learning

Course Code: **MCA-203**
Course Name: **Artificial Intelligence and Machine Learning**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. AI principles and approaches.
2. Develop basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic and learning.
3. Understanding nature of problems solved with ML.

PRE-REQUISITES:

1. Basic knowledge of Mathematical Logic
2. Linear algebra

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Define the meaning of Intelligence and recall various models for knowledge representation and reasoning within an AI problem domain.	BTL1	PO1, PO2
CO2	Summarize varied learning algorithms and model selection.	BTL2	PO1, PO2, PO3
CO3	Apply the concept of learning trends and patterns from data to build an appreciation for what is involved in learning from data.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Analyze and apply a variety of learning algorithms to data.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Appraise AI algorithms and assess their performance. Follow standards and ethical practices.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10

CO6	Develop a strong foundation for a wide variety of state of the art Machine Learning algorithms.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-6]**

AI Fundamentals: Defining Artificial Intelligence, Types of AI, Turing test, Defining AI techniques, Comparison - AI, ML and Deep Learning, Problem characterization and reduction, Defining State Space and AI Search Techniques (Hill Climbing, Breadth first and depth first search, Best first search, A*, AO*, Constraint Satisfaction), MEA, Ethics of AI.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 7- 9, 12-14]**

Knowledge Representation and Reasoning: Approaches to knowledge representation: Propositional Logic, First Order Predicate Logic, Inference Rules (Modus Ponen, Modus Tollen, Resolution, And elimination, Syllogism), Production Rules, Types of knowledge, Reasoning: Forward and backward reasoning, Non-monotonic Reasoning, Reasoning with uncertainties.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 18]; TB2 [Chapters 2-5]**

Machine Learning: Introduction to Machine Learning, Why Machine learning, Types of Machine Learning Problems, Applications of machine learning. Supervised machine Learning – Regression and Classification. Regression- Simple, Multiple Regression, Least Squares, Total sum of squares, Sum of Square of Residuals, Sum of square of Regression, odds, odds ratio. Classification: Logistic Regression, Accuracy methods: coefficient of determination, correlation, confusion matrix, Overfitting and underfitting, Bias and variance. Accuracy methods: coefficient of determination, correlation, confusion matrix.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 18]; TB2 [Chapters 10,14, 16]; TB3 [Chapters 6, 10]**

Unsupervised Learning: Dimensionality reduction (Principal component analysis), K-means clustering, Ensemble Learning (Boosting and Bagging). Neural Networks, Types of Neural networks, Activation functions, Feed forward, Back Propagation Algorithm, Recommender Systems, Content based recommendations.

TEXT BOOKS:

TB1. Stuart Russel, and Peter Norvig, "Artificial intelligence: A Modern Approach", Pearson Education Limited, 4th Edition, 2020.

TB2. T. Hastie, R. Tibshirani and J. Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, 2nd Edition, 2017.

TB3. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", Wiley, 2nd Edition, 2012.

REFERENCE BOOKS:

RB1. E. Rich, K. Knight. S. B. Nair, “Artificial Intelligence”, McGraw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 2017.
RB2. Mark Watson, “Practical Artificial Intelligence Programming with Java”, Leanpub, 5th Edition, 2020.
RB3. Ivan Bratko, “Prolog Programming for Artificial Intelligence”, Pearson Education, 5th Edition, 2011.
RB4. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education, Indian Edition, 2017.

Statistics and Data Analytics

Course Code: **MCA-205**
Course Name: **Statistics and Data Analytics**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Descriptive and inferential statistics and its application to real world problems.
2. Data analysis using different statistical tools and techniques.

PRE-REQUISITES:
Python Language for practical implementation of theoretical concepts.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain fundamental concepts and terminologies of statistics and data analytics	BTL2	PO1, PO2, PO5
CO2	Experiment with various measures of central tendency, dispersion, shape and their implication.	BTL3	PO1, PO2, PO3, PO5
CO3	Apply probability and probability distribution primitives.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Examine hypothesis testing and use inferential statistics- T, F, Z and Chi Square Test	BTL4	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Assess analysis of variance for specific cases.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-3]; TB2 [Chapter 1-5]

Introduction to Statistics: Definition, Importance & Scope of statistics, Applications of Statistics, Limitations of Statistics, Types of statistics: Descriptive and Inferential Statistics.

Basics of Data Analytics: Definition, Difference between Data Analytics and Statistics, Use and Importance of data analytics, Applications of data analytics.
Role of statistics in Data Analytics, Need for statistical tools, Commonly used statistical tools for data analytics, Types of Data Analytics: Descriptive Analysis, Diagnostic Predictive Analysis, Perspective Analysis. Types of Data, Data Measurement and Data Collection.
Descriptive Statistics: Graphical approaches, Measures of Central Tendency: mean, median, mode, partition values. Measures of Dispersion: Range, Quartile deviation, Mean Deviation, Standard Deviation, Variance, Coefficient of Variation, Measures of Shape, Empirical Rule, Chebyshev's Theorem, Box and Whiskers plot, Need for z-scores.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 4-6]; TB2 [Chapters 13-14]; TB4 [Chapters 1-2]**

Probability: Theory of Probability**,** Sample Spaces, Events, Conditional Probability, Some basic Relationships of Probability, Baye's Theorem
Probability Distribution: Random Variables, Discrete and Continuous Random Variables, Binomial, Poisson and Normal Probability Distribution

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 7-9]; TB2 [Chapters 15-18]**

Inferential Statistics: Reasons for sampling, Sampling Frame, Random and Non-Random Sampling Methods, Sampling Distribution: Large and Small Sample Test, Central Limit Theorem, Types of Estimates**,** Using the z Statistic for Estimating population Mean, Confidence Interval for Estimating Population Mean μ when σ is Unknown**,** Estimating Population Mean Using the t Statistic
Hypothesis: Formulation and Testing, Null and Alternate Hypothesis, Type I and II errors, Hypothesis testing in different cases

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 10-14]; TB2 [Chapters 23, 27]**

Analysis of Variance: Two Population Variances (F Distribution)**,** One-way and two-way classifications, Chi-Square test.
Curve Fitting and Principles of Least Squares, Regression and Correlation.

TEXT BOOKS:

TB1. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Jeffrey D. Camm, James J. Cochran, "Statistics for Business & Economics", Cenage, Revised 13th Edition, 2018.
TB2. S. C. Gupta, "Fundamentals of Statistics", Himalaya Publishing, 7th Edition, 2019.
TB3. J. K. Sharma, "Business Statistics", Pearson Education, 2nd Edition, 2010.
TB4. A. Maheshwari, "Data Analytics Made Accessible", Sandra Durcevic, 2018.

REFERENCE BOOKS:

RB1. S. P. Gupta, "Statistical Methods", Sultan Chand & Sons, 2012.

RB2. William Feller, “An Introduction to Probability Theory and its Applications”, 3rd Edition, Vol. I and Vol II, New York, Wiley India, 2008.
RB3. Wes McKinney,” Python for Data Analytics”, O’Reilly Publication, 2nd Edition, 2017.
RB4. Samir Madhavan, “Mastering Python for Data Science”, Packt Publishing, 2015.
RB5. Alex Root, “Python for Data Analytics”, Kindle Edition, 2019.

Enterprise Computing with JAVA

Course Code: **MCA- 207**
Course Name: **Enterprise Computing with JAVA**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the important concepts of web application design and development with understanding of the following concepts:-
1. Dynamic web pages using Servlets
2. Session management
3. Designing custom tags using JSP
4. Data access, searches and queries using HQL
5. Web Application development using Spring framework
6. Handling crosscutting concerns using Spring AOP

PRE-REQUISITES:
Core Java

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Model Java EE architectural components, Servlet creation and session management for web applications.	BTL3	PO1, PO2, PO3, PO6, PO10, PO11
CO2	Inspect the fundamentals of Java Server Pages (JSP) and Struts for web-based applications.	BTL4	PO1, PO2, PO3, PO5, PO6, PO10
CO3	Appraise Hibernate Framework of JEE and apply constructs of Object Relational Mapping.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Elaborate principles of Dependency Injection and its application in JEE.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10

CO5	Design applications based on Spring Boot and Spring AOP.	BTL6	PO1, PO2, PO43 PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1-3, 17-18, 25]; TB2 [Chapters 1, 3]**

Introduction to J2EE: Distributed Web Application Multi-Tier Architecture, MVC architecture, HTTP Basics, Introduction to servlets and it's life cycle, problems with CGI-Perl interface, generic and http servlet, servlet configuration, various session tracking techniques, servlet context, servlet configuration, servlet listeners, filters and annotations

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 19-22, 24]**

JSP Basics and Architecture: JSP directives, Scripting elements, standard actions, implicit objects, JSP design strategies. Using JSP Beans, Expression languages, JSP custom tags.

Struts Framework: Introduction of Struts and its architecture, advantages, and application of Struts.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters 1-3, 5-6, 8-9]; TB4 [Chapters 6-7]**

Hibernate Framework: Comparison between JDBC and Hibernate, Principles of Object Relational Mapping, Hibernate configuration, mapping and annotations, session management, searches and queries using HQL, Transaction integration and demarcation.

UNIT – IV

No. of Hours: 12 **Chapter / Book Reference: TB4 [Chapters1-4, 11-12, 14- 15]**

Spring Framework: Introduction of Spring Framework: Configuration of Spring environment, Spring Architecture, Dependency Injection, Inversion of Control (IoC), Spring Boot, Using Hibernate with Spring, Spring AOP and Spring Web.

TEXT BOOKS:

TB1. John Hunt and Chris Loftus, "Guide to J2EE: Enterprise Java", Springer Verlag Publications, 1st Edition, 2003.

TB2. Govind Sesadri, "Enterprise Java Computing: Application and Architectures", Cambridge University Publications, 2nd Edition, 1999.

TB3. Jeff Linwood and Dave Minter, "Beginning Hibernate", Apress Publishing Co., 2nd Edition, 2010.

TB4. Rod Johnson, "Professional Java Development with the Spring Framework", John Wiley & Sons, 2nd Edition, 2005.

REFERENCE BOOKS:

RB1. Ted Neward, "Effective Enterprise Java", Pearson Education, 2nd Edition, 2004.

RB2. Jim Farley and William Crawford, "Java Enterprise in a Nutshell", O'Reilly and Associates, 3rd Edition, 2005.

RB3. James Holmes and Herbert Schildt, “The Complete Reference- Struts”, Tata McGraw Hill, 2nd Edition, 2007.
RB4. Austin Sincock, “Enterprise Java for SAP, Apress Publications, 1st Edition, 2003.
RB5. Joe Wigglesworth and McMilan Paula, “Java Programming: Advanced Topic”, Thomson, 3rd Edition, 2003.
RB6. Ivan Bayross and Sharanam Shah, “Java Server Programming”, Shroff Publishers, 2nd Edition, 2008.

Natural Language Processing

Course Code**: MCA-209**
Course Name: **Natural Language Processing**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to Natural Language Processing and their applications.

PRE-REQUISITES:
Python programming language

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate to the existing NLP systems and determine the advantages and disadvantages of these systems.	BTL1	PO1, PO2
CO2	Demonstrate the skills of solving specific NLP tasks, as well as running experiments on textual data.	BTL2	PO1, PO2, PO3, PO4, PO5
CO3	Apply Natural Language Processing (NLP) knowledge to some of its application.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO4	Assess and apply the available tools of NLP on various case studies.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1, 2]**

Understanding Language, NLP Overview, Definition, History and Challenges, NLP Applications, Language as a rule, Artificial language (Logical language/programming language) vs. Natural Language, Language Modelling, Grammar based Language Models,

Statistical Language Models, Description of different branches of Linguistics: Statistical Linguistics, Psycho linguistics, Neuro linguistics, Computational Linguistics, Socio linguistics

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 3, 4]**

Language Models, Simple N-gram models. Estimating parameters and smoothing. Evaluating language models, Semantics, Discourse, Pragmatics, Part of Speech Tagging, Lexical syntax. Hidden Markov Models.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapters 4, 6]**

Syntactic parsing, Semantic Analysis, Lexical semantics and word-sense disambiguation. Tools for NLP: Introduction to NLTK, NLP with Machine Learning and Deep Learning, Word2Vecmodels, Language modeling using Naive Bayes Maximum entropy classifiers and their application to document classification

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapters 8, 10, 11]**

NLP Model Deployment Techniques using Flask, Information Extraction, Machine Translation, Other NLP applications: Automatic Text Summarization, Auto suggest / Auto complete, chat bots.

TEXT BOOKS:

TB1. Jurafsky & Martin, "Speech and Language Processing", Pearson Publication, 2nd Edition, 2013.

TB2. Tanveer & Tiwari, "Natural Language Processing and Information Retrieval", Oxford Press, 5th Edition, 2015.

REFERENCE BOOKS:

RB1. Jacob Einsein, "Introduction to Natural Language Processing", MIT Press, 2nd Edition, 2019.

RB2. Nitin Indurkhya and Fred Damerau, "Hand Book of Natural Language Processing" CRC Press, 2nd Edition.

Computer Graphics

Course Code: **MCA-211**
Course Name: **Computer Graphics**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Basic building blocks and core concepts of computer graphics.
2. Typical graphics pipeline.
3. Theoretical, mathematical foundation and practical aspects of different graphics algorithms.
4. Fundamental concepts of animation and its related technologies to design interactive graphics applications.

PRE-REQUISITES:
Basic Mathematical Concepts

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate graphics drawings with respect to graphics primitives.	BTL2	PO1, PO2
CO2	Explain the mathematical concepts of different graphics algorithms.	BTL2	PO1, PO2, PO3
CO3	Apply 2D & 3D transformation concepts to represent images with different dimensions and shapes.	BTL3	PO1, PO2, PO3, PO5
CO4	Analyze and evaluate the concepts of projections and shading methods to obtain realistic images.	BTL5	PO1, PO2, PO3, PO4, PO5
CO5	Develop scenes with different clipping methods and transform it to graphics display device.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10

CO6	Develop interactive applications using different computer graphics algorithms and animation effects.	BTL6	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 12 Chapter/Book Reference: TB1 [Chapters 1- 5]: TB2 [Chapter 37]

Introduction: Computer Graphics and its Applications, Overview of Graphics Systems – Video display devices, Raster-Scan Systems, Random-Scan Systems, Graphics Software.

Scan Conversion: Line Drawing Algorithms: DDA, Bresenham, Circle: Mid-Point, Bresenham, Ellipse Generation Algorithms: Mid-Point.

Transformations: Two-Dimensional and Three-Dimensional Geometric Transformations: Translation, Scaling, Rotation, Reflection, Shearing, Homogeneous Coordinates, Composite Transformations, Rotation about an arbitrary point, Reflection about an Arbitrary Line, Affine Transformations.

UNIT – II

No. of Hours: 11 Chapter/Book Reference: TB1 [Chapters 6-9]; TB2 [Chapter 37]; TB3 [Chapter 3]

Window to Viewport: Windowing, Clipping, 2D-Viewing Pipeline, Computing Location of Viewport, Window to Viewport Transformation.

Clipping: Point Clipping, Line Clipping, Line Clipping Algorithms: Cohen Sutherland Algorithm and Cyrus-Beck, Polygon Clipping, Polygon Clipping Algorithms: Sutherland Hodgeman Clipping.

Projections: Introduction to Projections, Types of Projections: Parallel and Perspective Projections, Parallel Projections: Oblique, Orthographic, Axonometric, Perspective Projections: One-Point, Two-Point, Three-Point, Vanishing Points, Perspective Anomalies, Comparison of Parallel and Perspective Projections.

Solid Modeling: Solid Representation, Regularized Boolean Set Operations, Sweep Representation, Spatial Partitioning Representation, Boundary Representation (B-Rep), Octrees, Constructive Solid Geometry (CSG), Comparison of Representations, FRACTALS.

UNIT – III

No. of Hours: 12 Chapter/Book Reference: TB1 [Chapters 11, 13]; TB3 [Chapters 5, 6]

Curves and Surfaces: Curves Representation, Parametric and Non-Parametric Curves, Bezier Curves: Cubic and Higher-Order Curves, Blending Function, Bernstein Polynomial, Continuity Conditions, Effect of Multiple Control Points at same Location, Limitations, B-Splines: Construction of B-Spline Curves, Cubic B-Spline Curves, Knot Vectors, Uniform, Open-Uniform, Non-Uniform, Beta and Rational Splines, Non-Uniform Rational Basis Splines (NURBS), Bezier and B-Spline Surfaces.

Animation: Introduction to Animation, Principles, Animation Methods, Animation Tools.

Open GL: Introduction to Open GL, Features in OpenGL, OpenGL Operations, Immediate Mode, Extensions, Open GL as a State Machine, Animation, Event-Handling with OpenGL Utility Toolkit (GLUT).

UNIT – IV

No. of Hours: 10 **Chapter/Book Reference: TB1 [Chapters 14, 15, 17]; TB2 [Chapter 36]**

Hidden Surface Removal: Need for Hidden Surface Removal, Categories of Hidden Surface Removal Methods, Z-buffer and A-buffer, Depth Sorting, BSP-Tree, Back-Face Removal, Scan-Line Method, Area-Subdivision Method.

Illumination and Shading Models: Object Rendering, Light Modelling Techniques: Ambient, Diffuse, Specular Reflection, Ray Tracing, Shading Models: Flat-Shading, Gouraud Shading, Phong Shading, Coloring: Color models – RGB, CMY, HSV and HSL Models.

TEXT BOOKS:

TB1. Donald Hearn and M. Pauline Baker, "Computer Graphics with OpenGL", Pearson, 4th Edition, 2014.
TB2. Foley James D, "Computer Graphics: Principles and Practice", Addison-Wesley Professional, 3rd Edition, 2013.
TB3. Rogers and Adams, "Mathematical Elements for Computer Graphics", McGraw-Hill, 2nd Edition, 2002.

REFERENCE BOOKS:

RB1. John M. Blain, "The Complete Guide to Blender Graphics: Computer Modeling & Animation", CRC Press, 5th Edition, 2019.
RB2. Malay K. Pakhira, "Computer Graphics Multimedia Animation", PHI, 2nd Edition, 2010.
RB3. F. S. Hill, Jr. Stephen M. Kelley, "Computer Graphics using Open GL", Pearson, 3rd Edition, 2008.
RB4. Rajesh K Maurya, "Computer Graphics with Virtual Reality System", Wiley, 2nd Edition, 2014.
RB5. Rogers, "Procedural Element of Computer Graphics", McGraw-Hill, 2nd Edition, 2001.
RB6. Zhigang Xiang and Roy Plastock, "Computer Graphics Schaum's Outlines Series", McGraw-Hill, 2nd Edition, 2015.

Wireless Sensor Networks

Course Code: **MCA-213**
Course Name: **Wireless Sensor Networks**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Understand about the basics of wireless communication and wireless sensor network.
2. Study about various types of protocols in different layers of wireless sensor network.
3. Understand the different applications of wireless sensor network.

PRE-REQUISITES:
Computer Networks

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the underlying technology and architecture of a Wireless sensor network	BTL2	PO1, PO2
CO2	Analyse the different variants of Operating systems in wireless sensor networks	BTL4	PO1, PO2, PO3
CO3	Examine the various types of protocols in MAC layer, network layer and transport layer	BTL4	PO1, PO2, PO3, PO6, PO10
CO4	Evaluate real world problems using appropriate sensor devices.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO5	Design different applications for network management	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-2]; TB2 [Chapter 1]

Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.
Characteristic requirements for WSN: Challenges for WSNs, WSN vs Adhoc Networks

Sensor node architecture (single node): The Sensing Subsystem, Processor Subsystem, Communication
Interfaces, Prototypes: IMote, IRIS, Mica Mote, EYES nodes, TelosB

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 3, 6]; TB2 [Chapter 4]

Operating Systems: Functional aspects – Scheduling, data types, stacks, system calls, memory allocation, handling interrupts. Prototypes – TinyOS, LA-TinyOS.
Introduction to Wireless Communication Characteristics: Link quality, fading effects, Shadowing, Localization, Connectivity and Topology – Sensor deployment mechanisms, Coverage issues, Node discovery protocols.
Fundamentals of Medium Access Protocol: Medium access layer protocols – Energy efficiency, Power allocation and Medium access control issues.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 4,5,8]; TB2 [Chapters 6,7]

Network Layer Protocols: Routing Metrics, Flooding and Gossiping, Data centric routing, cluster/hierarchical based routing protocols, Energy efficient routing, Location based routing, QoS based Routing.
Transport Layer: Transport protocol Design issues, Performance of Transport Control Protocols.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1, 7, 11, 16]; TB2 [Chapter 9, 12]

Middleware and Application Layer: Data dissemination, Data storage, Query processing.
Security: Issues, Attacks and Countermeasures, IEEE 802.15.4 and Zigbee Security.
Applications of WSN: Structural Health Monitoring, Traffic Control, Highway Monitoring, Medical Applications, Military Applications, Wildfire Instrumentation, Habitat Monitoring, Home Control, Building Automation, Industrial Automation, Precision Agriculture, Underground Mining.
WSN Simulation Platforms: TOSSIM, ns -2, Avrora, OPNET, QualNet

TEXT BOOKS:

TB1. Fei Hu and Xiaojun Cao, "Wireless Sensor Networks Principles and Practice", Auerbach Publications, 1st Edition, 2010.
TB2. C. S. Raghavendra, Krishna M. Sivalingam and Taeib Znati, "Wireless Sensor Networks", Springer, 1st Edition, 2006.

REFERENCE BOOKS:

RB1. Philip Levis and David Gay, "TinyOS Programming", Cambridge University Press, 1st Edition, 2009.
RB2. Waltenegus Dargie and Christian Poellabauer, "Fundamentals of Wireless Sensor Networks, Theory and Practice", John Wiley and Sons, 1st Edition, 2010.
RB3. H Karl and A Willig, "Protocols and Architecture for Wireless Sensor Networks", John Wiley and Sons, 1st Edition, 2014.

RB4. K. Sohraby, D. Minoli, and T. Znati, “Wireless Sensor Networks: Technology, Protocols and Applications”, John Wiley and Sons, 1st Edition, 2007.
RB5. Alasdair Allan and Kipp Bradford, “Distributed Network Data (Adruino)”, O-Reilly, 1st Edition, 2013.
RB6. E. H. Callaway Jr, “Wireless Sensor Networks: Architectures and Protocols”, Auerbach, 1st Edition, 2003.

Software Project Management

Course Code: **MCA-215**
Course Name: **Software Project Management**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Effective management of software projects.
2. Tools and techniques used for project management.
3. The model-based software architectures.
4. Workflows of the process of Software project Management.

PRE-REQUISITES:
1. Software Engineering Concepts
2. Academic Projects

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Illustrate project scheduling within time and budget	BTL2	PO1, PO2, PO3, PO5
CO2	Identify ethical issues related to software project management.	BTL3	PO1, PO2, PO3
CO3	Apply the model-based software architectures.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Analyse how a project can be monitored, controlled and assessed.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Evaluate risk associated with project development, and design policies to reduce risk.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10
CO6	Develop an efficient project to reduce rework and labour-intensiveness.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 3]; TB2 [Chapter 4]; TB3 [Chapters 6-9]**

Introduction: Introduction to software project management and control, Comparative study of different software projects, scope of project management, project life cycle management, role of the Software Project Manager, Software Tools for Project Management.

Project Planning: Business Planning - Determining Objectives, Forecasting demand for the Product, Proposal Writing, Requirements analysis, Legal issues (patent, copyright, liability, warranty), Financial planning – budgeting, Resource Allocation, Organizational considerations, (teams, hierarchies, etc.), Human factors and usability.

Use of Software (Microsoft Project/Project Libre/Open Source) to Assist in Project Planning Activities.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-2]; TB2 [Chapters 1-3]; TB3 [Chapters 1-2]**

Project Scheduling: Time Management, Project Network Diagram, Critical path Analysis, PERT, Gantt Chart, Finalizing the project schedule.

Project Cost Management: Resource planning, Cost Metrics, Cost Estimation (Types, Expert Judgment, Estimation by Analogy, COCOMO I & COCOMO II, Earned Value Management), Monitoring & Controlling the project budget.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 4-6]; TB2 [Chapter 5]**

Project Quality Management: Stages, Quality Planning, Quality Assurance, Quality Control, Quality Standards, Tools and Techniques for Quality Control.

Project Human Resource Management: Definition, Introduction to CRM, Key terms to management, Issues in Project Staff Acquisition and Team Development, Performance Reporting.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapter 6, 8-11]; TB3 [Chapters 11-13]**

Project Risk Management: Introduction and Importance of project risk management, Common Sources of risk in IT projects, Risk Identification, Risk Quantification, Risk Response Development and Control.

Project Procurement Management: Definition, Procurement Planning, Procurement phases.

Project progress monitoring, Configuration Management, Software project metrices, Project Execution and Closure.

TEXT BOOKS:

TB1. Bob Hughes, Mike Cotterell, “Software Project Management” Tata McGraw-Hill, 6th Edition, 2017.

TB2. Pankaj Jalote, “Software Project Management in Practice”, Pearson Education, 3rd Edition, 2010.
TB3. Elaine Marmel, “Microsoft Office Project 2010 Bible”, Wiley Publishing Inc., 1st Edition, 2010.

REFERENCE BOOKS:

RB1. S. A. Kelkar, “Software Project Management - A Concise Study”, PHI, 3rd Edition, 2012.
RB2. Tom DeMarco, Tim Lister, “Peopleware: Productive Projects and Teams”, Dorset House, 3rd Edition, 2013.
RB3. Joel Henry, “Software Project Management – A Real-World Guide to Success”, Addison-Wesley, 1st Edition, 2004.
RB4. Andrew Stellman, Jennifer Greene, “Applied Software Project Management”, O’Reilly, 1st Edition, 2005.

Advanced Computer Architecture

Course Code: **MCA-217**
Course Name: **Advanced Computer Architecture**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Fundamental techniques of high-performance computing.
2. Study and evaluate the benefits of design options in computer architecture.
3. Gain experience and understanding of the application of these techniques.

PRE-REQUISITES:
Computer Organization

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain micro-architectural design of processors	BTL2	PO1, PO2
CO2	Identify the meaning of Parallel Processing, its applications and associated hardware technologies	BTL3	PO1, PO2, PO3, PO5
CO3	Distingush between the different parallel architectures and compare their performance relative to various parameters	BTL4	PO1, PO2, PO3, PO4, PO5
CO4	Explain and evaluate the performance of different ILP methods, pipelining design/ approach for a given set of Instructions	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Evaluate the performance of pipelining and non-pipelining environment in a processor	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO6	Assess cache and memory related issues in multi-processors, and parallel programming models	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-2]; TB2 [Chapter 1]

Evolution of computer architecture, Flynn's Classification, System Attributes to Performance, Parallel computer models - Multiprocessors and multicomputer, Multivector and SIMD Computers. Types of Parallelism, Performance Metrics, Different Parallel Computer models

Data and resource dependences, Dependency Analysis, Partitioning and Scheduling. Control flow, data flow and Demand driven mechanisms.

Static interconnection networks, Dynamic interconnection Networks, Bus Systems, Crossbar Switch, Multiport Memory, Multistage and Combining Networks.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 4-5]; TB2 [Chapter 5]

Instruction set architecture, CISC Scalar Processors, RISC Scalar Processors, Superscalar processors, VLIW architecture, SIMD architecture (design space approach, overview of fine-grained & coarse-grained SIMD); Vector architectures (Basic concept, case studies); Concepts of data- pipelined and systolic array architectures.

Memory Hierarchy, Inclusion, Coherence and Locality, Memory capacity planning. Interleaved memory organization, memory interleaving, pipelined memory access, Bandwidth and Fault Tolerance. Cache addressing models.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 6]; TB2 [Chapters 2-3]

Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, pipeline hazards, Dynamic instruction scheduling - score boarding and Tomosulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic pipeline, Multifunctional arithmetic pipelines. Superscalar pipeline design, Super pipeline processor design.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 7-10]; TB2 [Chapter 4]

Principles of Multithreading, Introduction to MIMD architecture, basic concept of Multi-threaded architecture, Multithreading Issues and Solutions, design issues related to shared-memory & distributed-memory MIMD architectures, Multiple-Context Processors.

Performance issues, Synchronization- Models of memory consistency, Cache coherence, Snoopy protocols, Directory based protocols.

Parallel Programming Models, Shared-Variable Model, Message-Passing Model, Data-Parallel Model, Object-Oriented Model, Functional and Logic Models, Parallel Languages and Compilers, Language Features for Parallelism, Parallel Programming Environment, Software Tools and Environments.

TEXT BOOKS:

TB1. Kai Hwang and Naresh Jotwani, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", Tata McGraw Hill Education, 3rd Edition, 2015.

TB2. John L Hennessy and David A Patterson, "Computer Architecture: A Quantitative Approach", Morgan Kaufmann/ Elsevier, 5th Edition, 2013.

REFERENCE BOOKS:

RB1. Hwang and Briggs, "Computer Architecture and Parallel Processing", MGH, 2nd Edition, 1986.
RB2. J. P. Hayes, "Computer Architecture and Organization", MGH, 3rd Edition, 2017.
RB3. Kain, "Advanced Computer Architecture - A System Design Approach", PHI Learning, 1st Edition, 2010.
RB4. M. J. Flynn, "Computer Architecture, Pipelined and Parallel Processor Design", Narosa Publishing, 3rd Edition, 2011.
RB5. V. Rajaraman & C. S. R. Murthy, "Parallel Computers – Architecture and Programming", PHI, 2nd Edition, 2016.

Distributed Systems

Course Code: **MCA-219**
Course Name: **Distributed Systems**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learner will be able to develop expertise related to the following:-
1. Fundamentals of Distributed Systems.
2. Types of Distributed Systems.
3. Concepts of Communication, Synchronization and Resource Allocation.
4. Basics of Cloud, Fog and Edge Computing and Internet of Things.
5. Understanding of Parallel and Distributed Databases.

PRE-REQUISITES:
1. Practical Knowledge of Computer Networks
2. Operating System
3. Database Management System

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the real life applications, architecture and model of Distributed Systems	BTL2	PO1, PO2
CO2	Analyze fundamentals of Distributed Operating Systems and its concepts like synchronization, mutual exclusion, deadlocks and shared memory	BTL4	PO1, PO2, PO3, PO4, PO5,
CO3	Determine Cloud, Fog and Edge Computing, and apply adequate patterns for user-interaction with connected-objects.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO4	Analyze, design and implement Distributed Databases.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-4]**

Distributed Systems: Fundamentals, Goals of Distributed System, Types of Distributed systems, Distributed System architectures and fundamental models, Object-based and service-oriented architecture, Middleware, Threads, Clients, Servers, Code migration, Types of Communication, Remote Procedure Call, and Remote Method Invocation.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB4 [Chapters 3,6]**

Distributed Operating System: Clock synchronization, Logical clocks.

Mutual Exclusion Algorithms: Centralized, decentralized, distributed and token ring algorithms. Election algorithms. Distributed Deadlock detection and prevention.

Distributed System Shared Memory: Introduction to Shared Memory, Consistency models: Strict Consistency and Sequential Consistency.

Page Based Distributed Shared Memory: Basic Design, Replication.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapter 1, 2, 10, 12]**

Distributed Virtualization - an overview: Cloud Computing, Fog computing and Edge Computing.

Internet of Things (IoT): Introduction of the IoT, IoT Applications, IoT Architecture, Baseline Technologies, Overview of Connectivity Technologies, Internet-connected physical objects-Core Concepts.

Fog Computing: Fundamentals, Fog Architecture, Working of Fog, Application of Fog.

Edge Computing: Introduction, Characteristics & attributes, Benefits of Edge Computing, Fog and Edge Computing, Collaboration of Edge Computing and Cloud Computing, Benefits of Enabling Edge Computing for the IoT, Edge Computing in IoT.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters 20-23]**

Parallel and Distributed Databases: Overview**,** Database System Architecture, Data Partitioning, Replication, Distributed File Systems, Distributed Query Processing, Parallel Sort, Parallel Join, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases.

TEXT BOOKS:

TB1. M. V. Steen, A. S. Tanenbaum, “Distributed Operating Systems”, Prentice Hall, 3rd Edition, 2017.
TB2. Jeeva Jose, “Internet of Things”, Khanna Publication, 1st Edition, 2019.
TB3. A. Silberschatz, H. F. Korth, S. Sudarshan, “Database System Concepts”, 7th Edition, 2020.
TB4. A. S. Tanenbaum, “Distributed Operating Systems”, Pearson, 2012.

REFERENCE BOOKS:

RB1. A. D. Kshemkalyani, M. Singhal, “Distributed Computing: Principles, Algorithms, and Systems”, Cambridge, South Asian Edition, 2010.
RB2. P. K. Sinha, “Distributed Operating Systems: Concepts and Design”, IEEE Press, 1997.

RB3. Ajit Singh, “Edge Computing: Simply in Depth”, SPD, 1st Edition, 2019.
RB4. R. Elmasri, S. B. Navathe, “Fundamentals of Database Systems”, 7th Edition, 2016.

Applied Cryptography

Course Code: **MCA- 221**

Course Name: **Applied Cryptography**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Fundamental knowledge of crypto graphical technologies.
2. Security properties of the crypto graphical techniques.
3. Classical and modern crypto graphical techniques.
4. how secure systems are engineered.

PRE-REQUISITES:
Fundamental knowledge of Number Theory & Modular Arithmetic

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the basic primitives underlying the classical and modern cryptographic techniques.	BTL2	PO1, PO2
CO2	Demonstrate how security properties are defined and proven at cryptographic level.	BTL2	PO1, PO2, PO3
CO3	Identify common attacks and crypto graphical techniques to prevent them.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Analyze and apply appropriate cryptographic techniques to security engineer the problem at hand.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-3]**

Introduction to Cryptography: Introduction to Cryptography, Block Ciphers & Stream Ciphers, Types of Attacks, Concept of Modular Arithmetic, Substitution Cipher: Caesar cipher, Additive and Multiplicative ciphers, Affine cipher, Playfair cipher, Hill cipher & Traditional Transposition cipher

UNIT – II

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapter 5, 6, 9]; TB2 [Chapter 4]**

Modern Cryptography: Symmetric cryptosystem: confusion and diffusion, DES and AES, Encryption mode and analysis: ECB, CBC, and Counter. Public Key Cryptography: RSA Cryptosystem, Hash function and Message Digest

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 13]; TB2 [Chapter 5]**

PKI and Digital Signature: Introduction to the Public Key Infrastructure, Digital signature generation and verification methods, Key management and distribution, Digital certificates, Security of Certification Authorities

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 14-16]; TB2 [Chapter 6,7,9]**

Cryptographic Protocols for Secure Communications: Secure communication protocols (SSL/TLS), Wireless security protocols (WiFi Security), Secure protocols in resource constrained environments (Sensor networks, RFID systems), Protocols for anonymous communication, 2-factor authentications, One-time passwords, Practical authentication and authorization protocols (Kerberos, SAML and Oauth), Secure mailing – PGP and SMIME.

TEXT BOOKS:

TB1. William Stallings, “Cryptograhy and Network Security – Principles and Practices”, Prentice Hall, 6th Edition, 2013.

TB2. Atul Kahate, “Cryptography and Network Security”, McGraw Hill Education, 4th Edition, 2019.

REFERENCE BOOKS:

RB1. Alfred Menezes, Paul Van Oorschot & Scott Vanstone, “The Handbook of Applied Cryptography”, CRC Press, 1st Edition, 1996.

RB2. Behrouz Forouzan, “Cryptograhy and Network Security”, McGraw Hill Education, 3rd Edition, 2015.

RB3. Douglas R. Stinson, “Cryptography Theory & Practice”, Chapman & Hall, 3rd Edition, 2005.

RB4. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons, 2nd Edition, 2015.

Cloud Computing

Course Code: **MCA- 223**
Course Name: **Cloud Computing**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Cloud Computing Basic concepts and its applications.
2. Virtualization and its role in the implementation of cloud computing.
3. Data centre overview and its architecture.
4. Popular public clouds and their features.
5. Security issues in cloud and available countermeasures.

PRE-REQUISITES:

1. Computer Networks
2. Linux
3. Programming in Web Technologies / Full Stack Development

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Identify the importance of Cloud Computing Paradigm, Cloud Security primitives & Load Configurations.	BTL3	PO1, PO2
CO2	Model and apply the concepts of Virtualization and Security in the cloud computing environment.	BTL3	PO1, PO2, PO3, PO6, PO10
CO3	Analyze the concept of Data Centres with Cloud Computing and examine the Use cases of various Cloud Computing Titans.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10
CO4	Design & Appraise Cloud Computing based VMS and weigh the advantages & disadvantages of various proprietary platforms along with available best practices.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, P9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1,2]

Introduction to Cloud Computing: Definition, Evolution & Characteristics, Service Models of cloud computing Iaas, PaaS, SaaS and their Comparisons, Issues & Challenges of Cloud Computing, Applications of Cloud computing, Overview of Cloud Computing Security Configurations.

Cloud Computing Architecture: Introduction, Cloud Architecture, Deployment of Models – (Public, Private, Community, and Hybrid Clouds) and their comparisons, IDaaS, Over View of Data intensive computing through Map Reduce.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 3, 4]

Virtualization in Cloud: Virtualization, Implementation of Virtualization, Middleware Support for Virtualization, Advantages & Applications of Virtualization, Virtualization Implementation Techniques, Hardware Virtualization, Types of Virtualization.

Security Issues in Cloud Computing: Introduction, Security Challenges in Cloud Computing, Information Security, Privacy and Trust in Cloud Computing.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapter 3]; TB3 [Chapter 6]

Data Centre Architecture and Technologies: Architectural Building Blocks of Data Centre, Industry Direction and Operational and Technical Phasing, Industry Direction and Overview of Operational and Technical Phasing (Overview of 5 Phases).

Computing with Titans: Google, Microsoft, Amazon, IBM, Accessing the Cloud- Platforms through a brief overview of Web Applications, Web API's, Web Browsers.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB3 [Chapters 13,14]; TB4 [Chapter 6]

Migrating to the Cloud: Cloud Services for Individuals, Cloud Services aimed at Mid-Markets, Enterprise, Best Practices and Future of Cloud Computing.

Implementation of Cloud Using Any Cloud Platform : Introduction to Web Services**,** Structure, Objective, Cloud Portals, Groups, Mobile Apps, Setting up of Cloud Services, Containers, Handling Cloud Shell, Setting up of projects, Building Virtual Infrastructure, Deployment of Virtual Machine, Configuring Load Balancing.

TEXT BOOKS:

TB1. V. K. Pachghare, "Cloud Computing" PHI Learning, 1st Edition, 2016.

TB2. Venkata Josyula, Malcom Orr, Greg Page, "Cloud Computing – Automating the Virtualized Data Center", Cisco Press, 1st Edition, 2016.

TB3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing a Practical Approach", McGraw Hill, 1st Edition, 2015.

TB4. Mitanshi Joshi, "Agile, DevOps and Cloud Computing with Microsoft Azure", BPB Publications, 1st Edition, 2019.

REFERENCE BOOKS:

RB1. Erl Thomas, Puttini Ricardo, Mahmood Zaigham ,"Cloud Computing - Concepts, Technology and Architecture", Pearson India, 1st Edition, 2014.

RB2. Srinivas Cheemalapti Yi-an Chang, Shahir Daya, Matthieu Debeaux, Odilon Magroski Goulart, Vasfi Gucer, Rahul Gupta, Shamim Hossain, David Kwock, Jordan T Moore, David N Nguyen, Bobby Woolf, "Hybrid Cloud Data and API Integration: Integrate Your Enterprise and Cloud with Bluemix Integration Services", IBM Redbooks, 2nd Edition, 2016.

RB3. Has Altaiar Jack Lee, Michael Peña, "Cloud Analytics with Microsoft Azure: Build modern data warehouses with the combined power of analytics and Azure", Packt Publishing Ltd, 1st Edition, 2019.

RB4. Mitesh Soni, Wayde Gilchrist, "Designing AWS Environments: Architect large-scale cloud infrastructures with AWS", Packt Publishing Ltd, 1st Edition, 2018.

RB5. Dan Sullivan, "Official Google Cloud Certified Associate Cloud Engineer Study Guide", John Wiley & Sons, 1st Edition, 2019.

e-Business Systems

Course Code: MCA-225
Course Name: e-Business Systems

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. e-business and its applications to Information Technology.
2. Security over internet and data privacy issues.
3. Varied Payment systems and e-business models.
4. Various online strategies for e-business.

PRE-REQUISITES:
1. Basics of computers
2. Basics of online applications
3. Business-Concepts

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Define the concepts of e-business and e-commerce and the related information technology and web-based tools.	BTL1	PO1, PO2
CO2	Identify Security aspects of e-business-online threats, security protocols and understand and apply cryptographic applications for securing the e-businesses and data privacy.	BTL3	PO1, PO2, PO3, PO5, PO6, PO7
CO3	Examine various e-business models, revenue models, electronic payment systems and electronic fund transfers.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11
CO4	Create effective strategies for e-business, and mobile commerce while adapting to the emerging trends in e-business.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-3]

Introduction to e-business: Electronic Business, Electronic Commerce, Electronic Commerce Models, Types of Electronic Commerce, Value Chains in Electronic Commerce, E-Commerce in India. Internet, World Wide Web, Internet Architectures, Internet Applications, Web Based Tools for Electronic Commerce, Intranet, Composition of Intranet, and extranet, ERP and Web application comparison.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB3 [Chapters 1, 2, 6,10,11,14,15,16]

Security Threats to e-business: Security Overview, Electronic Commerce Threats, Data Privacy Issues.

Cryptography: Encryption, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Prominent Cryptographic Applications.

Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 3, 6]

Electronic Payment System: Concept of Money, Electronic Payment System, Types of Electronic Payment Systems, Electronic Data Interchange, Infrastructure Issues in EPS, Electronic Fund Transfer.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 3,4,6]

e-Business Applications & Strategies: Business Models & Revenue Models over Internet, Emerging Trends in e-Business, e-Governance, Digital Commerce, Mobile Commerce, Strategies for online Business Models.

TEXT BOOKS:

TB1. Schneider Gary P. and Perry, James T, “Electronic Commerce”, Thomson Learning, 1st Edition, 2000.

TB2. Bajaj, Kamlesh K and Nag, Debjani, “E-Commerce: The Cutting Edge of Business”, Tata McGraw Hill, 1st Edition, 1999.

TB3. William Stallings, “Cryptography & Network Security-Principles & Practices”, Prentice Hall, 4th Edition, 2005.

REFERENCE BOOKS:

RB1. Rayport and Jaworksi,” Introduction to E-Commerce”, Mcgraw-Hill /Irwin Series in Marketing, 2nd Edition, 2003.

RB2. Dave Chaffey,” E-Business and E-Commerce Management–Strategy, Implementation and Practice”, Prentice Hall, 4th Edition, 2011.

RB3. Micheal Shaw, Robert Blanning, Troy Strader, “Handbook on Electronic Commerce”, Springer, 1st Edition, 2012.

RB4. Donal O'Mahony, Michael A. Peirce, Hitesh Tewari, “Electronic Payment Systems for E-commerce”, Artech House, 2nd Edition, 2007.
RB5. Whitley, David, “e-Commerce Strategy, Technologies and Applications”, Mcgraw-Hill, 1st Edition, 2001.

Web Intelligence and Big Data

Course Code: **MCA-227**
Course Name: **Web Intelligence and Big Data**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Concepts of web intelligence and big data technologies.
2. Applications of web intelligence capabilities and big data analytics tools.

PRE-REQUISITES:
1. Concepts of Web Technology
2. Understanding Database Management Systems

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the fundamentals of web intelligence and big data	BTL2	PO1, PO2
CO2	Understand issues and apply text and Image pre-processing techniques to specific cases.	BTL3	PO1, PO2, PO3, PO6, PO10
CO3	Analyse the key issues in big data management and its associated applications.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Adapt Hadoop and related big data technologies such as Map Reduce, Pig and Hive in the context of big data management.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter/ Book Reference: TB1 [Chapters 1, 2]**

Introduction Web Intelligence: Characteristics of the Web, Web structure, Retrieval vs. browsing, The long tail in Social networks. What is Web Intelligence, Benefit of Web Intelligence, Ingredients of Web Intelligence, Related Technology and Application.

Information Retrieval: Document representation, Stemming, Term-Document Matrix, Standard Document collections.

Retrieval Model: Boolean retrieval Model, Vector space retrieval model, probabilistic information Model
Evaluation Criteria: Precision and Recall, Confusion Matrix

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 7]**

Architecture of a Web Search Engine: The crawler. Indexing systems, queries and ranking. Scalability. Ranking through link analysis.
Multimedia Search: images, audio and video
Image and Short Text Mining: Text Pre-processing: Data Cleaning, Data Integration, Data Transformation, Segmentation
Image Pre-Processing: Image histogram analysis, Noise cleaning, Segmentation
Classification Algorithms: Linear Regression, Decision Tree, K-means, Naive Bayes

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapters 1, 2]; TB3 [Chapters 2,3]**

Understanding Big Data: What is Big Data? Why Big Data? Big Data Applications, Big Data Analytics, Big Data Challenges.
Introduction to NoSQL: Aggregate Data Models, Key-Value and Document Data Models, Graph Databases, Schema Less Databases, Big Data Solutions.
Case Studies on Big Data

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB4 [Chapters 1,4,7,12]**

Introduction to Hadoop: Hadoop architecture, Hadoop Working, Advantages of Hadoop, HDFS Overview, Features of HDFS, HDFS Architecture
Map reduce applications: Map Reduce workflows, Hadoop streaming, Components of Hadoop Ecosystem (HBase, Sqoop, Flume, PigLatin scripts. Hive), Apache Spark

TEXT BOOKS:

TB1. Rajendra Akerkar, Pawan Lingras, "Building an Intelligent Web: Theory and Practice" Front Cover Jones & Bartlett Learning, 2010.
TB2. Data Science and Big Data Analytics, Discovering, Analyzing, Visualizing and Presenting Data, Wiley
TB3. Nathan Marz, James Warren, "Big Data: Principles and Best Practices of Scalable Real Time Data Systems", Manning, 2015
TB4. Dirk De Roos, Melnyk, Bruce Brown, Raefel Coss, "Hadoop For Dummies", John Wiley & Sons, 1st Edition, 2014.

REFERENCE BOOKS:

RB1. Zhong, Zhongying, Liu, Jiming, Yao, Yiyu (Eds.), "Web intelligence", Springer, 1st Edition, 2003.
RB2. DT Editorial Services, "Big Data Black Book", Dreamtech Press, 2015.

Flutter and Dart

Course Code: **MCA-229**

Course Name: **Flutter and Dart**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Understand the lifecycle of mobile app development.
2. Create cross-platform mobile app rapidly.
3. Build full-fledged mobile app.

PRE-REQUISITES:

1. Programming Skill
2. Basic Understanding of Mobile Applications

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate the basic primitives in Flutter and Dart framework	BTL2	PO1, PO2, PO3, PO6, PO10
CO2	Model native platform code using Flutter and Dart	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Examine the use of widgets and user interactions in application development	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Evaluate application development using the concepts of animation and interactive widgets	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10

CO5	Construct flutter and dart applications using customized layouts and service interactions	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1-4]; TB2 [Chapters 2-5, 8, 10-12]**

I**ntroduction to Flutter**: Flutter Framework, Working of Flutter and Dart, installation of Flutter SDK, Using Hot Reload and themes, External packages import, project templates, organizing files and folders.

Introduction to Dart: Declaring and referencing variables, using operators, flow control statements, using functions and classes, implementing asynchronous programming.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 5, 6, 12]; TB2 [Chapters 6, 10]**

Widgets: Stateless and stateful Widgets, Widget Tree, using common widgets: Scaffold, AppBar, SafeArea, Container, Text, Buttons, column, row, Using images and icons, decorators, form widgets, checking orientation

User Inputs: Collecting text Inputs, setting text limits, Writing platform native code.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 7-9, 11]**

Adding Animation to App using Widget: Using AnimatedContainer, AnimatedCrossfade, AnimatedOpacity, AnimationController, using staggered Animations, using CurveTween.

App's Navigation: Using Navigator, named navigator route, Hero widget, BottomNavigationBar BottomMapBar, TabBar, TabBarView, Drawer.

Applying Interactivity: GestureDetector, Dragable and DragTarget Widget, InkWell and InkResponse gestures Dismissible widget.

UNIT – IV

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 10, 13, 14]; TB2 [Chapters 9, 10, 12]**

Building layouts: Scrolling Lists: Card widget, Using ListView and ListTitle, GridView, Stack widget, Customising CustomScrollView using Slivers

Service interaction: Working with Future object, working with streams, building widgets based on stream and futures, handling various types of data: JSON, XML, HTML, Sending HTTP request

Saving data with local persistence: Reading and Writing files, working with key-value pairs, Supporting multiple locales, Introduction to Firebase and cloud Firestore

TEXT BOOKS:

TB1. Marco L. Napoli, “Beginning Flutter: A Hands on Guide to App Development”, John Wiley & Sons, 1st Edition, 2020.

TB2. D. Kopec, “Dart for Absolute Beginners”, Apress, 1st Edition, 2014.

TB3. Fu Cheng, “Flutter Recipes”, Apress, 1st Edition, 2019.

REFERENCE BOOKS:

RB1. Rap Payne, “Beginning App development with Flutter”, Apress, 1st Edition, 2019.

RB2. Frank Zammetti, “Practical Flutter: Improve your Mobile Development with Google’s Latest Open-Source”, Apress, 1st Edition, 2019.

RB3. Eric Windmill, “Flutter in Action”, Manning Publications, 1st Edition, 2019.

RB4. Simone Alessandria, “Flutter Projects: A Practical, Project-based Guide to Building Real-world Cross-platform Mobile Applications and Games”, Packt Publishing Limited, 1st Edition, 2020.

Service Oriented Architecture

Course Code: **MCA-231**
Course Name: **Service Oriented Architecture**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop understanding and expertise related to the important concepts and advanced features of contemporary Software Solution Architectures, as detailed here under:-
1. Understand goals of Service-Orientation (SO), its benefits and effects on an Enterprise.
2. Introduction to XML and its Advantages.
3. Analysis and Design of Service-Oriented Solutions.
4. Understand Web Services, REST API Services, Microservices and Contract Design.

PRE-REQUISITES:
1. Programming Experience
2. Database Management System
3. Computer Networks
4. Software Engineering
5. Web Technologies

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain Service Oriented Architecture, Service Oriented Application, Big Data, Cloud and Containers	BTL2	PO1, PO2, PO3
CO2	Apply XML in Service Oriented based Solution for a given problem	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO3	Analyze the architecture of Service Oriented solution for any given specific problem.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10

CO4	Assess Microservices based solution with other approaches.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-5]; TB2 [Chapters 8-10]

Service Oriented Architecture (SOA): Service Orientation in Daily Life, Service Oriented Architecture and Microservices Architecture, Conceptual Model of SOA.

Enterprise-Wide SOA: Considerations for Enterprise-Wide SOA, Strawman Architecture for Enterprise-Wide SOA, Enterprise SOA Reference Architecture, Object Oriented Analysis and Design (OOAD) Process, Service Oriented Analysis and Design (SOAD) Process.

Service Oriented Applications: Patterns for SOA, Pattern-based Architecture for Service Oriented Applications, Composite Applications.

XML: Introducing XML, Advantages of XML, Well Formed XML, XML Namespaces, DTD, Schema.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 11-14, 16]

Service Oriented Analysis and Design: Principles of Service Design, Non-functional Properties for Services, Design of Activity Services (or Business Services), Design of Data Services, Design of Client Services.

Technologies for SOA: Service Enablement, Service Integration, Service Orchestration.

Big Data and SOA: Data Concepts, Big Data and its characteristics, Technologies for Big Data, Service Orientation for Big Data Solutions.

SOA Governance and Implementation: Strategic Architecture Governance, Service Design-time Governance, Service Run-time Governance, Approach for Enterprise-Wide SOA Implementation.

SOA Best Practices: SOA Strategy, SOA Development, SOA Governance.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 18-19]; TB3 [Chapters 1, 3, 4]

Microservices Architecture (MSA): Services Model for Cloud and Mobile Solutions, Challenges and Takeways from SOA Implementations, MSA in Action. **Cloud and Microservices Architecture:** Cloud Services, Hybrid Cloud Services, Considerations for Hybrid Cloud Services, Cloud Services and MSA.

HoneyComb: Analogy, Principles of Microservices, Characteristics of Microservices, Microservices Benefits.

Building Microservices with Spring Boot: Setting up a development environment, Spring Boot for building RESTful Microservices, Developing a Spring Boot Microservices, HATEOAS - enabled Spring Boot Microservice, Reactive Spring Boot Microservices, Implementing security, Enabling cross origin for Microservices interactions, Spring Boot actuators for Microservices instrumentation.

Applying Microservices Concepts: Deciding Microservice boundaries, Designing communication styles, Overview of Orchestration of Microservices.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters 7-9]**

Scale Microservices with Spring Cloud Components: Overview of Spring Cloud, Setting up the environment for the BrownField PSS, Spring Cloud Config.

Containerizing Microservices with Docker: Microservices and Containers, Concepts of Docker Containers, Deploying Microservices into Docker, Running RabbitMQ on Docker, Using the Docker registry, Container Orchestration.

A case study on Cloud SOA.

TEXT BOOKS:

TB1. Danny Ayers, Liam R.E. Quin and Joe Fawcett, "Beginning XML", Wrox Publication, 5th Edition, 2012.

TB2. Shankar Kambhampaty, "Service - Oriented Architecture & Microservices Architecture: For Enterprise, Cloud, Big Data and Mobile", Wiley, 3rd Edition, 2018.

TB3. Rajesh RV, "Spring 5.0 Microservices", Packt Publishing, 2nd Edition, 2017.

REFERENCE BOOKS:

RB1. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 1st Edition, 2005.

RB2. Thomas Erl, Benjamin Carlyle, Cesare Pautasso , Raj Balasubramanian, H. Wilhelmsen, David Booth, "SOA with REST: Principles, Patterns & Constraints for Building Enterprise Solutions with REST", Pearson Education, 1st Edition, 2013.

Multimedia Technologies

Course Code: **MCA-233**
Course Name: **Multimedia Technologies**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Identify a range of concepts, techniques and tools for creating and editing the interactive multimedia applications.
2. Identify the current and future issues related to multimedia technology.
3. Identify both theoretical and practical aspects in designing multimedia systems surrounding the emergence of multimedia technologies using contemporary hardware and software technologies.

PRE-REQUISITES:

Basic knowledge of Information Technology

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the technical aspects of multimedia systems.	BTL2	PO1, PO2
CO2	Apply various file formats of audio, video and text media in different applications.	BTL3	PO1, PO2, PO3
CO3	Analyze the QoS parameters of various multimedia applications through internet.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Evaluate different types of multimedia compression methods.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Design interactive multimedia software applications using animations.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10

CO6	Develop real-time multimedia applications using different multimedia components.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter/Book Reference: TB1 [Chapter 1]; TB3 [Chapters 1-4, 7, 8]**

Introductory Concepts: Multimedia – Definitions, CD-ROM Technology and the Multimedia Highway, Applications of Multimedia, Introduction to Multimedia Projects – The Stages of Project, Requirements to make Good Multimedia, Multimedia Skills and Training, Introduction to Virtual Reality, Challenges in Multimedia Technologies.

Multimedia-Hardware and Software: Multimedia Hardware – Macintosh and Windows Production Platforms, Memory and Storage Devices, Multimedia Software – Basic Tools, Making Instant Multimedia.

Multimedia Building Blocks: Text, Sound, Images, Animation and Video, Image Color Schemes, Digitization of Audio and Video objects.

Assembling and Delivering a Project: Planning and Costing, Designing and Producing, Content and Talent, Delivering.

UNIT – II

No. of Hours: 10 **Chapter/Book Reference: TB1 [Chapter 7]; TB3 [Chapters 5, 6]**

Animation: Introduction, Basic Animation Techniques, Motion Graphics-2D & 3D Animation - Cell Animation, Computer Animation, Tweening & Morphing, Dynamics, Kinematics, Reverse Kinematics.

Video and Animation: Video Basics, How Video works, Analog Video, Digital Video, Video Recording and Tape Formats, Shooting and Editing Videos.

Exposure of Multimedia Tools: Authoring Tools, Modelling, Rendering, Texture Shading, Different File Formats.

UNIT – III

No. of Hours: 10 **Chapter/Book Reference: TB2 [Chapters 3, 4]; TB3 [Chapter 4]**

Compression Fundamentals: Need for Compression, Lossless and Lossy Compression, Taxonomy of Compression Algorithms, Basics of Information Theory.

Text Compression: Huffman Coding, Dynamic Huffman Coding, Arithmetic Technique.

Entropy Encoding: Run Length Coding, Lempel-Ziv-Welch (LZW) Algorithm.

Source Coding: Transform Coding- JPEG, MPEG, Audio Compression-MP3, Statistical Coding-Pattern Substitution.

UNIT – IV

No. of Hours: 10 **Chapter/Book Reference: TB2 [Chapters 1,2,5,7,8]**

Multimedia Communication and Applications: Multimedia Information Representation, Multimedia Networks, Integrated Services, RSVP- Differentiated Services, Multimedia on 4G/5G Networks, Standards for Multimedia Communications - Interpersonal Communication, Multimedia Conferencing, Interactive Application over Internet, Entertainment Applications and Interactive Television.

Multimedia and Internet: IP Datagram, Fragmentation and Reassembly, QoS Support, IPv4/IPv6 Interoperability, Designing for WWW- Audio, Video.

Digital Communication: Transmission Mode, Asynchronous, Synchronous and Isochronous Transmission Modes.
Streaming: Stored Audio and Video, Best-Effort Service, Protocols for Real-Time Interactive Applications, Scheduling and Policing Mechanism.

TEXT BOOKS:

TB1. John Vince, "Virtual Reality Systems", Pearson Education, 8th Edition, 2014.
TB2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson, 1st Edition, 2013.
TB3. Tay Vaughan, "Multimedia-Making it Works", McGraw-Hill, 9th Edition, 2014.

REFERENCE BOOKS:

RB1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, "Fundamentals of Multimedia", Springer, 2nd Edition, 2014.
RB2. Ralf Steinmetz and Klara Naharstedt, "Multimedia: Computing, Communications & Applications", Pearson, 1st Edition, 2014.
RB3. K. Andleigh and K. Thakkar, "Multimedia System Design", PHI, 1st Edition, 2015.
RB4. Keyes, "Multimedia Handbook", TMH, 2nd Edition, 2000.
RB5. Khalid Sayood, "Introduction to Data Compression", Elsevier, 5th Edition, 2017.

Internet of Things

Course Code: **MCA-235**
Course Name: **Internet of Things**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Understand the IoT Terminology, Technology, architecture and its implementation procedure.
2. Learn the Network and Communication protocols for IoT.
3. Identify the role of controllers and sensors in IoT.
4. Apply the Programming Concepts for IoT.

PRE-REQUISITES:
Basic Knowledge of Programming and Data Networking concepts

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain the architecture of Internet of Things	BTL2	PO1, PO2
CO2	Demonstrate the different enabling technologies for IoTs	BTL2	PO1, PO2
CO3	Apply Python Programming skills to develop IoT application	BTL3	PO1, PO2, PO3
CO4	Analyze the architecture of Arduino and Raspberry Pi	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Create Small IoT Applications using Sensors	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-2]; TB3 [Chapters 1-3]

Getting Familiar with Internet of Things (IoT): Definition, Characteristics, History and Evolution of IoT. **Physical Design of IoT**: Things in IoT, IoT Protocols. **Logical Design of IoT**:

Functional block, Communication Models and APIs, IoT Stack. **Enabling Technologies**: Sensors, Cloud Computing, Big Data analytics, Embedded Computing Boards, Communication Protocols, IoT Challenges, IoT Levels, Overview of Domain Specific IoTs applications Like Smart Cities, Smart Agriculture and Industrial IoT Applications.
The IoT Paradigm: Comparison with User interface related Technologies like SCADA, M2M, SDN. IoT Design Methodology: IoT Components.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 3-5]; TB3 [Chapter 8]

Internet Vs Internet of Things: IoT Layers, IoT Messaging Protocols: MQTT, CoAP. IoT Transport Protocols: BLE, LiFi, Network Protocol: 6LoWPAN.
Physical Design of IoT: Functional Block, Cloud Storage Models, Communication Models, and Communication APIs: REST based, Web Socket Based, Cloud for IoT: Challenges, Fog Computing.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 7]; TB3 [Chapter 7]

Physical Devices and Endpoints: Arduino Pin diagram, Arduino Architecture, Arduino Programming, Raspberry Pi Pin diagram, Raspberry Pi Architecture.
Sensors and Interfacing: Types of Sensors. **Integrating Sensors**: HDT (Humidity and Temperature Sensor), Gas Detector, HC-05 (Bluetooth Module), Ultrasonic Sensor, ESP8266 (Wi-Fi Module).

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 1-7]; TB3 [Chapter 6]

Logical Design of IoT: Revisiting Python Programming for IoT (Data types, Operators, Control Structures, List, Tuples, Dictionaries, Functions, Modules and File Handling). **Python Packages for connecting IoT Devices:** Bluetooth, Sockets, Time, Requests, Sys, Adafruit Python DHT, paho-mqtt, Python JSON, Python pip.

TEXT BOOKS:

TB1. S. K. Vasudevan, A. S. Nagarajan, RMD Sundaram, “Internet of Things”, Wiley, 1st Edition, 2014.
TB2. G. C. Hillar, “Internet of Things with Python”, PACKT Publications, 1st Edition, 2016.
TB3. V. Madisetti, A. Bahga, “Internet of Things: A Hands-on Approach”, United Kingdom: Arsheep Bahga & Vijay Madisetti, 1st Edition, 2015.

REFERENCE BOOKS:

RB1. J. C. Shovic, “Raspberry Pi IoT Projects: Prototyping Experiments for Makers”, Apress, 1st Edition, 2016.
RB2. M. Schwartz, “Internet of things with the Arduino Yun”, Packt Publishing Ltd., 1st Edition, 2014.
RB3. O. Hersent, D. Boswarthick, O. Elloumi, “The Internet of Things: Key Applications and Protocols”, John Wiley & Sons, 1st Edition, 2012.
RB4. C. Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus”, Wiley Publishing, 1st Edition, 2013.

Soft Computing

Course Code: **MCA-237**
Course Name: **Soft Computing**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Fuzzy logic and its applications.
2. Artificial neural networks and its applications.
3. Applications of Soft computing to solve problems in varieties of application domains.

PRE-REQUISITES:
1. A strong mathematical background.
2. Proficiency with algorithms.
3. Programming skills in C, C++, Java, MATLAB, etc.
4. Critical thinking and problem solving skills.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate the techniques of soft computing and their role in problem solving	BTL2	PO1, PO2, PO3
CO2	Apply various soft computing techniques in order to solve problems effectively and efficiently.	BTL3	PO1, PO2, PO3, PO4
CO3	Construct neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Analyze Fuzzy logic and neural networks primitives like fuzzy sets, fuzzy logic and heuristics based on human experience.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Assess the current research problems and research methods in Soft Computing Techniques.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6,

			PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapter 1]; TB3 [Chapter 1]

Introduction: Introduction to Soft Computing Concepts, Importance of tolerance in imprecision and uncertainty, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques

Classical and Fuzzy Sets: Introduction to Fuzzy Sets, Overview of Classical Sets, Membership Function

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 3,4,12]

Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations. Fuzzy rule generation, Fuzzy Propositions, implications and inferences

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Defuzzyfication techniques, Fuzzy logic controller design, some applications of Fuzzy logic.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB4 [Chapters 12]

Evolutionary Computation: Genetic Algorithms and Genetic Programming, Basic GA framework and different GA architectures.

Different operators of Genetic Algorithms, Analysis of Selection Operations, Convergence of Genetic Algorithms

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB3 [Chapters 2-3]; TB1 [Chapters 1-6]; TB4 [Chapter 13]

Neurons: Overview of Biological neurons and its working, Simulation of biological neurons to problem solving. Introduction to ANN, Different ANNs architectures, Training techniques for ANNs- perceptions, Training rules, Back Propagation Algorithm, Multilayer Perceptron Model, Hopfield Networks, Applications of ANNs to solve some real life problems.

Hybrid Systems: Neuro-Fuzzy Systems, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

TEXT BOOKS:

TB1. Anderson J. A., “An Introduction to Neural Networks”, PHI, 1999.
TB2. G. J. Klir & B. Yuan, “Fuzzy Sets & Fuzzy Logic”, PHI, 1995.
TB3. S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, Wiley India Edition, 2008.
TB4. Samir Roy, Udit Chakraborty, “Introduction to Soft Computing Neuro-Fuzzy and Genetic Algorithms”, Pearson Education.

REFERENCE BOOKS:

RB1. Freeman J. A. & D. M. Skapura. “Neural Networks: Algorithms, Applications and Programming Techniques”, Addison Wesley, Reading, Mass, 1992.
RB2. Melanie Mitchell, “An Introduction to Genetic Algorithm”, PHI, 1998.
RB3. Hertz J. Krogh, R. G. Palmer, “Introduction to the Theory of Neural Computation”, Addison-Wesley, California, 1991.

Software Quality Management

Course Code: **MCA-239**
Course Name: **Software Quality Management**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Fundamentals of Software Quality
2. Software Quality Factors
3. Components of Software Quality Management
4. Participants in Software Quality Management
5. Software Quality Metrics & Models
6. Standards of Software Quality
7. Cost of Software Quality
8. Future of Software Quality Management

PRE-REQUISITES:
Fundamentals of Software Engineering

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Identify software quality and the varied models and approaches aimed at realising software quality in varied software development environments.	BTL3	PO1, PO2, PO3, PO4, PO6, PO7,PO9
CO2	Discover software quality aspects and participants by improving different phases of software development.	BTL4	PO1, PO2, PO3, PO4, PO7, PO10
CO3	Analyze fundamental concepts of CASE Tools and quality metrics for specific software cases.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10
CO4	Appraise varied SQA standards and costs and challenges associated with Software Quality.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1-3]; TB3 [Chapter 1-3]

Fundamentals of Software Quality: Define Software Quality, Software Quality Assurance Context, Challenges of Software Quality, Environments for SQA, Relate Software Quality and the Software Development Life Cycle, Software Quality Assurance versus Software Quality Control

Software Quality Assurance: Components of Software Quality Assurance System, Software Requirements into Software Quality Factors, Product Operation, Revision and Transition Software Quality Factors, Alternative Models of Software Quality Factors, SQA Tools

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 4-12, 25-26]; TB3 [Chapter 4]

Tailoring the Software Quality Assurance System: The SQA Architecture, Pre-Project Components (Contract Review, Quality Plans), Software project life cycle components (Review, Audit planning and implementation, Testing), infrastructure and management components, Organizing SQA, Guidelines for SQA construction

Participants in Software Quality Management: Understand SQA management organization, Describe management roles, organization, and activities.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 13, 21]

CASE Tools in Software Quality: Overview of CASE Tool, Contribution of CASE Tool to Software Product, Software Maintenance and Software Project Quality

Software Quality Metrics: Classification, Process Metrics, Product Metrics, Implementation and Limitations.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 22-24, 26]

SQA Standards: Scope of Quality Standards, Six Sigma, Overview of ISO, CMMI, IEEE standards with examples

Costs of Software Quality: Cost of Software Quality Metrics, Classic and extended model of cost of software quality, Application and Problems.

Future of Software Quality: SQA Challenges and Capabilities

TEXT BOOKS:

TB1. Daniel Galin, "Software Quality Assurance: From Theory to Implementation", Addison Wesley, 1st Edition, 2003.

TB2. Stephen Kan, "Metrics and Models in Software Quality Engineering", Addison Wesley, 2nd Edition, 2002.

TB3. Claude Y. Laporte, Alain April, "Software Quality Assurance", Wiley, 1st Edition, 2017.

REFERENCE BOOKS:

RB1. Schulmeyer, G. Gordon and McManus, James, (eds), “Handbook of Software Quality Assurance”, Prentice Hall, 3rd Edition, 1999.

RB2. Anderson D. J. "Stretching Agile to fit CMMI level 3 - the story of creating MSF for CMMI/SPL Reg/Process Improvement at Microsoft Corporation," Agile Development Conference (ADC’05), Denver, CO, USA, 2005, pp. 193-201, doi: 10.1109/ADC.2005.42.

RB3. Boehm, B., Huang, L., Jain, A., and Madachy, R. "The ROI of Software Dependability: The iDAVE Model", Software, IEEE(21:3) 2004, pp 54-61

RB4. Kshirasagar Naik, Priyadarshi Tripathy, “Software Testing and Quality Assurance-Theory and Practice,” Wiley, 1st Edition, 2008.

Digital Image Processing

Course Code: **MCA- 241**

Course Name: **Digital Image Processing**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Fundamental steps in Digital Image Processing and image formation.
2. Various techniques to improve the visual appeal of an image.
3. Filtering of images in spatial and frequency domain for enhancement
4. Image restoration process.
5. Image compression and image segmentation useful in various applications.
6. Implementation of various algorithms for image analysis.

PRE-REQUISITES:

Basics of Digital Signal Processing, Transform Techniques

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate to the digital image processing primitives and the different types of images and their application areas.	BLT1	PO1, PO2
CO2	Explain the image formation process, and the filtering techniques for image enhancement.	BLT2	PO1, PO2, Po3
CO3	Apply appropriate image processing algorithms in both the spatial and frequency domain.	BLT3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Analyze types of noise and the techniques useful to remove the noise from the degraded images.	BLT4	PO1, PO2, PO3, PO4, PO5, PO6, PO10

CO5	Assess image segmentation and compression techniques for various image processing applications.	BLT5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1-3]**

Introduction to Digital Images: Image processing steps, Digital Image Fundamentals, Image Sampling and Digitization, relationships between pixels, mathematical tools for image processing.
Image Transformations: Intensity Transforms, Histogram processing, Spatial filtering, smoothing and sharpening spatial filters.

UNIT – II

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 4-5]**

Image Enhancement in Frequency Domain: Basics of signal and system, Fourier Transform and frequency domain. Basics of filtering images in the frequency domain, Image smoothing and sharpening using frequency domain filters, Homomorphic filtering,
Image Restoration: Inverse Filtering, Algebraic Approach to Restoration, Wiener (LMS) approach, Constrained Least Squares Restoration, Interactive and other methods for restoration.

UNIT – III

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 5, 8]**

Image Reconstruction from Projections: The Filtered Back-Projection Algorithm, Algebraic reconstruction method.
Image Data Compression: Fundamentals, Image compression coding, Image compression models and standards, basic Image compression methods.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapter 9-10]**

Image Segmentation: Fundamentals, Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region based segmentation. Morphological processing.

TEXT BOOKS:

TB1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing”, Pearson Education, 4th Edition, 2018

TB2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision, Cengage Learning, 4th Edition, 2014.

REFERENCE BOOKS:

RB1. W. K. Pratt, “Digital Image Processing”, John Wiley and Sons, 2nd Edition, 1991.

RB2. S. Annadurai, R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, 1st Edition, 2007.

Compiler Design

Course Code: **MCA- 243**
Course Name: **Compiler Design**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Concept of Lexical Analyzer and working of Lex tool.
2. Concept of Syntactical Analyzer and working of YACC tool.
3. Code generation and Code Optimization.
4. Algorithms and data structures.
5. Compiler and cross-compiler.

PRE-REQUISITES:
1. Programming Language
2. Theory of Computation

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall different language translation tools.	BTL1	PO1
CO2	Explain the importance of code optimization.	BTL2	PO1, PO2
CO3	Identify compiler generation tools and techniques.	BTL3	PO1, PO2, PO3, PO5
CO4	Construct compiler and its applications.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Design a compiler for a simple programming language.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT - I

No. of Hours: 13 **Chapter / Book Reference: TB1 [Chapters 1, 3, 4]; TB2 [Chapters 2, 7]; TB4 [Chapters 4,7]**

Introduction: Concept of Compilers, Phases of Compiler, Grammar (CFG), Registers of Microprocessor, Assembly Language and Programming.

Lexical Analysis: Introduction/Revision to Lexical Analysis, Implementation of Lexical Analyser using Lex/Flex.

Top Down Parsing Parser: Introduction/Revision of Parser, Recursive Decent Parser, Operator Precedence Parser, LL(1) Parser.

UNIT - II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 4, 5]; TB2 [Chapters 3,7]

Bottom Up Parsing: SLR Parser, LR(k) Parser, LALR Parser, Implementation of Parser using YACC or Bison.

Introduction to Syntax Directed Definitions: Inherited and Synthesized Attributes, Dependency Graph, Evaluation Order, Bottom Up and Top Down Evaluation of Attributes, L- and S-Attributed Definitions.

UNIT - III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 6, 8, 11]

Type Checking: Type System, Type Expressions, Structural and Name Equivalence of Types, Type Conversion, Overloaded Function and Operators, Polymorphic Function.

Intermediate Code Generation: Intermediate Representation, Translation of Declarations, Assignments, Intermediate Code Generation for Control Flow, Boolean Expressions and Procedure Calls, Implementation Issues.

Code Optimization: Source of Optimizations, Optimization of Basic Blocks, Loops, Global Dataflow Analysis, Solution to Iterative Data Flow Equations, Code Improving Transformations, Dealing with Aliases, Data Flow Analysis of Structured Flow Graphs.

UNIT - IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 12]; TB3 [Chapters 10,11,15]

Code Generation and Instruction Selection: Issues, Basic Blocks and Flow Graphs, Register Allocation, Code Generation, DAG Representation of Programs, Code Generation from DAGS, Peephole Optimization, Code Generator Generators, Specification of Machine.

Run Time System: Storage Organization, Activation Tree, Activation Record, Parameter Passing Symbol Table, Dynamic Storage Allocation.

Error Recovery: Error Detection & Recovery, Ad-Hoc and Systematic Methods.

TEXT BOOKS:

TB1. Alfred V. Aho, and Jeffrey D. Ullman, “Compilers Principles, Techniques and Tools”, Pearson Education, 1st Edition, 2006.

TB2. Levine, Mason and Brown, “Lex & Yacc”, O’ Reilly, 2nd Edition, 1992.

TB3. Alfred V. Aho, and Jeffrey D. Ullman “Principles of Compiler Design”, Narosa Publications, 5th Edition, 2002.

TB4. Morris Mano “Computer System Architecture“, Pearson Education, 3rd Edition, 1993.

REFERENCE BOOKS:

RB1. Allen I. Holub, “Compiler Design in C”, Prentice-Hall, 2nd Edition, 1990.

RB2. K. C. Louden, “Compiler Construction, Principle and Practice”, Cengage Publication, 2nd Edition, 2006.

RB3. V. Raghvan, “Principles of Compiler Design”, TMH, 2nd Edition, 2011.
RB4. Vinu V. Das, “Compiler Design using FLEX and YACC”, PHI, 3rd Edition, 2014.
RB5. Fisher, “Crafting a Compiler in C”, Pearson Education, 2nd Edition, 2005.
RB6. O. G. Kakde, “Compiler Design”, Laxmi Publications, 4th Edition, 2014.

Parallel Computing

Course Code: **MCA-245**
Course Name: **Parallel Computing**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Concepts of parallelism which enhances the speed of operations of an OS.
2. Various architectures of multiprocessor are taught.

PRE-REQUISITES:
1. The concepts of Computer System and Architecture.
2. Introduction of Operating System.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Define the terminology associated with parallel computing, such as efficiency and speedup	BTL1	PO1
CO2	Demonstrate different parallel architectures and inter-connect networks	BTL2	PO1, PO2
CO3	Identify the challenges in efficient implementation of large-scale parallel applications	BTL3	PO1, PO2, PO3
CO4	Analyze the hardware and software challenges in parallelism	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Assess different parallel programming models, and algorithms	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10, PO11

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1-4]**

Theory of Parallelism: Parallelism, Reason of parallel processing, Concepts and challenges, applications of parallel processing.

Parallel computer models: The state of computing, Classification of parallel computers, Flynn and Feng's classification, SIMD and MIMD operations, Shared Memory vs. message passing multiprocessors, Distributed shared memory, Amdahl's law, speedup and efficiency, Hybrid multiprocessors, multiprocessors and multicomputers, Multivector and SIMD computers, PRAM and VLSI Models.
Program and Network Properties: Conditions of parallelism, program partitioning and scheduling, program flow mechanism, system interconnection architecture.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 1-4]

Memory Hierarchy Design: Memory technologies and optimization, inclusion, coherence and locality, cache memory organization and cache performance optimization, shared memory organization, memory protection, virtual memory technology and introduction to buses, crossbar and multi-stage switches.
Pipelining and ILP: Instruction level parallelism and its exploitation- concepts and challenges, overcoming data hazards with dynamic scheduling. Pipelining, instruction and arithmetic pipelining designs, branch handling techniques, linear and non-linear pipeline processors, superscalar and super pipeline design.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 8-9]; TB3 [Chapters 2-6]

Parallel Architectures: message passing mechanism, vector processing principles, multi-vector multiprocessors, compound vector processing, principles of multithreading, latency hiding techniques- shared virtual memory, pre-fetching techniques, distributed coherent cache, scalable and multithread architectures, dataflow and hybrid architecture.
Parallel Algorithms: Cost, Efficiency, PRAM algorithms, Mesh algorithms, hypercube algorithms, combinational circuit algorithms.

UNIT – IV

No. of Hours: 12 Chapter / Book Reference: TB2 [Chapter 10]

Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, and Routing Mechanisms for Interconnection Networks.
Parallel languages and compilers: Language features for parallelism, parallel language constructs, optimizing compilers for parallelism, dependency analysis, code optimization and scheduling, loop parallelization and pipelining.

TEXT BOOKS:

TB1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", Pearson Publication, 2nd Edition, 2003.
TB2. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture", Tata McGraw Hill publications, 3rd Edition, 2017.
TB3. Michael J. Quinn, "Parallel Computing Theory and Practice", McGrawHill, 2nd Edition, 2002.

REFERENCE BOOKS:

RB1. P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare, “Introduction to Parallel Processing”, PHI Publications, 2nd Edition, 2014.
RB2. V. Rajaraman, C. Siva Ram Murthy, “Parallel Computers – Architecture and Programming”, PHI, 2nd Edition, 2016.
RB3. Steven Brawer, “Introduction to Parallel Programming”, Academic Press, 1st Edition, 1989.
RB4. Behrooz Parhami, “Introduction to Parallel Processing: Algorithms & Architectures”, Springer, 2006.

Numerical and Scientific Computing

Course Code: **MCA-247**
Course Name: **Numerical and Scientific Computing**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to following:-
1. Overview of some of the issues and problems that arise in scientific computation, such as (non-)linear systems, numerical and symbolic integration, differential equation and simulation.
2. Suitable and effective methods called Numerical Methods, for obtaining approximate representative numerical results of the problems.
3. Problems in the field of Applied Mathematics, Theoretical Physics and Engineering which requires computing of numerical results using certain raw data.
4. To solve complex mathematical problems using only simple arithmetic operations. The approach involves formulation of mathematical models of physical situations that can be solved with arithmetic operations.
5. To deal with various topics like finding roots of equations, solving systems of linear algebraic equations, interpolation and regression analysis, numerical integration & differentiation, solution of differential equation, boundary value problems, solution of matrix problems.

PRE-REQUISITES:
Basic of Mathematics

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall finite precision computation.	BTL1	PO1
CO2	Demonstrate understanding of common numerical methods used to obtain approximate solutions to otherwise intractable mathematical problems.	BTL2	PO1, PO2

CO3	Apply Numerical analysis which has enormous applications in the field of Science and some fields of Engineering.	BTL3	PO1, PO2, PO3
CO4	Examine numerical methods for various mathematical operations and tasks.	BTL4	PO1, PO2, PO3, PO4, PO5
CO5	Analyze and evaluate the accuracy of common numerical methods.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Assess calculation and interpretation of errors in numerical method.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 0-1]; TB2 [Chapters 2-3]**

Floating Point Arithmetic: Representation of floating point numbers, Operations, Normalization, Pitfalls of floating point representation. Errors in numerical computation-Absolute error, Relative error, truncation error and rounding off error.

Solution of Transcendental and Polynomial Equations: Zeros of a single transcendental equation and zeros of a polynomial using Bisection Method, Secant Method, False Position method, Newton-Raphson method, Ramanujan's Method .Rate of Convergence, Rate of Convergence of Bisection Method, Rate of Convergence of Newton Raphson Method Rate of convergence of Iterative methods. Methods for finding complex roots.

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 2-4]; TB2 [Chapters 4, 7, 9]**

Systems of Linear Equations: Solutions of systems of Linear equations. Gauss Elimination: Direct method and pivoting. LU-decomposition method, Gauss Seidal iterative method, Gauss Jacobi iterative Method, Rate of Convergence of Gauss Seidel method, Finding inverse of a matrix using Gauss Jordan Method, Ill Conditioned system of equations, Refinement of solutions. Interpolation and Approximation: Langrange's Interpolation, Newton Divided difference method. Finite Differences, Polynomial Interpolation: Newton's forward and backward formula.

Central Difference Formulae: Gauss forward and backward formula, Bessel and Stirling Method, Everett's formula. Hermite's Interpolation. Approximation of function by Taylor's series and Chebyshev polynomial.

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 5-6]; TB2 [Chapters 4-5, 10]**

Numerical Differentiation and Integration: Introduction to Numerical Differentiation. **Numerical Integration:** Trapezoidal rule, Simpson's rules, Boole's Rule, Weddle's Rule, Gauss quadrature formulas, Romberg's integration, Error in Trapezoidal Rule, Error in Simpsons' Rules.

Numerical Solution of Ordinary Differential Equations: Picard's Method, Taylor's series method, Euler's Method, Modified Euler's method.

Runge-Kutta (RK) Methods: Second and fourth order RK methods, Automatic error monitoring, stability of solution.
Boundary Value Problems: Finite Difference Method.

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB3 [Chapters 7-11]**

Curve Fitting and Regression Analysis: Method of least squares, fitting of straight lines, polynomials, exponential curves etc, Linear and Non-linear regression, Multiple regression, Moving averages, smoothening of curves. Random Sampling,
Sampling distributions: Mean, Variance, Difference of Means, and Proportions. Parameter Estimation: method of Moments, Maximum Likelihood Estimation, Interval Estimation.
Hypothesis Testing: Mean, Variance, Level of Significance, Type I, Type II errors Difference of Means, Proportions. Chi-square Test, t-Test, F-Test for best fit.

TEXT BOOKS:

TB1. Curtis F. Gerald and Patrick O. Wheatley, "Applied Numerical Analyses", Pearson, 7th Edition, 2003.
TB2. David Kincaid and Ward Cheney Thomson, "Numerical Analysis: Mathematics of Scientific Computing", Brooks/Cole Publishing Co., 6th Edition, 2002.
TB3. C. R. Kothari, Gaurav Garg, "Research Methodology" New Age International Publishers, 4th Edition, 2019.

REFERENCE BOOKS:

RB1. M. K. Jain, SRK Iyengar and R. K. Jain, "Numerical Methods for Scientific and Engineering Computations", New Age International Publishers, 7th Edition, 2019.
RB2. B. S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publishers, 1st Edition, 2013.
RB3. T. Veerarajan, T. Ramachandran, "Theory and Problems in Numerical Methods", TMH, 1st Edition, 2004.
RB4. Pradip Niyogi, "Numerical Analysis and Algorithms", TMH, 1st Edition, 2003.
RB5. S. S. Shastry, "Introductory Methods of Numerical Analysis", PHI Publication, 5th Edition, 2012.
RB6. J. P. Singh, "Probability and Numerical Methods", ANE Books Pvt Ltd., 4th Edition, 2019.

Research Methodology

Course Code: **MCA-249**
Course Name: **Research Methodology**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to following:-
1. Fundamentals of Experiment Design and Statistics.
2. Reading and Analyzing Research Papers.
3. Data Processing.
4. Paper Writing and Citation Management.
5. Oral Presentations.

PRE-REQUISITES:
Basic Statistics and Basic Applied Mathematics

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Identify how Research is done in Computer Science to improve Individual Research Productivity.	BTL3	PO1, PO2, PO3, PO4
CO2	Discover the types of Experiments and Measurements possible in Research.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Analyze the fundamental concepts of Sampling and Data Analysis.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO4	Develop appropriate Technical Writing Skills.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 12 **Chapter / Book Reference: TB1 [Chapters 1-3,9]**

Fundamentals of Research: Introduction to Research, Meaning, Objectives and Significance, Types of Research, Research Methods versus Methodology, Research Process, Criteria of good research, Research problems, Necessity of defining the problem,

Technique involved in defining the problem, Design and Development Research Methods, Meaning of Research Design, Need for Research Design, Features of a Good Design, Different Research Designs, Basic principles of Experimental Designs, Ethics in Research, Formulation of Research Title, development of criteria based Research Proposal**,** Problem Identification & Formulation, Research Question, Investigation Question, Measurement Issue, Questionnaire Design, Features of a Good Questionnaire.

Hypothesis: Definition, Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing –Logic & Importance.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 5]

Methods of Data Collection: Methods of Primary and Secondary Data Collection.

Metrics: Throughput, Latency, Overhead, Reliability, Precision, Recall, Running Time, Accuracy, Latency, Discomfort.

Measurement and Scaling: Concept of Measurement–what is measured? Measurement Scales, Problems in Measurement in Research - Validity and Reliability. Levels of Measurement - Nominal, Ordinal, Interval, Ratio.

UNIT – III

No. of Hours: 12 Chapter / Book Reference: TB1 [Chapters 4, 8, 10]

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample –Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the Sample –Practical considerations in Sampling and Sample size.

Data Analysis: Data Preparation-Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis-Cross tabulations and Chi-square test including Testing Hypothesis of Association.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapter 14]

Technical Writing using LATEX: Scientific Writing: Significance of report writing, Structured and Components of Report Writing, Types of Report: Research Papers, Thesis, Research Project Reports, Introduction to technical writing using LATEX.

Citation Management with Zotero/Mendeley: Fundamentals of Citations, Citation Styles, Managing Citations and Bibliography in a Report.

TEXT BOOKS:

TB1. C. R. Kothari, "Research Methodology Methods & Techniques", New Age International Publisher, 4th Edition, 2019.

TB2. Leslie Lamport, "LaTeX: A Document Preparation System", Pearson Education, 2nd Edition, 2006.

TB3. Deepak Chawla, Neena Sondhi, "Research Methodology: Concepts and Cases" Vikas Publications, 2nd Edition, 2016.

REFERENCE BOOKS:

RB1. Goddard W. and Melville S., Research Methodology-An Introduction, Juta and Company Ltd., 2nd Edition, 2004.

RB2. Misra R. P., “Research Methodology-A Hand Book”, Concept Publishing Company, New Delhi, 1st Edition, 1989.
RB3. Ranjit Kumar "Research Methodology" Pearson Publications, 2nd Edition, 2005.
RB4. John Adams, Hafiz T. A. Khan, Robert Raeside, "Research Methods for Business and Social Science", Sage Publications, 2nd Edition, 2014.
RB5. O. R. Krishnaswamy, M. Ranaganatham, "Methodology of Research in Social Sciences", Himalaya Publishers, 1st Edition, 2011.

Operational Research

Course Code: **MCA-251**
Course Name: **Operational Research**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Formulation of various real-life problems as Operations Research models and study of methodologies to solve these problems.
2. Introduce Linear Programming, Transportation and Assignment problems and discuss methods to find optimum solutions.
3. Study the theory of duality and sensitivity analysis in linear programming.
4. Learn Project management techniques and their solution.
5. Explore Queuing models and its applications.

PRE-REQUISITES:
Basic Knowledge of Mathematics, Statistics, Information Technology & Economics

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate linear programming problems and appreciate their limitations.	BTL2	PO1, PO2
CO2	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.	BTL3	PO1, PO2, PO3
CO3	Solve different queuing situations and find the optimal solutions using models for different situations.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Apply these techniques constructively to make effective business decisions.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Examine different models of queuing theory and game theory.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10

CO6	Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 1-4]; TB3 [Chapters 1-4]

Introduction to Operations Research: Introduction, Historical Background, operations research and decision-making Scope and applications of Operations Research, Features of Operations Research, Phases of Operations Research, Types of Operations Research Models, Operations Research Methodology, Operations Research Techniques and Tools, Structure of the Mathematical Model, Limitations of Operations Research.

Linear Programming: Introduction, Linear Programming Problem, Basic assumptions of LPP, Mathematical Formulation of LPP, Graphical Methods, special cases in graphical methods, Simplex Method, standard Form of LPP, Minimization of LPP, special cases in applying simplex method, Big-M Method, Two-Phase Method, Duality, Economic interpretation of Dual Problem, Sensitivity Analysis. Solving Linear programming problem using software like lingo/excel solver/Tora.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 5-6]; TB3 [Chapters 5-6]

Transportation Problems: Introduction, Formulation of Transportation Problem (TP), Initial Basic Feasible Solution using North West corner method, least cost method, Vogel approximation method.

Optimality Condition: MODI method, Unbalanced transportation problem, maximization in Transportation problem, special cases in transportation problem, degeneracy.

Assignment Problems: Introduction, Mathematical Formulation of the problem, Hungarian Method Algorithm. Unbalanced assignment problem, Maximization case, special cases in assignment problem Travelling Salesperson Problem. Solving transportation problem using softwares like Lingo/ Tora/ excel solver.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 9,13]; TB3 [Chapters 10,12]

Infinite Queuing Models: Introduction, Queuing Theory, Operating Characteristics of a Queuing System, (elementary structure of Queuing process) Constituents of a Queuing System, Service Facility, Queue Discipline.

Mathematical Analysis of Queuing Theory: Introduction, Mathematical Analysis of Queuing Process, Properties of Queuing System, Notations, Service System, Single Channel Models, Multiple Service Channels, Erlang Family of Distribution of Service Times, Applications of Queuing Theory, Limitations of Queuing Theory.

Project Scheduling and PERT&CPM: Introduction, Network Analysis Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship, Project Management – PERT Time Cost trade- off.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 8,11,14]; TB3 [Chapters 11,15-16]

Game Theory: Introduction, Competitive Situations, Characteristics of Competitive Games, Maximin–Minimax Principle, Dominance Mixed strategy.
Replacement Models: Replacement of items that deteriorate whose maintenance costs increase with time without change in the money value.
Replacement of items that fail suddenly: Individual replacement policy, Group replacement policy.
Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation.

TEXT BOOKS:

TB1. J. K. Sharma, "Mathematical Models in Operations Research", TMH, 1st Edition, 1989.
TB2. V. K. Kapoor, "Operations Research Quantitative Techniques for Management", Sultan Chand & Sons, 1st Edition, 2013.
TB3. N. D. Vohra, "Quantitative Techniques in Management", Tata-McGraw-Hill, 3rd Edition 2007.

REFERENCE BOOKS:

RB1. A. Ravindran, Don T. Phillips and James J. Solberg, "Operations Research- Principles and Practice", John Wiley, 2nd Edition, 2007.
RB2. Hamdy A. Taha, "Operations Research-An Introduction, Prentice Hall of India", 8th Edition, 2007.
RB3. Frederick S. Hillier and Gerald J. Lieberman, "Introduction to Operations Research", McGraw Hill, 10th Edition, 2017.
RB4. Kanti Swarup, P. K. Gupta and Man Mohan, "Operations Research", Sultan Chand and Sons, 1st Edition, 2014.
RB5. Harvery M Wagner, "Principles of Operations Research", PHI, Englewood Cliffs, N.J., 2nd Edition, 1975.
RB6. J. P. Singh, N.P. Singh, "Operations Research, Revised and Updated", ANE Books Pvt. Ltd., 1st Edition, 2017.

Cyber Security and Cyber Laws

Course Code: **MCA-253**
Course Name: **Cyber Security and Cyber Laws**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to the following:-
1. Fundamentals of cyber security and related safeguards.
2. Cyber threats and vulnerabilities.
3. Securing web applications.
4. Cyber Laws, Cyber Forensics and IPR.

PRE-REQUISITES:
Knowledge of computer basics and computer networks

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate computer technologies, digital evidence collection, and reporting in forensic acquisition.	BTL2	PO1, PO2
CO2	Apply strategies of using information as a weapon and a target.	BTL3	PO1, PO2, PO3, PO5
CO3	Identify the principles of offensive and defensive information warfare for a given context.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Analyze the social, legal and ethical implications of information warfare.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Appraise key terms and concepts in cyber law, intellectual property and cyber crimes, trademarks, domain theft and Cyber Forensics.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 1-3]**

Introduction to Cyber Security: Overview of Cyber Security, Internet Governance – Challenges and Constraints

Cyber Threats: Cyber Squatting, Cyber Warfare, Cyber terrorism, Cybercrime, Cyber Offenses

Classification of Cybercrimes: Email spoofing, Spamming, Cyber defamation, Internet Time Theft, Data Diddling, Espionage, Hacking, Online Frauds, Computer Sabotage, Email Bombing, Computer Network Intrusion, Password Sniffing, Credit Card Frauds, Identify Theft

Cybercrime-Mobile and Wireless Devices: Proliferation of Mobile and Wireless Devices, Authentication Service Security, Attacks on Mobile Phones, Security Implications for Organizations, Measures for Handling Mobile Devices

Cyber Offenses: Categories, Attacks, Social Engineering, Cyber stalking, Botnets, Cloud Computing

UNIT – II

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 4-5]**

Cyber Security Vulnerabilities and Cyber Security Safeguards: Cyber Security Vulnerabilities-Overview, vulnerabilities in software, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow, Attack on wireless Networks, Identity Theft (ID Theft)

UNIT – III

No. of Hours: 10 **Chapter / Book Reference: TB2 [Chapters 3-5]**

Securing Web Application, Services: Introduction, Basic security for HTTP Applications, Email Security, Back up Issues, Identity Management and Web Services, Authorization Patterns, Firewall

Intrusion Detection and Prevention System: Intrusion, Physical Theft, Abuse of Privileges, Access Management, Access management Models (DAC, OAC, RBAC), Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation

UNIT – IV

No. of Hours: 10 **Chapter / Book Reference: TB1 [Chapters 6,7,9,10]**

Cybercrime and Cyber Security: The Legal Perspective: Introduction, Cyber Security Regulations, Legal Landscape around the World, The Indian IT Act and Amendments, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment

Understanding Computer Forensics: Cyber forensics and digital Evidences. Digital Forensics Life cycle, Network Forensics, Relevance of the OSI 7 layer model to Computer Forensics, Forensics and Social Networking Sites, Challenges in Computer Forensics, Forensics Auditing, Anti forensics

Intellectual Property in the Cyber Space: Copyrights, Jurisdiction Issues and Copyright Infringement, Multimedia and Copyright issues, WIPO, Intellectual Property Rights, Understanding Patents, Understanding Trademarks, Trademarks in Internet, Trade Secrets, Trade Name, Domain name registration, Software Piracy, Legal Issues in Cyber Contracts, Authorship, Document Forgery

TEXT BOOKS:

TB1. Nina Godbole, Sunita Belapure, “Cyber Security-Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley, 1st Edition, 2011.

TB2. Bhushan M, Rathore Singh R, Jamshed A, “Fundamental of Cyber Security Principles, Theory and Practices”, BPB Publication, 2017.

REFERENCE BOOKS:

RB1. Nina Godbole, “Information Systems Security–Security Management, Metrics, Frameworks and Best Practices”, Wiley, 2nd Edition, 2017.

RB2. Mark Rhodes-Ousley, “Information Security-The Complete Reference“, McGraw Hill Education , 2nd Edition, 2012.

RB3. Mark Merkow, James Breithaupt, “Information Security: Principles and Practices”, Pearson Education, 1st Edition, 2007.

RB4. Matt Bishop, “Computer Security Art and Science”, Pearson Education, 2nd Edition, 2018.

e-Content Development

Course Code: **MCA-255**
Course Name: **e-Content Development**

INSTRUCTIONS TO PAPER SETTERS:
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:
In this course, the learners will be able to develop expertise related to following:-
1. Developing e-content in a creative and standardized way.
2. Designing e-content with multimedia features like audio, video & animation.
3. Deploying content on a Content Management system.
4. Using authoring and publishing tools for content design and presentation.
5. Become professional e-content designers.

PRE-REQUISITES:
1. Knowledge of computers and computer presentation tools.
2. Knowledge of audio, video tools and MS power point skills.
3. Attending or participating in any online course, on any topic.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Relate to the meaning and standards of e-learning and e-content.	BTL1	PO1
CO2	Demonstrate instructional content designing and standardized course designing with e-content designing.	BTL2	PO1, PO2
CO3	Apply digital media for e-content development.	BTL3	PO1, PO2, PO3
CO4	Examine Content Management systems (CMS) and Learning Management Systems (LMS).	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO11
CO5	Evaluate various authoring and publishing tools for e-content design and presentation.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO11

CO6	Elaborate innovative practices in the design & development of e-content.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO11

UNIT – I

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 1,6]

e-Learning and Instructional Design for e-learning: Introduction, Stages and categories of e-Learning, Technologies & infrastructure in e-Learning, Instructional Design- theory & models, Concept Mapping.

Content Development in e-Learning: Stages of Content Development, Storyboard, scripting technologies, Content authoring & publishing, Content development standards & models, Developing standard compliant e-Learning content.

UNIT – II

No. of Hours: 10 Chapter / Book Reference: TB2 [Chapters 1,2,4,5]

Content Management Systems: Basics of CMS and LMS, CMS vs LMS, Features & Requirements of CMS, Development & Customization of open source LMS, Choosing open source vs closed source LMS, Development & Deployment of e-content through LMS.

Practical: Working on an open source CMS like Moodle.

UNIT – III

No. of Hours: 10 Chapter / Book Reference: TB1 [Chapters 4,8,9,10]

Designing e-Content: Learning with media, Content Authoring and publishing tools, Design of Multimedia based e-content- Graphics and Animation, Online video creation, Audio and podcasting, design of online assessments & activities, Design & Development of interactive components of e-Learning, Design & Development of mobile learning components.

Practical: Designing e-content of 2 hours with all components.

UNIT – IV

No. of Hours: 10 Chapter / Book Reference: TB3 [Chapters 28]

e-Content Trends & Advancements: Virtual Classroom based content delivery, MOOC's and MOOC based content delivery, Mobile content, Personalized and adaptive e-content, Professional Ethics towards content usage, development and writing.

Practical: Any two week course from course era.

TEXT BOOKS:

TB1. Diane Elkins et al., "E-Learning Fundamentals: A PRACTICAL GUIDE", 2015, ISBN: 9781562869472.

TB2. Nirav Mehta, "Choosing an Open Source CMS: Beginner's Guide", Paperback Publishing, 2010.

TB3. Marina Arshavskiy, "Instructional Design for e-learning: Essential Guide to Creating Successful e-learning Courses", CreateSpace Independent Publishing Platform, 2nd Edition, 2018.

REFERENCE BOOKS:

RB1. Nick Rushby and Dan Surry, “The Wiley Handbook of Learning Technology”, Wiley-Blackwell, 2016.
RB2. Marjorie Vai and Kristen Sosulski, “Essentials of Online Course Design: A Standards-Based Guide (Essentials of Online Learning)”, Paperback, 2015.
RB3. Michael W. Allen, “Michael Allen's Guide to e-Learning: Building Interactive, Fun, and Effective Learning Programs for Any Company”, Paperback, 2nd Edition, 2016.
RB4. Alex Buchner, “Moodle 3: Administration”, Paperback, 3rd Edition, 2016.
RB5. Tay Vaughan, “Multimedia: Making it Work”, McGraw Hill, Paperback, 8th Edition, 2011.

Design and Analysis of Algorithms Lab.

Course Code: **MCA- 261**
Course Name: **Design and Analysis of Algorithms Lab.**

LEARNING OBJECTIVE:
In this course, the learners will be able to develop working expertise of implementation and expressing the algorithmic solutions using programming languages.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply logical thinking to build solutions for given problems.	BTL3	PO1, PO2, PO3, PO5
CO2	Evaluate correctness & efficiency of algorithms using inductive proofs and invariants.	BTL5	PO1, PO2, PO3, PO4, PO5
CO3	Design and perform parameter-based analysis of the searching, sorting and tree-based algorithms.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Create and test optimal solutions for various problems.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Artificial Intelligence and Machine Learning Lab.

Course Code: **MCA-263**
Course Name: **Artificial Intelligence and Machine Learning Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the following:-
1. Design the knowledge base of specific domains.
2. Design intelligent systems.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply heuristic search based algorithms to solve different puzzles.	BTL3	PO1, PO2, PO3, PO5
CO2	Identify reduction techniques on large datasets and reduce their dimensionality.	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Analyze the datasets for bias and apply appropriate regression techniques.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Evaluate the learning techniques for classification.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Implement the knowledge of inferences rules to design the knowledge base.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Create a domain specific intelligent application.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO11, PO12

Statistics and Data Analytics Lab.

Course Code: **MCA- 265 (Lab. based on Core Elective – II)**
Course Name: **Statistics and Data Analytics Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the following:-
1. Statistics and data analytics concepts using python.
2. Implement descriptive and inferential statistics using data analytics.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Identify various measures like Central tendency, Measures of Dispersion, Measures of shape etc.	BTL3	PO1, PO2, PO3
CO2	Analyze Probability Distribution on specific cases	BTL4	PO1, PO2, PO3, PO4, PO5
CO3	Assess hypothesis testing and apply inferential statistics- t, F, Z and Chi Square Test to specific cases	BTL5	PO1, PO2, PO3, PO4, PO5
CO4	Deduct Correlation and Regression on specific problems.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Elaborate Statistical and Data analytics techniques on real time data (case study).	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Enterprise Computing with JAVA Lab.

Course Code: **MCA-265 (Lab. based on Core Elective – II)**
Course Name: **Enterprise Computing with JAVA Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of concepts of Enterprise Computing with JAVA and develop web applications.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Model Java EE architectural components, Servlet and session management for web applications.	BTL3	PO1, PO2, PO3, PO4, PO5
CO2	Examine Java Server Pages (JSP) and Struts for web-based applications.	BTL4	PO1, PO2, PO3, PO4, PO5
CO3	Appraise Hibernate Framework of JEE and apply Object Relational Mapping to specific cases.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Elaborate principles of Dependency Injection and its application in JEE.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO5	Design applications based on Spring Boot and Spring AOP.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Natural Language Processing Lab.

Course Code: **MCA-265 (Lab. Based on Core Elective – II)**
Course Name: **Natural Language Processing Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of
1. Text preprocessing
2. Text analysis
3. Web scrapping

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply lemmatization primitives using python.	BTL3	PO1, PO2, PO3, PO4, PO5
CO2	Analyze Lexical analysis on various text corpuses.	BTL4	PO1, PO2, PO3, PO4, PO5
CO3	Assess the text classification algorithms on text and speech tagging.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Create an NLP model for analyzing the text documents.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Computer Graphics Lab.

Course Code: **MCA-265 (Lab. based on Core Elective-II)**
Course Name: **Computer Graphics Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. Graphics primitives and attributes.
2. Implementation of different computer graphics algorithms.
3. Development of interactive applications ranging from games to business applications using animations and shading effects using OpenGL.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate basic objects using graphic primitives.	BTL2	PO1, PO2, PO3, PO5
CO2	Experiment with scan-conversion and clipping algorithms.	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Apply transformation operations to images and generate animated sequences.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Implement projections and hidden surface removal algorithms and analyze their role in architectural drawings.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Create interactive applications with use of animation and shading effects.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Wireless Sensor Networks Lab.

Course Code: **MCA-265 (Lab. Based on Core Elective-II)**
Course Name: **Wireless Sensor Networks Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of

1. Simulation Tools for Wireless sensor networks.
2. Designing a wireless sensor network.
3. Creating energy efficient networks on tools.
4. Creating MAC layer protocols.
5. Creating routing protocols.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Build a Wireless Sensor Network using appropriate simulator.	BTL3	PO1, PO2, PO3, PO5
CO2	Analyze the transmission between different sensor nodes and find throughput of network under different scenarios.	BTL4	PO1, PO2, PO3, PO4, PO5
CO3	Examine the different types of clustering protocols to analyze the topology.	BTL4	PO1, PO2, PO3, PO4, PO5
CO4	Evaluate different routing algorithms.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Appraise the energy efficiency of different networks.	BTL45	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Elaborate data storage and data dissemination techniques on different networks.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Software Project Management Lab.

Course Code: **MCA-265 (Lab. based on Core Elective-II)**
Course Name: **Software Project Management Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. Tools used for project management.
2. Create Scheduling and Costing of Project.
3. Customer Relationship Management.
4. Managing the Software Projects.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Construct Proposal for software project.	BTL3	PO1, PO2, PO3, PO5, PO6, PO10, PO11
CO2	Examine and schedule the working progress and budget of the project.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11
CO3	Analyse and assess the Risk associated with the project.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11
CO4	Estimate the resources for project development.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11
CO5	Create a novel solution of project for a specific problem.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Advanced Computer Architecture Lab.

Course Code: **MCA-265 (Lab. based on Core Elective-II)**
Course Name: **Advanced Computer Architecture Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the following:-
1. Develop an understanding about different processor architectures.
2. Understand the components and operations of a memory hierarchy.
3. Discuss the performance issues and its influence on the design of processor.

PRE-REQUISITES:
Computer Organization

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate parallelism in hardware/ software with appropriate tools.	BTL2	PO1, PO2, PO3, PO5
CO2	Apply memory organization and mapping techniques to specific problems.	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Examine the architectural features of advanced processors for different problems.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Evaluate the performance of different pipelined processors.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Distributed Systems Lab.

Course Code: **MCA-265 (Lab. based on Core Elective – II)**
Course Name: **Distributed Systems Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop hands on experience related to the important concepts and applications of Distributed Systems.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Model the applications based on client-server architecture, threads and CORBA in distributed systems.	BTL3	PO1, PO2, PO3, PO5, PO6, PO10
CO2	Experiment to implement Remote method invocation in distributed systems.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Examine distributed algorithms for different primitives like shared memory, mutual exclusion and deadlock detection.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Compose a development environment and deploy an app locally on Cloud.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11
CO5	Analyze techniques to implement distributed databases and create tables to demonstrate data fragmentation.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Applied Cryptography Lab.

Course Code: **MCA-265 (Lab. based on Core Elective – II)**

Course Name: **Applied Cryptography Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. Fundamental knowledge of cryptographical technologies.
2. Security properties of the cryptographical techniques.
3. Classical and modern cryptographical techniques.
4. How secure systems are engineered.

PRE-REQUISITES:

Fundamental knowledge of Number Theory & Modular Arithmetic

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate the classical and modern cryptographic primitives.	BTL2	PO1, PO2, PO3, PO5
CO2	Experiment with security properties at the cryptographic level	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Analyze common attacks and cryptographical techniques to prevent them	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Adapt appropriate cryptographic techniques to security engineer the problem at hand	BLT6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Cloud Computing Lab.

Course Code: **MCA- 265 (Lab. based on Core Elective-II)**
Course Name: **Cloud Computing Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the following:-
1. Creation of Virtual Cloud Platform.
2. Implementing Load balancing in Cloud.
3. Implement Security, Privacy & Trust.
4. Creating and Managing a Storage Account on Cloud.
5. Monitoring & Implementing Virtualization through IaaS.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate the cloud platform on an appropriate tool.	BTL2	PO1, PO2, PO3, PO5
CO2	Apply virtualization in clouds.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Distinguish between at least two cloud-based platforms.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Choose and implement best security practices of cloud.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11
CO5	Create automation on load balancing in cloud.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

e-Business Systems Lab.

Course Code: **MCA-265 (Lab. based on Core Elective – II)**
Course Name: **e-Business Systems Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of e-Business and e-Commerce systems.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Model an appropriate Business model for a proposed website	BTL3	PO1, PO2, PO3, PO5
CO3	Distinguish varied online payment methods	BTL4	PO1, PO2, PO3, PO4, PO5
CO4	Assess varied e-commerce software's	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Create an e-commerce website and compare it with similar existing websites	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Web Intelligence and Big Data Lab.

Course Code: **MCA-267 (Lab. based on Core Elective – III)**
Course Name: **Web Intelligence and Big Data Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of Hadoop and MapReduce related tool.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Construct specific data sets on Hadoop.	BTL3	PO1, PO2, PO3, PO4, PO5
CO2	Examine Web Scrapping/ Crawling on suitable datasets.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Evaluate the characteristics of NoSQL databases and implement Big Data concepts.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Compile machine learning libraries and mathematical and statistical tools with modern technologies like Hadoop and MapReduce.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Flutter and Dart Lab.

Course Code: **MCA-267 (Lab. based on Core Elective-III)**

Course Name: **Flutter and Dart Lab.**

LEARNING OBJECTIVES: In this course, the learners will be able to develop expertise in developing cross platform mobile application development by implementing various solutions.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Construct applications with Flutter and Dart primitives.	BTL3	PO1, PO2, PO3, PO5
CO2	Experiment with native platform code development on given case studies.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO3	Analyze case studies to discover interactive widget-based solutions.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Design animated solutions using flutter and dart.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO10, PO11
CO5	Create service based custom applications using flutter and dart.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Service Oriented Architecture Lab.

Course Code: **MCA-267 (Lab. based on Core Elective – III)**
Course Name: **Service Oriented Architecture Lab.**

LEARNING OBJECTIVES:

In this course, the learners will get hands-on experience to implement Service Oriented Software Solution, as detailed here under:-

1. Build XML Document
2. Design and deploy REST Services, Microservices and Web Services
3. Design and deploy RESTful Services using Spring Boot
4. Implement Dockers and Containers

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Build XML document with appropriate SOAP Services.	BTL3	PO1, PO2, PO3, PO5
CO2	Discover customized Web Services and REST Services for appropriate cases.	BTL4	PO1, PO2, PO3, PO4, PO5
CO3	Appraise Microservices using Spring Boot and Honeycomb.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Design and implement the Microservices and deploy them using a Container based systems	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Multimedia Technologies Lab.

Course Code: **MCA-267 (Lab. based on Core Elective – III)**
Course Name: **Multimedia Technologies Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. Multimedia Authoring Tools.
2. Animations.
3. Development of interactive applications using different multimedia components.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate modelling of 2D and 3D graphical scenes using Open Graphics Library suits.	BTL2	PO1, PO2, PO5
CO2	Apply various delivery methods including streaming.	BTL3	PO1, PO2, PO3, PO5
CO3	Analyse audio and text compression algorithms.	BTL4	PO1, PO2, PO3, PO4, PO5
CO4	Examine video compression algorithms.	BTL4	PO1, PO2, PO3, PO4, PO5
CO5	Create 2D animation applications using appropriate multimedia tools.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11
CO6	Develop customized multimedia projects using different components.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Internet of Things Lab.

Course Code: **MCA-267 (Lab based on Core Elective-III)**
Course Name: **Internet of Things Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. IoT Protocols, IoT Stack
2. IoT Design Methodology, IoT Communication Models
3. Sensors Interfacing using Python
4. Developing Arduino and Raspberry Pi based applications

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate IoT based application components.	BTL2	PO1, PO2, PO5
CO2	Build IoT Protocols at each layer.	BTL3	PO1, PO2, PO3, PO5
CO3	Analyze IoT Physical devices through appropriate programming language.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Assess Sensor Interfacing through Embedded boards.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Create small IoT Applications using available communication APIs.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Soft Computing Lab.

Course Code: **MCA-267 (Lab. Based on Core Elective-III)**
Course Name: **Soft Computing Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. Implement basics of mathematical functions in MATLAB.
2. Able to implement Fuzzy logic and create applications.
3. Able to learn basics of Neural Networks and Implement it.
4. Ability to design and implement genetic algorithm to create optimized solutions for real complex problems.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate the basic of De-Morgan's Law, Union and Intersection operations in suitable tool.	BTL2	PO1, PO2, PO5
CO2	Apply FIS Editor and use Fuzzy toolbox to map temperature scale for anti-lock brakes.	BTL3	PO1, PO2, PO3, PO4, PO5
CO3	Construct AND-NOT function and XOR Function using McCulloch-Pitts neural net by suitable program.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Create and view custom neural networks by defining topology, transfer function, configure network, train net and calculate neuron output.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Implement Genetic Algorithm and develop quality solutions to optimization and search problems by relying on biological inspired operator.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Software Quality Management Lab.

Course Code: **MCA-267 (Lab. based on Core Elective-III)**
Course Name: **Software Quality Management Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the methods and tools applied to achieve software quality at varied levels through a software system life. The course shall prepare students to methodically develop a software quality assurance program in conformance with the applicable quality standards.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Build software quality assurance plans through appropriate tools (IBM RUP/ Star UML).	BTL3	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Apply quality assurance tools and techniques.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO3	Examine software quality plans through checklists for a specific software system.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8
CO4	Appraise runtime assurances and requirements monitoring,	BTL5	PO4, PO5, PO6, PO7, PO8, PO9
CO5	Formulate a common software process model and tailor it for increased quality.	BTL6	PO4, PO5, PO6, PO7, PO8, PO9, PO10
CO6	Work in teams to design a software quality assurance plan for a specific software system case.	BTL6	PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

Digital Image Processing Lab.

Course Code: **MCA-267 (Lab. based on Core Elective-III)**
Course Name: **Digital Image Processing Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of the MATLAB for implementing image processing algorithms and analyze the results.

PRE-REQUISITES:
1. Basic Knowledge of MATLAB
2. Digital Image Processing concepts

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate basic tool usage to explore digital image formats and their processing.	BTL2	PO1, PO2, PO5
CO3	Experiment with basic image processing operations on the images.	BTL3	PO1, PO2, PO5
CO4	Analyze the image enhancement technique for the improvement of pictorial information for human perception, vision and understanding.	BTL4	PO1, PO2, PO3, PO4, PO5
CO5	Assess complex frequency domain filtering and apply this knowledge to remove different types of noises from an image.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Build data compression techniques and test them on images for efficient storage.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Compiler Design Lab.

Course Code: **MCA-267 (Lab. based on Core Elective – III)**
Course Name: **Compiler Design Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. Write Assembly Language Programs.
2. Develop various types of Parsers.
3. Use Compiler tools like Lex & YACC.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply the knowledge of the LEX tool & YACC tool to develop a scanner & parser.	BTL3	PO1, PO2, PO5
CO2	Experiment with Intermediate Code Generation in a compiler	BTL3	PO1, PO2, PO3, PO5
CO3	Examine the knowledge of patterns, tokens & regular expressions for solving problems.	BTL4	PO1, PO2, PO3, PO4, PO5
CO4	Inspect programs for solving complex problems in a compiler	BTL5	PO1, PO2, PO3, PO4, PO5
CO5	Assess the available tools and technologies for writing a compiler.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11

Parallel Computing Lab.

Course Code: **MCA-267 (Lab. based on Core Elective – III)**
Course Name: **Parallel Computing Lab.**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working experience related the following:-

1. Understand basic concepts associated with parallel computing environments.
2. Develop an understanding about the requirements of parallel systems.

PRE-REQUISITES:

1. Computer System and architecture
2. Operating Systems

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Explain and outline the impact of synchronization issues, latency and bandwidth on the efficiency and effectiveness of parallel computing applications.	BTL2	PO1, PO2
CO2	Demonstrate the requirements of parallel systems and critically evaluate the strengths and weaknesses of parallel computing models.	BTL2	PO1, PO2, PO3, PO5
CO3	Model different parallel computing paradigms including memory passing, memory sharing, data-parallel and various other approaches.	BTL3	PO1, PO2, PO3, PO4, PO5
CO4	Develop appropriate solutions to real-life parallel computing problems and issues.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Numerical and Scientific Computing Lab.

Course Code: **MCA-267 (Lab. Based on Core Elective – III)**
Course Name: **Numerical and Scientific Computing Lab.**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop working expertise of the following:-

1. Overview of some of the issues and problems that arise in scientific computation, such as (non-)linear systems, numerical and symbolic integration, differential equations and simulation.
2. Application of the algorithms covered in the course.
3. Describe and perform tasks in connection to the key concepts covered in the course.

COURSE OUTCOMES (COs):

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Identify properties for numerical methods and mathematical models by using the analysis methods.	BTL3	PO1, PO2, PO3, PO5
CO2	Construct an algorithm by structuring and dividing a computational problem into sub-problems and formulating an algorithm.	BTL3	PO1, PO2, PO3, PO5
CO3	Analyze various numerical methods and implement them in problem solving.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO4	Assess the limitations, advantages, and disadvantages of different numerical methods.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11

Minor Project – III

Course Code: **MCA-269**
Course Name: **Minor Project – III**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of solving complex computing problems through project based learning approach using real world case studies by implementing the concepts studied in the theory courses of this semester.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO#	Detailed Statement of the CO	BT Level	Mapping to PO#
CO1	Apply acquired knowledge within the chosen technology for solution of specific problem.	BTL3	PO1, PO2, PO3, PO4
CO2	Analyze the technical aspects of the chosen project through a systematic and comprehensive approach.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Deduct plausible solution for the technical aspects of the project.	BTL5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10
CO4	Work as an individual or in teams to develop the technical project.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10, PO11, PO12
CO5	Create effective reports and documentation for all project related activities and solutions.	BTL6	PO11

Entrepreneurship Mindset

Course Code: **MCA-271**

Course Name: **Entrepreneurship Mindset**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 12 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

CO #	Detailed statement of the CO	BT Level	Mapping to PO#
CO 1	Apply a foundation for basic entrepreneurial skills and to acquaint them with the world of entrepreneurship and inspire them to set up and manage their businesses.	BT3	PO3, PO4, PO6, PO7, PO8, PO9, P11
CO 2	Evaluate the process of creativity and innovation	BT5	PO3, PO4, PO6, PO7, PO8, PO9, P11
CO 3	Describe various aspects of entrepreneurship and business	BT2	PO3, PO4, PO6, PO7, PO8, PO9, P11
CO 4	Analyze the case studies on successful entrepreneurs	BT4	PO3, PO4, PO6, PO7, PO8, PO9, P11

UNIT I

No. of Hours: 12

Introduction: The Entrepreneur; Theories of Entrepreneurship; Characteristics of successful entrepreneurs, myths of entrepreneurship; entrepreneurial mindset- creativity (steps to generate creative ideas, developing creativity) and innovation (types of innovation)

UNIT II

No. of Hours: 10

Promotion of a Venture and Writing a business plan: Opportunity Analysis; External

Environment Analysis Economic, Social and Technological Analysis. Business plan- What is business plan, parts of a business plan. Writing a Business Plan

UNIT III

No. of Hours: 10

Entrepreneurship Support: Entrepreneurial Development Programmes (EDP): EDP, Role of Government in Organizing EDPs. Institutions supporting small business enterprises: central level, state level, other agencies, industry associations.

UNIT IV

No. of Hours: 10

Case Studies: Presenting a business plan, Project on Startup India or any other government policy on entrepreneurship, Discussion on why startup fails, role of MSME etc., Discussion on role of entrepreneur in eco-nomic growth, Discussion on technology park, Case study discussion on successful Indian entrepreneurs.

TEXTBOOKS:

TB1. Charantimath (8th Ed., 2014), Entrepreneurship Development and Small Business Enterprise, Pears Education.

TB2. Bamford C.E (1st Ed 2015), Entrepreneurship: A Small Business Approach, McGraw Hill Education.

TB3. Hisrich et al. (2013) Entrepreneurship, McGraw Hill Education

TB4. Balaraju, Theduri (2012), Entrepreneurship Development: An Analytical Study, Akansha Publishing House.

REFERENCE BOOKS :

RB1. David, Otis, (2014), A Guide to Entrepreneurship, Jaico Books Publishing House, Delhi.

RB2. Kaulgud, Aruna, (2012), Entrepreneurship Management, Vikas Publishing House, Delhi.

RB3. Chhabra, T.N. (2014), Entrepreneurship Development, Sun India

Professional Proficiency – III

Course Code: **MCA-273**
Course Name: **Professional Proficiency – III**

Objective and Structure of this Course:
General Proficiency (under NUES Scheme) is aimed to impart value added modules to students, based upon the changing requirements of the industry, from time to time. This innovative practice makes the scheme open and adaptive to the changing requirements of the industry, by keeping inbuilt flexibility of introducing any value added module based upon industry input, from time to time. The required decision of the value added module and related assessment guidelines shall be finalized by the Programme Co-ordination Committee, before start of the semester. Its COs and required mapping shall be done by the Programme Co-ordination Committee, after finalizing the value added module to be offered under this course. There shall not be any external examination of the University for this course. The performance of the candidates should continuously be evaluated by an internal committee, at the College level, as per the guidelines of the Programme Coordination Committee.

Suggestion:
It is suggested to have IPR, Human Values and Professional Ethics Course in third semester under Professional Proficiency - III. However, the final decision shall be taken by the Programme Coordination Committee, before start of the semester.

Dissertation (Major Project)

Course Code: **MCA-202**
Course Name: **Dissertation (Major Project)**

LEARNING OBJECTIVES:
In this course, the learners will be able to develop working expertise of solving complex computing problems through project based learning approach using real world case studies by implementing the concepts studied in all the courses upto semester.

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO#	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Apply techniques, skills and modern computing tools necessary for project development.	BTL3	PO1, PO2, PO3, PO4, PO5
CO2	Apply team-skills, ethics and professional attitude in professional endeavour.	BTL3	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO11
CO3	Model overall project management through sustainable practices.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11
CO4	Adapt technological changes and futuristic challenges of the contemporary world.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11
CO5	Create technical documents and reports.	BTL6	PO9, PO11

Professional Proficiency – IV

Course Code: **MCA-274**
Course Name: **Professional Proficiency – IV**

Objective and Structure of this Course:
General Proficiency (under NUES Scheme) is aimed to impart value added modules to students, based upon the changing requirements of the industry, from time to time. This innovative practice makes the scheme open and adaptive to the changing requirements of the industry, by keeping inbuilt flexibility of introducing any value added module based upon industry input, from time to time. The required decision of the value added module and related assessment guidelines shall be finalized by the Programme Co-ordination Committee, before start of the semester. Its COs and required mapping shall be done by the Programme Co-ordination Committee, after finalizing the value added module to be offered under this course. There shall not be any external examination of the University for this course. The performance of the candidates should continuously be evaluated by an internal committee, at the College level, as per the guidelines of the Programme Coordination Committee.

Suggestion:
It is suggested to have Seminar and Progress Report related to the Dissertation work in fourth semester under Professional Proficiency - IV. However, the final decision shall be taken by the Programme Coordination Committee, before start of the semester.