BMS Institute of Technology & Management

(An Autonomous Institution, Affiliated to VTU, Belagavi)
Approved by AICTE New Delhi, Accredited by NAAC with 'A' Grade
Yelahanka, Bengaluru - 560119

Master of Computer Applications (MCA)

(Accredited by NBA, New Delhi)

CURRICULUM

Scheme of Teaching and Examination
2024 Scheme
Academic Year 2025-26

I – IV Semesters

BMS EDUCATIONAL TRUST, BENGALURU

Dharmaprakasha Rajakarya Prasaktha

Late. Sri B. M. Sreenivasaiah

Founder, BMSCE

Late Sri. B. S. Narayan

Founder, BMS Educational Trust
Founder Donor Trustee

Vision of BMS Educational Trust

"Promoting Prosperity of Mankind by Augmenting Human Resource Capital Through Quality Technical Education and Training"

Mission of BMS Educational Trust

"Accomplish Excellence in the Field of Technical Education Through Education Research and Service Needs of Society"

About BMS Educational Trust

The history of BMS educational institutions can be traced back to 1946, when a noted philanthropist Dharmaprakasha, Rajakarya Prasaktha late Sri. B.M. Sreenivasaiah established the first-ever private engineering college in the country named, BMS College of Engineering (BMSCE). He had a great vision of promoting the prosperity of mankind by augmenting human resource capital through quality education and training. After his sad demise, his illustrious son Late Sri B.S. Narayan strived hard to realize the vision set through the formation of BMS Educational Trust in 1953. He was instrumental in establishing several educational institutions under the Trust. After his passing away, his wife Dr. B.S. Ragini Narayan continued with unwavering devotion the tradition of contributing high-quality human resource to the society, the objective with which the Trust was established. She is now the Chairperson, Donor Trustee and Member Secretary of the Trust. The activities of BMS educational institutions are well guided by a Council of Trustees appointed by her. It has established a conducive academic environment in all its institutions to effectively realize the vision.

Presently, the Trust runs the following 10 high quality and reputed institutions.

1. BMS College of Engineering (BMSCE), Bengaluru
2. BMS College of Law (BMSCL), Bengaluru
3. BMS Pre-University College for Women (BMSPUCW), Bengaluru
4. BMS Degree college for Women (BMSCW), Bengaluru
5. BMS Evening College of Engineering (BMSECE), Bengaluru
6. BMS Institute of Technology and Management (BMSIT&M), Bengaluru
7. BMS School of Architecture (BMSSA), Bengaluru.
8. BMS Evening College of Arts and Commerce (BMSCE), Bengaluru
9. BMS College of Architecture (BMSCA), Bengaluru
10. BMS College of Commerce and Management (BMSCCM), Bengaluru

About BMS Institute of Technology and Management

BMS Institute of Technology and Management was established in 2002 to cater to the need for high-quality technical education in India. The 22-acre lush green and serene campus of BMSIT&M is located in Northern Bengaluru closer to the Kempegowda International Airport (KIAL). Currently, there are 9 UG programs, 3 PG programs and 11 research centers under VTU catering to the educational needs of close to 4000 students and 143 research scholars. All the programs are being run as per the VTU guidelines for affiliated institutions. Now that BMSIT&M has been granted fresh autonomous status by the UGC and VTU from the academic year 2021-22, the curriculum design, delivery, assessment and evaluation with respect to the batch of students getting admitted w.e.f. 2021-22 will be the responsibility of the institution. The high-quality faculty and staff members, excellent academic and support infrastructure, quality learning aids, productive collaborations with industry, research institutes and government have together created a highly conducive ambience for students to realize their full potential. With continuous improvement in all dimensions, BMSIT&M has become one of the preferred destinations for engineering education for students across the country and neighboring countries as well.

About the Department of MCA

The Department of Master of Computer Applications (MCA) was established during the academic year 2003-04, with an approved intake of 60, to develop quality IT professionals to meet the human resource demand. The department is accredited by NBA, New Delhi and obtained academic autonomy in the year 2021-22. The department is recognized as a Research Centre under Visvesvaraya Technological University from the academic year 2016-17 and currently having 16 research scholars registered for Ph.D. The Department has 12 qualified and dedicated teaching staff, 2 technical staff and 1 office staff who put in their best possible efforts to ensure that the students gain the knowledge along with other life-skills, which helps them to face the world confidently and with high self-esteem while making their journey with BMIT&M comfortable as well. Disciplined environment conducive to Teaching-Learning, along with rigorous academic mentoring, is maintained at the department.

VISION OF THE INSTITUTE

To emerge as one of the finest technical institutions of higher learning, to develop engineering professionals who are technically competent, ethical and environment friendly for betterment of the society.

MISSION OF THE INSTITUTE

Accomplish stimulating learning environment through high quality academic instruction, innovation and industry-institute interface.

VISION OF THE DEPARTMENT

To emerge as a leading department in computer applications, producing skilled professionals equipped to deliver sustainable solutions.

MISSION OF THE DEPARTMENT

Facilitate effective learning environment through quality education, industry interaction with orientation towards research, critical thinking and entrepreneurial skills.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Excel in IT career by developing sustainable solutions that drive industry growth and societal progress.

PEO2: Adapt themselves to evolving domain requirements.

PEO3: Exhibit leadership skills and progress in their chosen career path.

PROGRAM OUTCOMES (POs)

PO1: Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.

PO2: Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.

PO3: Design, develop and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.

PO4: Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.

PO5: Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups using methodologies such as agile.

PO6: Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.

PO7: Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.

PO8: Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

Preamble:

Technical education, today, is faced with extremely complex challenges due to the pressing need for comprehensive, inclusive, optimal and sustainable solutions to global and local problems. Hence, there is a need for engineering colleges to utilize the academic autonomy granted to them in full measure to assess the gaps in the present system, review and redesign the curriculum, its delivery and evaluation processes to effectively meet all such challenges. Such an exercise should be broad-based and take into consideration:

- The ever-increasing influence of science and technology on human society.
- The faster pace of new developments and the rapid obsolescence of prevailing practices.
- Penetration of Information and Communication Technology in all sectors of human activity and economic development.
- Service sector becoming a major avenue for the employment of technical professionals and economic gains.
- Increasing multicultural work environment and fading organizational boundaries
- Very volatile, uncertain, complex and ambiguous business environment.

A higher education institute with academic autonomy should see opportunities in these challenges. From that perspective, these institutions are responsible for producing graduates who, among others, will have:

- A strong foundation in the basics of science, technology, mathematics and engineering disciplines.
- The command over the chosen area of technical specialization.
- The capacity to apply the professional knowledge and skills acquired to solve complex engineering problems most optimally.
- Ability to self-learn and for life-long learning.
- The expertise in analysis, design, modelling and simulation of complex systems.
- The ability of rational, logical and critical thinking.
- The leadership qualities to inspire team members to achieve grand shared vision.

BMSIT&M intends to produce such graduates who strive to be complete engineers in all respects and to succeed in addressing the challenges posed by the modern world. BMSIT&M exercises the academic freedom given by the University -

- With a great sense of responsibility and accountability
- To enhance the visibility and credibility of the institute in the national and international Higher Education segment.
- To demonstrate its research prowess, creativity, innovativeness and entrepreneurial capabilities.
- To gain the confidence and respect of all its stakeholders, especially students, alumni, parents and the society at large.

Program Information - MCA

Name of the Programme	**Master of Computer Applications - MCA**
Scheme	Choice Based Credit System
Duration of the course	2 years (4 Semesters)
Duration of Semester	16 Weeks
Total credits	80
CIE : SEE	50:50
Maximum duration of course completion	4 years
10-12 hours of Teaching-Learning Process	1 credit
2 hours Laboratory/Tutorial per week	
25 hours of Teaching-Learning Process	2 credits
40 hours of Teaching-Learning Process	3 credits
50 hours of Teaching-Learning Process	4 credits
40 hours of Teaching-Learning Process with 10-12 laboratory sessions	4 credits (IPCC)

Semester-wise Credit Distribution

Sem	Core	Elective	Major Project	Internship	Mathematics	Humanities, Ethics & Management	Online Learning	Total
I	16	-	-	-	4	Mandatory Course (NC)*	-	20
II	18	3	-	-	-	-	Mandatory Course (NC)~	21
III	-	9	10	-	-	-	-	19
IV	-	-	6	11	-	-	3	20
Total	34	12	16	11	4	-	3	80

~ **Online Learning can be taken up and completed only on recognized and authorized platforms**

* **Communication and Soft Skills course can be completed using Quiklrn platform**

Curriculum 2024-26 Scheme – MCA

BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

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Scheme of Teaching and Examination: Effective from AY 2024 – 25

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

PG PROGRAM: MASTER OF COMPUTER APPLICATIONS (MCA) | **Semester: I**

Sl. No	Course Category	Course Code	Course Title	Credit Distribution			Credits	Contact Hours/Week	Examination			
				L	T	P			Duration	CIE Marks	SEE Marks	Total Marks
1	BSC	**MMCA11**	Mathematical Foundation for Computer Applications	3	1	0	4	5	3	50	50	100
2	IPCC	**MMCA12**	Java Programming	3	0	1	4	5	3	50	50	100
3	PCC	**MMCA13**	Data Structures and Algorithms	3	0	0	3	3	3	50	50	100
4	PCC	**MMCA14**	Database Management Systems	3	0	0	3	3	3	50	50	100
5	PCC	**MMCA15**	Operating System with Unix	3	0	0	3	3	3	50	50	100
6	PCCL	**MMCAL16**	Data Structures and Algorithms Lab	0	0	1	1	2	3	50	50	100
7	PCCL	**MMCAL17**	Database Management Systems Lab	0	0	1	1	2	3	50	50	100
8	PCCL	**MMCAL18**	Web Programming Lab	0	0	1	1	3	3	50	50	100
9	NCMC	**MMCAL19**	Communication and Soft Skills 1	0	0	0	0	2	-	-	-	PP
			TOTAL	**15**	**1**	**4**	**20**	**28**	**-**	**-**	**-**	**800**

*Bridge Course for students with non-computer science background shall be conducted with 2 hours per week culminating with a structured assessment process.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

PG PROGRAM: MASTER OF COMPUTER APPLICATIONS (MCA) | **Semester: II**

Sl. No	Course Category	Course Code	Course Title	Credit Distribution			Credits	Contact Hours/Week	Examination			
				L	T	P			Duration	CIE Marks	SEE Marks	Total Marks
1	IPCC	**MMCA21**	Full Stack Development	3	0	1	4	5	3	50	50	100
2	PCC	**MMCA22**	Machine Learning	3	0	0	3	3	3	50	50	100
3	PCC	**MMCA23**	Mobile Application Development	3	0	0	3	3	3	50	50	100
4	PCC	**MMCA24**	Cloud Computing	3	0	0	3	3	3	50	50	100
5	PCC	**MMCA25**	Computer Networks	3	0	0	3	3	3	50	50	100
6	PEC	**MMCA26X**	Elective	3	0	0	3	3	3	50	50	100
7	PCCL	**MMCAL27**	Machine Learning Lab	0	0	1	1	2	3	50	50	100
8	PCCL	**MMCAL28**	Mobile Application Development Lab	0	0	1	1	2	3	50	50	100
9	NCMC	**MMCAL29**	Communication and Soft Skills 2	0	0	0	0	2	-	-	-	PP
10	NCMC Online Mode	**MMCA1AU**	Research Methodology & IPR	0	0	0	0	1	-	-	-	PP
			TOTAL	**18**	**0**	**3**	**21**	**27**	-	**-**	**-**	**800**

Elective MMCA26X	
Course Code	**Course Title**
MMCA261	Cyber Security
MMCA262	Robotic Process Automation
MMCA263	Big Data Analytics
MMCA264	Blockchain Technology
MMCA265	Software Quality Assurance

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

PG PROGRAM: MASTER OF COMPUTER APPLICATIONS (MCA) | **Semester: III**

Sl. No	Course Category	Course Code	Course Title	Credit Distribution			Credits	Contact Hours/Week	Examination			
				L	T	P			Duration	CIE Marks	SEE Marks	Total Marks
1	PEC	**MMCA3X1**	Specialization – I	3	0	0	3	3	3	50	50	100
2	PEC	**MMCA3X2**	Specialization – II	3	0	0	3	3	3	50	50	100
3	PEC	**MMCA3X3**	Specialization – III	3	0	0	3	3	3	50	50	100
4	PW	**MMCA34**	Project Phase - I	0	0	10	10	20	3	50	50	100
			TOTAL	**9**	**0**	**10**	**19**	**29**	-	**-**	**-**	**400**

	Artificial Intelligence & Data Science (A)	Software Development and Operations (B)	Advanced Network Systems (C)	System Security & Applications (D)
Specialization I MMCA3X1	Business Analytics	Agile Software Development	Augmented & Virtual Reality	Web Security
Specialization II MMCA3X2	Natural Language Processing	Object Oriented Analysis and Design	Industrial IoT	Ethical Hacking
Specialization III MMCA3X3	Data Engineering	Enterprise Resource Planning	Wireless Networks & Mobile Computing	Cryptography and Network Security

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

PG PROGRAM: MASTER OF COMPUTER APPLICATIONS (MCA) | **Semester: IV**

Sl. No	Course Category	Course Code	Course Title	Credit Distribution			Credits	Contact Hours/Week	Examination			
				L	T	P			Duration	CIE Marks	SEE Marks	Total Marks
1	PEC Online Mode	**MMCA41**	Online Course on Emerging Technology (12 Weeks) / Professional Certification	0	3	0	**3**	**6**	-	100	-	100
2	INT	**MMCA42**	Internship	0	0	11	**11**	**22**	3	50	50	100
3	PW	**MMCA43**	Project Phase - II	0	0	6	**6**	**12**	3	50	50	100
			TOTAL	**0**	**3**	**17**	**20**	**40**	**-**	**-**	**-**	**300**

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CONTINUOUS INTERNAL EVALUATION AND SEMESTER END EXAMINATION PATTERN
ACADEMIC BATCH 2024-25 (MCA)

CONTINUOUS INTERNAL EVALUATION (CIE): IPCC Course (3-0-2)

Max. Marks: 50

		Internal Assessments (IAs)	Max. Marks	Average /Sum	Marks after scale-down	Final Marks
Theory Component (60% of CIE)	IA Tests	IA-1 (1.5 Hr)	40	40	20	20+ 10+ 10+ 10= 50
		IA-2 (1.5 Hr)	40			
	Assignment	ASMT	10	20	10	
	AAT	AAT	10			
Practical Component (40% of CIE)	Cumulative assessment of laboratory program execution	10 Marks for each program	100	-	10	
	IA Test	IA (03 Hrs.)	50	100	10	
		Open Ended Programs	50			

SEMESTER END EXAMINATION (SEE): IPCC Courses (3-0-2)

Examination Duration: 03 Hrs — Max. Marks: 50

			Max. Marks	Marks after scale-down	Final Marks
Theory Component (100% of SEE)	No. of Modules	05	100	50	50
	Questions/Module	02			
	Marks/Question	20			
	No. of Questions to be answered/ module	01			
	No. of Questions to be answered/course	05			

The minimum marks to be secured in CIE to appear for SEE shall be 25. (50% of maximum marks (30M) under theory component i.e., 15M and 50% of maximum marks (20) under laboratory component i.e., 10)).

A minimum of 40% in SEE is required i.e., 20M.

In addition to the minimum CIE and SEE requirements, an aggregate of 50% marks from CIE and SEE, put together, is required for passing the course i.e., 50M.

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CONTINUOUS INTERNAL EVALUATION AND SEMESTER END EXAMINATION PATTERN
ACADEMIC BATCH 2024-25 (MCA)

CONTINUOUS INTERNAL EVALUATION (CIE): PCCL or PEC Course (0:3:3) (0:1:3)

Max. Marks: 50

		Internal Assessments (IAs)	Max. Marks	Average/ Sum	Marks after scale-down	Final Marks
Practical Component	Cumulative Marks of Programs	10 Marks for each program	100	-	30	30+ 20= 50
	IA Tests	IA (03 Hrs.)	50	150	20	
	Open Ended Programs	Prg 1	50			
		Prg 2	50			

SEMESTER END EXAMINATION (SEE): PCCL or PEC Course (0:3:3) (0:1:3)

Examination Duration: 03 Hrs — Max. Marks: 50

			Max. Marks - 100	Marks after scale-down	Final Marks
Practical Component	Write up	20%	20	50	50
	Conduction procedure and result	60%	60		
	Viva-Voce	20%	20		
	Change of experiment	-10% from marks allotted for procedure part	-6	-	

The minimum marks to be secured in CIE to appear for SEE shall be 25.

A minimum of 40% in SEE is required i.e., 20M.

In addition to the minimum CIE and SEE requirements, an aggregate of 50% marks from CIE and SEE, put together, is required for passing the course i.e., 50M.

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CONTINUOUS INTERNAL EVALUATION AND SEMESTER END EXAMINATION PATTERN
ACADEMIC BATCH 2024-25 (MCA)

CONTINUOUS INTERNAL EVALUATION (CIE): PCC or PEC Course (3:2:0) (2:0:0) (3:0:0)

Max. Marks: 50

		Internal Assessments (IAs)	Max. Marks	Average/ Sum	Marks after scale-down	Final Marks
Theory Component	IA Tests	IA-1 (1.5 Hr)	40	40	30	30+ 20= 50
		IA-2 (1.5 Hr)	40			
	AAT	AAT-1	10	20	20	
		AAT-2	10			

SEMESTER END EXAMINATION (SEE): PCC or PEC Course (3:2:0) (2:0:0) (3:0:0)

Examination Duration: 03 Hrs — Max. Marks: 50

			Max. Marks	Marks after scale-down	Final Marks
Theory Component	No. of Modules	05	100	50	50
	Questions/Module	02			
	Marks/Question	20			
	No. of Questions to be answered/ module	01			
	No. of Questions to be answered/	05			

The minimum marks to be secured in CIE to appear for SEE shall be 25.

A minimum of 40% in SEE is required i.e., 20M.

In addition to the minimum CIE and SEE requirements, an aggregate of 50% marks from CIE and SEE, put together, is required for passing the course i.e., 50M.

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Mathematical Foundations for Computer Applications

Course Code	MMCA11	CIE Marks	50
Contact Hours (L:T:P)	3:2:0	SEE Marks	50
Total Number of Lecture Hours	40L14T	Exam Hours	3

Credits: 04

Course objectives:

This course will enable the students to

1. Understand the concepts of sets and number theory.
2. Perform various basic operations on propositional logic.
3. Solve problems using concepts of relations & probability distribution
4. Apply the abstract concepts of algebra & graph theory
5. Compute statistical measures for the given set of data.

Preamble: Mathematical foundation is essential in both theoretical and applied areas of computer science. It covers wide range of concepts such as set theory, probability, graph theory, matrices and vectors, and statistical methods which are applied in the domains of machine learning, artificial intelligence, and data science.

Module – 1

Mathematical Logic, Set Theory, Functions and Relations

Propositional logic, Propositional Equivalences, Sets, Set operations, Inclusion and Exclusion principle, Functions, Relation, Properties of relations, Equivalence relations, Partial Ordering, Applications of set theory and logic in computer science, Use cases of the concepts.

(08 Hours)

Module – 2

Probability Distribution

Concept of Random variable, Discrete Probability Distributions, Continuous Probability Distributions, Mean and Variance of random variables. Binomial and Poisson Distribution, Exponential and Normal Distribution with Mean and Variance.

(08 Hours)

Module – 3

Matrices and Vector Algebra

Matrices, Matrix operations, Related matrices, Rank of a matrix, Determinant of a matrix, Eigen values and Eigen vectors.

Sequence and Series

Introduction, Sequences, Series, Arithmetic Progression, Sum of Finite number of terms in A.P, Arithmetic Means, Geometric Progression, sum to n terms of G.P, Geometric Mean, relation between A.M and G.M.

(08 Hours)

Module – 4

Graph Theory

Graphs and graphs models and terminologies, Representation of graphs, Euler and Hamilton Graphs, Shortest-Path-Travelling salesman problem, Planar graph and graph coloring, Use cases of the concepts.

(08 Hours)

Module – 5

Statistical Methods

Collection of data, Graphical representation, Comparison of frequency distribution, Measures of tendency, Correlation, Coefficient of correlation, Lines of regression, Rank correlation, Curve Fitting-Graphical method, Principle of Least Square- to fit a straight line and Parabola, Fitting of other curves of the form $y=ax^b$, $y=ae^{bx}$, Applications of linear regression and curve fitting.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Solve the problems based on mathematical logic, set theory and relations.
CO2: Apply appropriate probability distribution for a given problem.
CO3: Apply matrices and various progressions for a given use case.
CO4: Model the given problem using graph theory concepts.
CO5: Perform statistical evaluation for curve fitting.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Kenneth H Rosen, "Discrete Mathematics and its Applications", McGraw Hill publications,7th edition.
2. Dr. B. S. Grewal," Higher Engineering Mathematics", Khanna Publishers, 44th Edition.
3. Walpole Myers, "Probability and Statistics for Engineers and Scientists", Pearson Education, 8th Edition.

References:

1. Ralph P. Grimaldi and B V Ramana, Discrete and combinatorial Mathematics", 5th Edition, Pearson,2011.
2. J K Sharma, "Discrete Mathematics", MacMillan Publishers India Ltd, 3rd Edition, 2011.
3. J P Trembly and R Manohar, "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill, 2017.

Alternate Assessment Tools (AATs) suggested:

1. Problem Solving

Web links/e-resources:

1. Probability distributions: https://www.youtube.com/watch?v=CfZa1daLjwo&list=PLaFfQroTgZnzbfK-Rie19FdV6diehETQy.
2. Travelling salesman problem Graph Theory 13 Travelling salesman's problem & Chinese postman problem.
3. Eigen values and Eigen vectors Eigenvalues and Eigenvectors | Properties and Important Result | Matrices.
4. Curve fitting : https://www.youtube.com/watch?v=PtRq60VZGlE&list=PLNKD1qB9pptvgPP_zrKXa64SPYtKQpy-C.

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SEMESTER – I

Java Programming

Course Code	MMCA12	CIE Marks	50
Contact Hours (L:T:P)	3:0:2	SEE Marks	50
Total Number of Lecture Hours	40L 28P	Exam Hours	3

Credits: 04

Course objectives:

This course will enable the students to

1. Understand the basic syntax, operators set, functions and OOP concepts in Java.
2. Develop problem-solving skills using java programming to tackle real world problems.
3. Master advanced Java programming concepts, including threads, exceptions and interfaces.
4. Apply OOP design principles to design and develop robust, scalable Java applications.
5. Develop GUI based applications using Java frameworks and libraries.

Preamble: The Java Programming course is a comprehensive program designed to equip students with the fundamental knowledge and skills required to develop robust, scalable, and efficient software applications using Java. Java is a widely used programming language in various industries, including web development, Android app development, Enterprise software development.

Module – 1

Java Programming Fundamentals

An overview of Java, Data Types and Operators, Program Control Statements, Introducing Classes, Objects and Methods. Methods, Classes, Constructors, Access control, Pass Objects to Methods, How Arguments are passed, Returning Objects, Method Overloading, Overloading Constructors.

(08 Hours)

Module – 2

Inheritance, Interfaces and Packages

Inheritance, using super to Call Superclass constructors, using super to Access Superclass Members, creating a Multilevel Hierarchy, Superclass References and Subclass Objects, Method Overriding, Using Abstract Classes. Interface Fundamentals, Creating an Interface, implementing an Interface, Using Interface References, Implementing Multiple Interfaces, Constants in Interfaces, Interfaces can be extended, Nested Interfaces, Package Fundamentals, Packages and Member Access, Importing Packages.

(08 Hours)

Module – 3

Exception Handling and Multi-Threading Programming

The Exception Hierarchy, Exception Handling Fundamentals, the Consequences of an Uncaught Exception, using Multiple catch clauses, Catching subclass Exceptions, Throwing an Exception, Throwable, using finally, using throws; Multithreading: The Thread Class and Runnable Interface, Creating Thread, Creating Multiple Threads, Determining When a Thread Ends, Thread Priorities, Synchronization, using Synchronization Methods, The Synchronized

Statement, Thread Communication using notify(), wait() and notify All(), Suspending, Resuming and stopping Threads.

(08 Hours)

Module – 4

Servlet Programming

Servlet Structure, Packaging, Lifecycle, HTTP Request and response, Handling client request, Form data, HTTP status request headers, HTTP Status codes, HTTP response headers, Handling cookies, Session tracking.

JSP Programming

Need of JSP, Basic syntax, Scripting elements, Limiting Java code in JSP, JSP expression, JSP directives, JSP attributes.

(08 Hours)

Module – 5

Spring Framework and Hibernate

Introducing the Spring Framework, Problems with the Traditional Approach to J2EE, Lightweight Frameworks, Spring's Values, Spring in Context, Inversion of Control and Dependency Injection, Architecting Applications with Spring; Introduction to Hibernate, Application of Hibernate.

(08 Hours)

Practical components for IPCC

Sl.No.	Experiments
1	a. Class, object b. Method Overloading & Constructor Overloading.
2	Inheritance a. Method Overriding b. Abstract class
3	a. Interfaces b. Packages
4	a. Exception Handling b. Creating own exception subclasses
5	a. Multithreaded Programming b. Thread Priorities and Synchronization
6	a. Java Servlets b. Java Server Pages
7	JDBC Connectivity
8	A simple Spring application

Course outcomes:

The students will be able to:

CO1: Demonstrate object-oriented programming concepts.
CO2: Apply Java constructs to obtain solutions.
CO3: Develop reusable and efficient Java code.
CO4: Build a Java based client-server application.
CO5: Implement Java application using Spring framework.

CIE:

- CIE is based on Theory and Laboratory Components of the course.
- Theory component is evaluated for 60% of CIE i.e., 30 Marks and Laboratory component is evaluated for 40% of CIE i.e., 20 Marks.

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. "Java: The Complete Reference" by Herbert Schildt (Publisher: McGraw-Hill), 9th Edition, ISBN: 978-0-07-180856-9, 2014.
2. Professional Java™ Development with the Spring Framework by Rod Johnson, Juergen Hoeller, Alef Arendsen, Thomas Risberg, Colin Sampaleanu , Released July 2005, Publisher(s): Wrox ,ISBN: 9780764574832.
3. Java Servlet and JSP Programming" by Jason Brittain and Brian D. Eubanks (Publisher: O'Reilly Media).

References:

1. "Head First Design Patterns" by Kathy Sierra and Bert Bates (Publisher: O'Reilly Media).
2. "Beginning Hibernate 6 Java Persistence from Beginner to Pro" , by Joseph B. Ottinger Jeff Linwood Dave Minte Fifth Edition, Apress.

Alternate Assessment Tools (AATs) suggested:

1. Spring Framework
2. Project Development and Presentation

Web links/e-resources:

1. www.java.com
2. https://www.programiz.com/java-programming

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Data Structures and Algorithms

Course Code	MMCA13	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand fundamentals of data structures and their applications essential for programming/problem solving.
2. Utilize an appropriate data structure like stack, queues, lists, trees and graphs to solve a given problem.
3. Develop non-linear data structures and their applications such as trees and graphs sorting, traversing and searching algorithms.
4. State algorithm's efficiencies using asymptotic notations.
5. Analyse the efficiency of various algorithms.

Preamble: Data Structures are a specialized means of organizing and storing data in computers in such a way that operations can be performed on the stored data more efficiently. Data structures have a wide and diverse scope of usage across the fields of Computer Science and many other fields of Engineering. Data Structures are the main part of many computer science algorithms as they enable the programmers to handle the data in an efficient way. It plays a vital role in enhancing the performance of a software.

Module – 1

Data Structures

Definition, Classification and Operations, Dynamic memory allocation, Dynamic Arrays, Self-referential structures.

Stacks

Definition, Stack operations, Array representation of stacks, Stacks using dynamic arrays.

Stack applications

Infix to postfix conversion, Evaluation of postfix expression.

Recursion

Factorial, GCD, Fibonacci sequence, Tower of Hanoi, Ackerman's function.

(08 Hours)

Module – 2

Queues

Definition, Array representation, Queue operations, Circular queues, Circular queues using dynamic arrays, De-queues, Priority queues.

Linked Lists

Definition, Representation of linked lists in memory, Memory allocation; Garbage collection.

(08 Hours)

Module – 3

Linked list operations

Traversing, Searching, Insertion, and deletion. Doubly linked lists, Circular linked lists.

Trees

Terminology, Binary trees, Properties of binary trees, Array and linked representation of Tree, Binary tree traversals - Inorder, Preorder, Postorder.

Binary Search Trees

BST insert and delete operations, Application of binary search trees.

(08 Hours)

Module – 4

Asymptotic Notations

Big-Oh notation (O), Omega notation (Ω), Theta notation(Θ) with examples, Basic efficiency classes, Important problem types, Mathematical analysis of non-recursive and Recursive algorithms with examples problems.

Brute force design technique

Selection sort, Sequential search, String matching algorithm with complexity Analysis.

(08 Hours)

Module – 5

Divide and Conquer

Binary search, Merge sort, Quick sort with complexity analysis.

Greedy Technique

Prim's Algorithm, Kruskal's algorithm, Dijkstra's algorithm with performance analysis, Decrease and conquer – DFS, BFS.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Illustrate linear and non-linear data structures.

CO2: Apply suitable data structures for a given problem.

CO3: Implement sorting and searching techniques.

CO4: Analyse the algorithms using complexity metrics.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, Universities Press, 2nd edition, 2019
2. Seymour Lipschutz, Data Structures, Schaum's Outline Series, 1st Edition, 2014.

References:

1. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, Cengage Learning, 2nd edition, 2014.
2. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, McGraw Hill, 2nd Edition, 2013.
3. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.

Alternate Assessment Tools (AATs) suggested:

1. Linked List Applications.
2. Time complexity.

Web links/e-resources:

1. Introduction to Data Structures: http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
2. Sorting: https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
3. Trees, BFS,DFS : https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Database Management System

Course Code	MMCA14	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand the fundamental concepts of Database Management Systems.
2. Compare between file systems and database systems.
3. Design ER diagrams, schema and relational tables.
4. Formulate SQL queries.
5. Develop real-time database applications.

Preamble: Database Management Systems (DBMS) is a software system that allows users to create, manage, and manipulate data in a database and are important because they help businesses store, manage, and access data efficiently. It is used in all applications.

Module – 1

Overview

Characteristics of Database approach, Actors on the Scene, Workers behind the scene, Advantages of using DBMS approach, Data models, Schemas and instances, Three schema architecture and data independence.

Entity-Relationship Model

Conceptual database using high level conceptual data models for Database design, A sample database application, Entity types, Entity sets, Attributes and Keys relationship types, Relationship sets, Roles and structural constraints, Weak entity types.

(08 Hours)

Module – 2

Relational Model

Relational vs non-relational DBMS, Relational model concepts, Relational model constraints and Relational database schema update operations, Transactions and dealing with constraint violations, Unary relational operations, Relational algebra operations from set theory, Binary relational operations, JOIN and DIVISION, Additional relational operations, Examples of queries in relational algebra, Relational database design using ER-to-relational mapping.

(08 Hours)

Module – 3

Introduction to SQL

Overview of the SQL query language, SQL data definition, Basic structure of SQL queries, additional basic operations, Null values, Aggregate functions, Modification of the Database, Join Expressions, Views, Transactions, Integrity constraints, SQL data types and schemas, Authorization, Database programming issues and techniques, Embedded SQL.

(08 Hours)

Module – 4

Database Design

Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of 2nd and 3rd Normal forms, Boyce Code Normal Forms, Stored procedures and functions, Triggers, Views.

(08 Hours)

Module – 5

Transaction Management

Transaction concept, A simple transaction model, Desirable properties of transaction.

Concurrency Control

Lock based protocols, Recovery concepts, Recovery in multi-database systems, Database backup and recovery from catastrophic failures.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Apply the basic concepts of database management.
CO2: Formulate SQL queries for a given problem scenario.
CO3: Improve the database design by normalization.
CO4: Create stored procedures/ functions for a given use case.
CO5: Implement transaction management concepts.

CIE:

- 60% of CIE is based on Internal Assessment Tests.
- 40% of CIE is based on Alternate Assessment Methods.

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Elmasri and Navathe, "Fundamentals of Database Systems", 5th Edition, Addison - Wesley, 2011.

References:

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw-Hill, 2003.
2. Silberschatz, Korth and Sudarshan, "Data base System Concepts", 6th Edition, Tata McGraw Hill, 2011.

Alternate Assessment Tools (AATs) suggested:

1. Develop an application with proper interface and database.

Web links/e-resources:

1. Stored Procedure: https://www.youtube.com/watch?app=desktop&v=Sggdhot-MoM
2. Research paper using DBMS https://www.ijrte.org/wp-content/uploads/papers/v7i6s5/F10370476S519.pdf

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Operating System with Unix

Course Code	MMCA15	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students

1. To understand the services of operating system.
2. To know about various types of operating systems.
3. To analyse and understand the need for processes, threads and their implementation models.
4. To learn CPU and Memory management technique.
5. To study the architecture of a Linux system.

Preamble: Operating system is an interface between the user and the computer. Operating system is critical to implement any software: system software or application software. It's application is there in almost all electronic gadgets/devices viz: Laptops, smart watches, mobiles, refrigerators etc.

Module – 1

Operating System Basics

Introduction to Operating System, OS types, Feature Migration, Computing Environments, System Components, Operating – System Services, System Calls, System Programs, System Structure, Virtual machines.

(08 Hours)

Module – 2

Process Management

Process Concept, Process control block, Scheduling Criteria, Scheduling Algorithms. Process Synchronization: The Critical Section Problem, Semaphores, Readers-Writers Problem, Dining Philosopher's Problem using Semaphores.

(08 Hours)

Module – 3

Deadlocks

System model, Deadlock Characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from deadlock.

(08 Hours)

Module – 4

Memory Management

Memory Management Strategies, Basic hardware, Swapping, Memory Allocation, Paging, Segmentation, Virtual Memory concept.

(08 Hours)

Module – 5
Unix Unix architecture, Components of Unix, Unix file system, Environment variables, Unix files. **Linux Case Study** Basic Linux commands to deal with files and directories, File permissions, Pipes and filters, Pattern matching, Find command, Administrative commands. (08 Hours)
Course outcomes: The students will be able to: CO1: Illustrate operating system concepts. CO2: Apply the suitable OS algorithm for any given use case. CO3: Analyse memory management techniques. CO4: Build shell scripts using Linux commands and language constructs.
CIE: • 60% of CIE is based on Internal Assessment Tests. • 40% of CIE is based on Alternate Assessment Methods.
SEE: • SEE will be conducted for 100 marks.
Text Books: 1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating Systems Principles", 8th Edition, Wiley – India. 2. Unix Concepts and Applications- Sumitaba Das, 4th Edition, Mc Graw Hill Publications. **References:** 1. D M Dhamdhere, "Operating Systems – A Concept Based Approach", 2nd Edition, Tata McGraw – Hill, 2002. 2. Behrouz A Forouzan and Richard F Gilberg, "LINUX and Shell Programming", 1st Edition, Thomson Course Technology, 2005.
Alternate Assessment Tools (AATs) suggested: 1. Unix commands. 2. Shell Script.
Web links/e-resources: 1. Basic Unix Commands https://www.unixtutorial.org/basic-unix-commands.

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Data Structures and Algorithms Lab

Course Code	MMCAL16	CIE Marks	50
Contact Hours (L:T:P)	0:0:2	SEE Marks	50
Total Number of Lecture Hours	28P	Exam Hours	3

Credits: 01

Course objectives:

This course will enable the students to

1. Develop linear data structures and their applications such as stacks, queues and lists.
2. Develop non-linear data structures and their applications
3. Implement sorting and searching algorithms based on their complexity metrics.

Sl.No.	Experiments
1	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate Overflow and Underflow situations on Stack d. Display the status of Stack e. Exit Support the program with appropriate functions for each of the above operations
2	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^ (Power) and alphanumeric operands.
3	Design, Develop and Implement a menu driven Program in C for the following operations on QUEUE of integers (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to QUEUE b. Delete an Element from QUEUE c. Demonstrate Overflow and Underflow situations on QUEUE d. Display the status of QUEUE e. Exit Support the program with appropriate functions for each of the above operations.
4	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of integers (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit

5	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, PhNo a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL (Demonstration of stack) e. Exit
6	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept. a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue f. Exit
7	Design, Develop and Implement a menu driven Program in C for the following operations on Circular Linked List (CLL) of Employee Data with the fields: SSN, Name, Dept. a. Create a CLL of N Employees Data by using end insertion. b. Display the status of CLL and count the number of nodes in it c. Perform Insertion and Deletion at End of CLL d. Perform Insertion and Deletion at Front of DLL e. Exit
8	Implement a menu driven Program in C for the following operations on Binary Search Tree(BST) of Integers a. Create a BST of N Integers b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element and report the appropriate message e. Exit
9	Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C/C++ how the divide and conquer method works along with its time complexity analysis
10	Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using any traversal method (DFS/BFS).

Course outcomes:

The students will be able to:

CO1: Illustrate linear and non-linear data structures.

CO2: Apply suitable data structures for a given problem.

CO3: Implement sorting and searching techniques.

CO4: Analyse the algorithms using complexity metrics.

CIE: • 60% of CIE is based on Cumulative assessment of laboratory program execution. • 40% of CIE is based on IA Test and Alternate Assessment Method.
SEE: • SEE will be conducted for 100 marks

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic Year 2024-25)

SEMESTER – I

Database Management System LAB

Course Code	MMCAL17	CIE Marks	50
Contact Hours (L:T:P)	0:0:2	SEE Marks	50
Total Number of Lecture Hours	28P	Exam Hours	3

Credits: 01

Course objectives:
This course will enable students to
1. Design ER diagrams, schema and relational tables
2. Formulate SQL Queries
3. Develop real-time database applications.

Sl. No.	Experiments
1.	Implementation of • DDL Commands • DML Commands • TCL Commands • Integrity Constraints
2.	**STUDENT INFORMATION TABLE** **Consider the following schema:** **STUDENT (USN, name, date_of_birth, branch, mark1, mark2, mark3, total, GPA)** **Queries:** i. Update the column total by adding the columns mark1, mark2, mark3. ii. Find the GPA score of all the students. iii. Find the students who were born on a particular year of birth from the date_of_birth column. iv. List the students who are studying in a particular branch of study. v. Find the maximum GPA score of the student branch-wise. vi. Find the students whose name starts with the alphabet “S”. vii. Find the students whose name ends with the alphabets “AR”. viii. Delete the student details whose USN is given as 1001. ix. Partition the Student table based on the branch. Demonstrate its working with a simple query. x. Find the rank of students based on GPA in descending order. xi. Find top 2 students by GPA per branch.
3.	**BOOK DATABASE** Create the following tables with properly specifying Primary keys, Foreign keys and solve the following queries:

	BRANCH (Branchid, Branchname, HOD) STUDENT (USN, Name, Address, Branchid, sem) BOOK (Bookid, Bookname, Authorid, Publisher, Branchid) AUTHOR (Authorid, Authorname, Country, Age) BORROW (USN, Bookid, Borrowed_date) **Queries:** i. List the details of Students who are all Studying in 2nd sem MCA. ii. List the students who have not borrowed any books. iii. Display the USN, Student name, Branch-name, Book-name, Author-name, Books-Borrowed-Date of 2nd sem MCA Students who borrowed books. iv. Display the number of books written by each Author. v. Display the student details who have borrowed more than two books. vi. Display the student details who have borrowed books of more than one Author. vii. Display the Book names in descending order of their names. viii. List the details of students who have borrowed the books that are all published by a specific Publisher.
4.	**COMPANY DATABASE** Consider the following scenario. Design an ER-diagram and map the designed ER-diagram into a Relational Model. Consider an organization "ABC" having many employees. An employee works for one department. Each employee is identified by Empid, Name, Address (described as House_no, city, district, state, pincode) and more than one phone number. Each Department is identified by a DNo, Dname, and Dlocation. Each department is managed by a Manager. Every department is having many employees. There are many Projects, each Project is controlled by a Department. Each Project is uniquely identified by a PNo, Pname and Project_location. An employee can work on many projects. Number of hours per week worked on each project by an employee also needs to be recorded in the database. Many employees can work on the same project. Each employee is supervised by the supervisor. An employee can have many dependents. Each dependent is identified by an Empid, dependent_name, gender, age, address. **Queries:** i. Display the details of the employees who are working on both the projects – Project_no 5 and Project_no 10. ii. Display the details of employees having at least two dependants. iii. Display the project name on which maximum number of employees are working. iv. Retrieve the employees who do not have any dependents. v. Create a view to display the number of employees working in each department.
5.	**MOVIE DATABASE** The Bollywood film studio *CineMax* wants to maintain details about its movies, the actors who perform in them, their directors, and the ratings each movie receives. Each

	movie is identified by a Movie_ID, with details such as Title, Year, Language, and Director_ID. Each movie is directed by one director. Each director is identified by Director_ID, with attributes Name and Phone. One director can direct many movies. Each actor is identified by Actor_ID, with attributes Name and Gender. One actor can act in many movies, and one movie can have many actors. The role played by the actor in each movie should also be stored. Each movie can have multiple audience ratings. A Rating record includes Rating_ID, Movie_ID, Stars, and Reviewer_Name. **Queries:** i. List the titles of all movies directed by 'Sanjay Leela Bhansali'. ii. Find the names of actors who have acted in more than 2 movies. iii. Display all movies released after 2015 that have at least one 5-star rating. iv. Retrieve the movie titles along with their average rating, sorted in descending order of rating. v. List directors who have directed at least one movie featuring 'Deepika Padukone'. vi. Create a view that shows each director's name and the number of movies they have directed.
6.	**ELECTION DATABASE** Consider the following scenario. Design an ER-diagram and map the designed ER-diagram into a Relational Model. A country wants to conduct an election for the parliament. A county is having many constituencies. Each constituency is uniquely identified by constituency_id, name, belongs to a state, number_of_voters. A constituency can have many voters. Each voter is uniquely identified by voter_id, name, age, address (involves house_no, city, state, pincode). Each voter belongs to only one constituency. There are many candidates contesting in the election. Each candidate is uniquely identified by candidate_id, having name, phone_no, age and state. A candidate belongs to only one party. There are many parties. Each party is uniquely identified by party_id, party_name, party_symbol. A candidate can contest from many constituencies under the same party. A party can have many candidates contesting from different constituencies. No constituency can have candidates from the same party. A constituency can have many contesting candidates belonging to different parties. Each voter votes only one candidate of his/her constituency. **Queries:** i. List the details of the candidates who are contesting from more than one constituencies which belongs to different states. ii. Display the state name having maximum number of constituencies. iii. Create a stored procedure to insert the tuple into the voter table by checking the voter age. If voter's age is atleast 18 years old, then insert the tuple into the voter else display the "Not an Eligible voter" msg.

	iv. Create a stored procedure to display the number of voters in the specified constituency, where the constituency name is passed as an argument to the stored procedure. v. Create a TRIGGER to UPDATE the count of "Number_of_voters" of the respective constituency in "CONSTITUENCY" table, AFTER inserting a tuple into the "VOTERS" table.
Course outcomes: The students will be able to: CO1: Apply the basic concepts of database management CO2: Formulate SQL queries for a given problem scenario CO3: Improve the database design by normalization CO4: Create stored procedures / functions for a given use case. CO5: Implement transaction management concepts.	
CIE: • 60% of CIE is based on Cumulative assessment of laboratory program execution. • 40% of CIE is based on IA Test and Alternate Assessment Method.	
SEE: • SEE will be conducted for 100 Marks.	

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Web Programming Lab

Course Code	MMCAL18	CIE Marks	50
Contact Hours (L:T:P)	0:0:2	SEE Marks	50
Total Number of Lecture Hours	28P	Exam Hours	3

Credits: 01

Course objectives:

This course will enable the students to

1. Explore the various web scripting technologies.
2. Use HTML/XHTML, CSS, and Bootstrap to Design and Decorate simple to complex web pages.
3. Validate the web page at client side, server side using either JavaScript.
4. Build a Web application for any use case.

Preamble: Web Technology is a basic web development programming language. We can develop both static and responsive webpages using this. Many real-time web applications are developed using this programming.

Sl.No.	Experiments
1	Create an XHTML page that provides information about your department. Your XHTML page must use the following tags: a. Text Formatting tags b. Horizontal rule c. Meta element d. Links e. Images f. Ordered list unordered list (use of additional tags encouraged)
2	Write a HTML program for time-table using tables.
3	Write a HTML program to divide the webpage using frames.
4	Develop and demonstrate the usage of inline, external and internal style sheet using CSS. Use HTML page that contains at least three paragraphs of text, listed elements and a table with four rows and four columns.
5	Develop and demonstrate a HTML file that includes JavaScript script for the following problems: a) Input: A number n obtained using prompt Output: The first n Fibonacci numbers b) Input: A number n obtained using prompt Output : A table of numbers from 1 to n and their squares using alert
6	Develop and demonstrate, using JavaScript script, a XHTML document that contains three short paragraphs of text, stacked on top of each other, with only enough of each

	showing so that the mouse cursor can be placed over some part of them. When the cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely visible. Modify the above document so that when a text is moved from the top stacking position, it returns to its original position rather than to the bottom.
7	Develop and demonstrate a HTML file which includes JavaScript that uses functions for the following problems: a. Parameter: A string Output: The position in the string of the left-most vowel. b. Parameter: A number Output: The number with its digits in the reverse order.
8	Develop a simple calculator to perform arithmetic (addition, subtraction, multiplication and division) operations on given two numbers. Use an HTML tag that allows the user to input two numbers and to display the result of arithmetic operation. Write suitable HTML and JavaScript and CSS to your simple calculator.
9	Design a Login web page to accept the username and password as input and do the following: Validate the password, it should consist of at least 8 characters in length, must consists 1 capital case, 1 small case, 1 special characters.
10	Write a HTML program to develop a static Web Page for Book Catalog.

Course outcomes:

The students will be able to:

CO1: Apply basic concepts and tools of web technologies.

CO2: Design web pages using suitable tools & technologies.

CO3: Build a web application with proper validation.

CIE:

- 60% of CIE is based on Cumulative assessment of laboratory program execution.
- 40% of CIE is based on IA Test and Alternate Assessment Method.

SEE:

- SEE will be conducted for 100 marks.

Alternate Assessment Tools (AATs) suggested:

- Develop a website using appropriate tags.

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Bridge Course

Course Code	BC	CIE Marks	-
Contact Hours (L:T:P)	0:2:0	SEE Marks	-
Total Number of Lecture Hours	25T	Exam Hours	-

Credits: 00

Course objectives:

This course will enable the students to

1. Realize the functionality of logic gates.
2. Apply Boolean axioms to simplify Boolean expressions, combinational and sequential circuits.
3. Explain the basic principles and operations of different components of digital computer.
4. Apply C concepts to simple programs.
5. Obtain a thorough understanding of fundamentals.

Preamble: Bridge Course is designed to fill the gap and connect non-computer science background students so that they easily adapt to the curriculum of MCA.

Module – 1

Introduction

Digital logic gates, Number systems, Boolean Algebra, S implification,Construction of logic circuits, Adders, Subtractors, 1's and 2's complement.

(05 Hours)

Module – 2

Computer Basics

Functional units of computers, Operational concepts, Byte addressability,Instruction types, Sequencing, Addressing modes.

(05 Hours)

Module – 3

Memory

Basic memory concepts, Memory types, Semi-Conductor RAM organization, Memory hierarchy, Cache memory, Virtual memory, Secondary storage devices.

(05 Hours)

Module – 4

C Basics

Data Types, Operators, Control structures, Arrays, Procedures and Functions, Parameter passing, Recursion.

(05 Hours)

Module – 5

C Basics

Structures and Unions, Pointers, Memory allocation functions, I/o formatting.

(05 Hours)

Textbooks:

1. M.Morris Mano, “Digital Logic and Computer Design”, Pearson, 2012.
2. Carl Hamacher, Zvonko Vranesic Safwat Zaky, “Computer Organization”, 5th edition,TataMcGraw-Hill, 2011
3. Balaguruswamy, “Basics of C Programming”.

Alternate Assessment Tools (AATs) suggested:

1. Assignment on problem solving in digital electronics.
2. Writing C programs to solve simple problems.

Web links/e-resources:

1. https://www.coursera.org/courses?query=computer%20architecture
2. https://www.edx.org/learn/computer-architecture
3. https://www.udemy.com/topic/computer-architecture/
4. https://www.linkedin.com/learning/
5. https://www.youtube.com/c/Freecodecamp
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/
7. https://www.cs.cmu.edu/~213/
8. https://cs50.harvard.edu/
9. https://cs50.harvard.edu/discuss/
10. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/
11. https://www.youtube.com/user/Computerphile
12. https://www.youtube.com/c/GateSmashers
13. https://www.youtube.com/user/nesoacademy

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – I

Communication and Soft Skills 1

Course Code	MMCAL19	CIE Marks	-
Contact Hours (L:T:P)	0:0:2	SEE Marks	-
Total Number of Lecture Hours	26P	Exam Hours	-

Credits: 0

Course objectives:

This course will enable students to

1. Familiarise with basic English Grammar and Communication Skills in general.
2. Identify the nuances of phonetics, intonation and enhance pronunciation skills.
3. Enhance English vocabulary and language proficiency for better communication skills.
4. Learn about Techniques of Information Transfer through presentation.

Module – 1

Fundamentals of Communication

Introduction, Communication-an overview, Definition of communication, Features of successful professional communication, Importance of communication, Purpose of professional communication, Rule of critical and creative thinking in effective communication, Role of emotions in communication, Role of Inter-Cultural Communication, Different forms of communication, Communication network in an organization, Barriers to communication, Some remedies.

Non-verbal communication

Introduction, Body language, Paralinguistic features, Proxemics/ Space distance, Haptics.

(04 Hours)

Module – 2

Grammar: Essentials and Applications

Introduction, Parts of Speech, Articles and Prepositions, Modals, Sentences and their types, Subject-verb, Concord, using tenses, Moods of Verbs, Active passive voice, Direct indirect speech, Clause and its types, Using non-Finites.

Basic of Phonetics

Introduction, Reasons for incorrect pronunciations, received pronunciation, Misconceptions about sounds, Transcriptions, Problems of Indian English, Syllables, Word stress, How to transcribe, Weak forms, Intonation and rhythm, Difference between British American and Indian spoken English**.**

(06 Hours)

Module – 3

Reading skills

Introduction, need for developing efficient reading skills, Benefits of effective reading, Speed of reading, four basic steps to effective reading, overcoming common obstacles, Types, Approaches to efficient reading, Tips for effective reading, employing different reading skills, Understanding the authors point of view, Identifying the central idea, inferring lexical and contextual meaning, employing discourse analysis, Worked out passages.

Listening skills

Introduction, Listening is an art, Listening vs hearing, Poor vs effective listening, Advantages of good listening, Process of listening, Types of listening. Intensive listening vs extensive listening, Barriers to effective listening, five steps of active listening techniques for effective listening, Listening and not taking.

(08 Hours)

Module – 4

Paragraphs and Precis Writing

Precise, Summary, Abstract, Synopsis, Paraphrasing, Art of condensation, Some working principles, Seven step ladder to writing an effective precis, Writing precise for given passages, Structure of a paragraph, Construction of a paragraph, Features of a paragraph, Descriptive writing techniques, Augmentative paragraph, Analytical paragraph.

(04 Hours)

Module – 5

Professional Presentations

Introduction, combating stage fright, preparing PPT slides, Describing objects, Situations and people, Individual and group presentations, Delivering JAMs

Essays, Letters, Resumes

Introduction, Types of essays, Characteristic features of an essay, Stages in essay writing, Components comprising an essay, Essay writing-guiding principles, Business letters and resumes-Importance, Elements of structure, Layout. Business letters- Elements of style, Types of business letters, Resume preparation.

(04 Hours)

Course outcomes:

The students will be able to:

CO1: Understand and apply basic English grammar for effective communication.
CO2: Identify the nuances of phonetics, intonation, and enhance pronunciation skills.
CO3: Understand and use all types of English vocabulary and language proficiency.
CO4: Enhance their knowledge about techniques of information transfer through presentations.

Textbooks

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford Publications, 3rd Edition, 2015
2. Sanjay Kumar and Pushpa Lata, Communication Skills, Oxford University Press,
3. A Textbook of English Language Communication Skills, (ISBN-978-81-955465-2-7), Published by Infinite Learning Solutions, Bengaluru - 2022.

References

1. Gajendra Singh Chauhan, Technical Communication Cengage Learning India Pvt Limited, Latest Revised Edition, 2019
2. Michael Swan, Practical English Usage, Oxford University Press, 2016
3. N.P.Sudharshana and C.Savitha, English for Engineers, Cambridge University Press, 2018

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
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SEMESTER – II

Full Stack Development

Course Code	MMCA21	CIE Marks	50
Contact Hours (L:T:P)	3:0:2	SEE Marks	50
Total Number of Lecture Hours	40L 28P	Exam Hours	3

Credits: 04

Course objectives:

This course will enable the students to

1. Understanding the MERN stack and its role in full-stack development.
2. Learn to build dynamic React apps using components, state, events, and controlled forms with Bootstrap.
3. Build RESTful APIs with Express for efficient data handling, validation, and error management.
4. Understand MongoDB basics.
5. Learn project setup, automation, and code organization for improved productivity.

Preamble: The MERN stack equips students with essential skills for developing modern web applications using MongoDB, Express, React, and Node.js. This course enables the creation of dynamic user interfaces and robust back-end services, meeting the high demand for full-stack developers in today's job market and creates opportunities in web development and software engineering, particularly in e-commerce, social media, and real-time applications.

Module – 1

Introduction

What's MERN? MERN Components, Why MERN?, Server-less Hello World, JSX, Project setup, Express, Separate script files, JSX transform, Older browsers support, Automate.

(08 Hours)

Module – 2

React Component

Issue tracker, React classes, Composing components, Passing data using properties, Passing data using children, Dynamic composition.

React State

Initial state, Async state initialization, Updating state, Lifting state up, Event handling, Stateless components, Designing components.

(08 Hours)

Module – 3

React Forms

Controlled components in forms, More filters, Typed input, Edit form, Specialized input components, Number input, Date input, Text input, Update API, Updating an issue, Updating a field, Delete API, Deleting an issue.

React Bootstrap

Bootstrap Installation, Buttons, Navigation bar, Panels, Tables, Forms, The grid system, Inline forms, Horizontal forms, Validation alerts, Toasts, Modals.

(08 Hours)

<table>
<tr><th colspan="2">Module – 4</th></tr>
<tr><td colspan="2">Express
Express, Rest API, The List API, List API integration, The create API, Create API integration, Query variables, Input validations, Displaying errors.
(08 Hours)</td></tr>
<tr><th colspan="2">Module – 5</th></tr>
<tr><td colspan="2">MongoDB
MongoDB basics, MongoDB CRUD operations, MongoDB node.js driver, Schema initialization, reading from MongoDB, Writing to MongoDB.
(08 Hours)</td></tr>
<tr><th colspan="2">Practical components for IPCC</th></tr>
<tr><th>Sl.No.</th><th>Experiments</th></tr>
<tr><td></td><td>Ticket Management System
Design and develop a Ticket Management Web Application using the MERN Stack (MongoDB, Express.js, React.js, Node.js) that allows users to create, manage, and track tickets for various issues or tasks.
The application should include:
• Ticket creation and tracking functionality
• Backend models and routes for ticket data
• Frontend React application with proper component structure
• Styling using external CSS files
• API-based communication between frontend and backend</td></tr>
<tr><td>1</td><td>Project Setup and File Structure
Initialize a MERN stack project by creating the main project directory and organizing separate folders for the React frontend and Node.js with Express backend. Initialize both applications, create basic functional React components, and verify successful execution of the project.</td></tr>
<tr><td>2</td><td>Props, State, and Event Handling
Develop reusable React components by passing data using props, managing component state with the useState hook, handling user events such as button clicks and input changes, and dynamically displaying ticket data.</td></tr>
<tr><td>3</td><td>Rendering and Forms
Implement dynamic rendering and form handling in React by designing a ticket creation form, managing form inputs and submission, performing conditional rendering, rendering a list of tickets dynamically, and validating user input.</td></tr>
<tr><td>4</td><td>CRUD Operations and MongoDB Integration
Implement CRUD operations for ticket data storage by designing a Ticket schema using MongoDB, connecting the backend to MongoDB, and performing Create, Read, Update, and Delete operations to ensure data persistence.</td></tr>
<tr><td>5</td><td>Express Backend Setup
Build the backend using Express.js by creating and configuring the Express server, setting up middleware, defining routes for ticket operations, connecting routes to controllers, and handling HTTP requests and responses.</td></tr>
<tr><td>6</td><td>API Integration and Server Communication
Complete the MERN workflow by creating REST APIs for ticket operations, integrating the React frontend with the backend using Axios or Fetch, handling API responses, running frontend and backend servers together, and applying CSS styling to frontend components.</td></tr>
</table>

Course outcomes:

The students will be able to:

CO1: Demonstrate MERN stack and its components.

CO2: Design React applications using various components.

CO3: Implement RESTful APIs.

CO4: Integrate MongoDB for data management.

CIE:

- CIE is based on Theory and Laboratory Components of the course.
- Theory component is evaluated for 60% of CIE i.e., 30 Marks and Laboratory component is evaluated for 40% of CIE i.e., 20 Marks.

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Vasan Subramanian, Pro MERN Stack Full Stack Web App development with Mongo, Express, React and Node, Second Edition, Apress, ISBN-13 (pbk): 978-1-4842-4390-9 ISBN-13 (electronic): 978-1-4842-4391-6 https://doi.org/10.1007/978-1-4842-4391-6.

References:

1. David Choi, Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL, Packt Publishing, 2020.
2. Frank Zammetti, Modern Full-Stack Development Using TypeScript, React, Node.js, Webpack, and Docker, Apress, 2020.

Alternate Assessment Tools (AATs) suggested:

1. Building an Application Development using MERN stack.
2. Case study on tools implemented to deploy Full Stack Application.

Web links/e-resources:

1. https://youtu.be/98BzS5Oz5E4?si=MDuN9SaSFIr-u-8M.
2. https://www.youtube.com/watch?v=O3BUHwfHf84.

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Machine Learning

Course Code	MMCA22	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand the basic theory underlying machine learning.
2. Formulate machine learning problems corresponding to different applications.
3. Explore a range of machine learning algorithms along with their pros and cons.
4. Apply machine learning algorithms to solve problems of moderate complexity.
5. Optimize the models learnt and report on the expected accuracy achieved.

Preamble: Machine learning (ML) is the science of getting computers to act in particular applications, without being explicitly programmed for every possible outcome. ML has paved the way to self-driving cars, on-device speech recognition, fast and efficient web search, improved understanding of the human genome, etc. This course will deal with the most common and effective ML algorithms, and ways to implement these algorithms from scratch. The theoretical foundations of frequently used ML algorithms and the practical know-how needed will be addressed. Several case studies and applications will be utilized to learn how to apply learning algorithms to new/unforeseen practical applications.

Module – 1

Overview

Data objects and Attribute types, Overview of Machine Learning Algorithms – Basics of Supervised and Unsupervised Algorithms.

Machine Learning Basics

Well posed learning problems, Perspectives and issues in Machine Learning, Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version Space, Candidate Elimination Algorithm.

(08 Hours)

Module – 2

Decision Tree Learning

Decision Tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, Problems based on ID3 algorithm, Issues in decision tree learning.

(08 Hours)

Module – 3

Bayesian Learning

Introduction, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, Naïve Bayes Classifier, Bayesian belief networks.

(08 Hours)

Module – 4

Unsupervised Learning

Association Analysis - basic concepts and methods, Frequent itemset Generation, Apriori algorithm, FP-Growth Algorithm, Categorization of Major Clustering Methods, Instance based learning: Introduction to K-NN.

(08 Hours)

Module – 5

Evaluating Hypothesis

Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypotheses, Case study based on 1-tail and 2-tail tests, AB Testing.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Analyze the various learning models
CO2: Apply machine learning algorithms for the given problems
CO3: Build an appropriate learning model for a given data set
CO4: Perform statistical and probabilistic analysis of machine learning techniques
CO5: Evaluate machine learning algorithms on various data sets.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education Inc, 4th Edition.

References:

1. Ethem Alpaydin, Introduction to Machine learning, 2nd Edition, MIT Press.
2. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining Concepts and Techniques, Morgan Kauffman Publishing, 3rd Edition, 2012

Alternate Assessment Tools (AATs) suggested:

1. Case Study / Implementation of ML algorithms.
2. Evaluate ML algorithms on data sets.

Web links/e-resources:

1. Reinforcement Learning - IIT Madras, https://tinyurl.com/3ptxbf43
2. Statistics for Data Science – IIT Madras, https://tinyurl.com/yc4uk5ya

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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MASTER OF COMPUTER APPLICATIONS
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SEMESTER – II

Mobile Application Development

Course Code	MMCA23	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand the preliminary requirements to build mobile applications.
2. Design the GUI based activity screens using one of the tools of mobile application.
3. Analyze the flows of activities of mobile applications.
4. Apply the technologies to create mobile adaptive web applications.
5. Implement and Test Builds using one of the marketing tools of mobile.

Preamble: Mobile application development refers to the process of creating software applications that run on mobile devices, such as smartphones and tablets. It involves a combination of design, programming, testing, and deployment to produce apps that provide users with specific functionalities and experiences. As mobile devices have become integral to daily life, mobile app development has grown significantly, influencing industries, services, and entertainment globally.

Module – 1

Introduction

Preliminary considerations, Cost of development, Importance of mobile Strategies in the business world and Effective use of screen real estate.

Understanding MobileApplications

Understanding mobile applications users, Understanding mobile information design, Understanding mobile platforms, Using the tools of mobile interface design.

(08 Hours)

Module – 2

Getting Started with Android Programming

What is Android, Obtaining the required tools, Anatomy of an android application, Components of android applications, Activities, and Fragments, Utilizing the action bar.

(08 Hours)

Module – 3

Android UI Design and Location Based Services

Views and view groups, Basic views, Fragments, Displaying maps, Getting location data, Publishing for publishing, Deploying APK Files.

(08 Hours)

Module – 4

Android Messaging and Networking

SMS Messaging, Sending Email, Networking, Downloading binary data, Text files, Accessing web services, Performing asynchronous call, Creating your own services, Communicating between a service and an activity, Binding, Activities to services.

(08 Hours)

Module – 5
Flutter Installation on windows, Architecture of flutter application, Introduction to DART programming, Widgets and layouts, State management, Writing android specific code. (08 Hours)
Course outcomes: The students will be able to: CO1: Analyse the features of mobile devices. CO2: Implement views, intents, fragments and graphics in application development. CO3: Build an application using Internal and external database. CO4: Design an application with image capturing and location-based services. CO5: Develop a mobile application based on societal and environmental issues.
CIE: • 60% of CIE is based on Internal Assessment Tests. • 40% of CIE is based on Alternate Assessment Methods.
SEE: • SEE will be conducted for 100 marks.
Text Books: 1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 1st Edition, 2012, ISBN: 978-1-118-20390-3. 2. Wei-Meng Lee, "Beginning Android Application Development", Wiley 2011. 3. Flutter – Tutorials Point, Tutorials Point (I) Pvt. Ltd – 2019. **References:** 1. Reto Meier, "Professional Android 4 Application Development", Wrox Publications 2012.
Alternate Assessment Tools (AATs) suggested: 1. Mobile Application Development on Societal/Environmental issues using Android Studio. 2. Mobile Application Development on Management issues using Flutter framework.
Web links/e-resources: 1. https://flutter.dev/docs 2. https://developer.android.com/ 3. https://reactnative.dev/docs/getting-started 4. https://www.udemy.com/ 5. https://www.freecodecamp.org/

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Cloud Computing

Course Code	MMCA24	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Explore basics of Cloud.
2. Know the purpose of various cloud services and their limitations.
3. Understand various services provided by different cloud service providers.
4. Differentiate between various service models and deployment models.
5. Deploy applications using AWS.

Preamble: Cloud is further extension of Distributed computing. Cloud provides us so many services that can be accessed via web. It has become an indispensable part of our lives. From entertainment to programming to storage, cloud is very critical in today's world.

Module – 1

Introduction: Implication and Scope of Cloud Computing concepts and its Importance in Economic growth of Nation, Impact of the course on Societal Problems / Sustainable Solutions / National Economy, Career Perspective, Overview of the course in current Innovations and Research Trends.

Cloud Computing Basics: Distributed System Models and Enabling Technologies - Scalable Computing Service over the Internet, System Models for Distributed and Cloud Computing, Performance, Security and Energy efficiency.

(08 Hours)

Module – 2

Virtualization: Implementation levels of Virtualization, Virtualization structure/tools and mechanisms: Hypervisor and Xen architecture, Binary translation with full virtualization, Para virtualization with compiler support, Live VM migration steps.

Cloud computing architecture: Cloud computing and Service models: IaaS, PaaS, SaaS

(08 hours)

Module – 3

Data Center design and inter-connection networks: Warehouse-scale data center, modular data centers

Cloud Deployment models: Public, private and hybrid clouds, examples.

Cloud security: Cloud security defence strategies, Distributed intrusion/anomaly detection

(08 hours)

Module – 4

Cloud Implementations:

Programming support of GAE: Programming the GAE, Google file system(GFS), BigTable, Google's NoSQL system.

AWS: Creating an EC2 instance using AWS, hosting a web application, S3 storage service, lambda service, Autoscaling.
Azure Cloud: architecture, storage, infrastructure and compute services.

(08 hours)

Module – 5

Emerging Software Cloud Environments: Open source Eucalyptus and Nimbus
Applications of Cloud: Healthcare, business, social media applications.
Case study: Salesforce Cloud

(08 hours)

Course outcomes:
The students will be able to:
CO1: Analyse Cloud Computing's enabling technologies and environments.
CO2: Evaluate various Cloud service models and their providers.
CO3: Analyse various Cloud deployment models.
CO4: Deploy applications on AWS Cloud platform.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Kai Hwang, Geoffrey C. Fox. Jack J Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", MK Publishers, 2012.

References:

1. Judith Hurwitz, R.Bloor, M. Kanfman, F.Halper , "Cloud Computing for Dummies" (Wiley India Edition).
2. J.Vette, Toby J. Vette, Robert Elsenpeter, "Cloud Computing: A Practical Approach", (Tata McGraw Hill).

Alternate Assessment Tools (AATs) suggested:

1. Deploy any project using EC2 and demonstrate its execution using AWS.
2. Explain the role of Cloud in DevOps. Illustrate the use of commonly used cloud services with the help of an example.

Web links/e-resources:

1. https://aws.amazon.com (Module 4)
2. https://portal.azure.com (Module 4)
3. https://cloud.google.com (Module 4)

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
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SEMESTER – II

Computer Networks

Course Code	MMCA25	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:
This course will enable the students to
1. Learn the Basic concepts of Computer Networking.
2. Understand the concepts of OSI and TCP/IP model.
3. Describe the functions of Physical and Data Link layers.
4. Describe the functions of Network and Transport layers.
5. Demonstrate the TCP/IP sockets in UNIX operating System.

Preamble: Computer networks are systems that connect multiple computing devices to share resources, data, and communication across physical or digital distances. They form the backbone of modern digital communication, enabling everything from personal emails to large-scale data transfers and cloud computing. Computer networks allow for resource sharing, internet access, collaborative working, and global connectivity, making them essential in both personal and organizational environments.

Module – 1

Introduction
Networks, protocols and standards, Layered tasks, The OSI model, Layers in the OSI model, TCP/IP protocol suite, Addressing.

(08 Hours)

Module – 2

Physical Layer and Media
Periodic analog signals, Digital signals, Transmission impairment, Data rate limits, performance, Transmission media.

Data Link Layer
Error detection and Correction, Data link control, Multiple access.

(08 Hours)

Module – 3

Network Layer
Logical addressing, Internet protocol, Address Mapping, Error reporting and Multicasting, Delivery forwarding and Routing.

(08 Hours)

Module – 4

Transport Layer
Process-to-Process Delivery, UDP, TCP and SCTP, Congestion control and Quality of service.

(08 Hours)

Module – 5

Application Layer

Domain name system, Distribution of name space, DNS in the Internet, Resolution, DNS messages.

Linux Networking

Elementary TCP sockets, TCP client/server example.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Analyze the basic concepts of computer networking
CO2: Demonstrate OSI reference model and TCP/IP model
CO3: Apply the working of network protocols for given use case.
CO4: Implement key networking concepts using appropriate tools.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Forouzan, "Data Communications and Networking 5E", McGraw Hill Education.
2. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, "UNIX Network Programming",Volume 1, 3rd Edition, PHI Learning Publication, 2010.

References:

1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Publication, 2011
2. Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", Version 6.2, MK Publication.

Alternate Assessment Tools (AATs) suggested:

1. Implementation of Computer Network concepts using Java/Python

Web links/e-resources:

1. https://www.geeksforgeeks.org/network-configuration-trouble-shooting-commands-linux/
2. https://www.javatpoint.com/java-networking
3. https://www.coursera.org/courses?query=computer%20networks
4. https://www.edx.org/learn/computer-networking
5. https://www.udemy.com/topic/computer-networking/
6. https://www.youtube.com/c/Freecodecamp

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Cyber Security

Course Code	**MMCA261**	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Familiarize cybercrime terminologies and perspectives.
2. Understand Cyber Offenses and Botnets.
3. Gain knowledge on tools and methods used in cybercrimes.
4. Understand phishing and computer forensics

Preamble: The course outlines the purpose, scope, and guiding principles of a cybersecurity policy or strategy. It establishes the context for why the policy is needed, what it aims to protect, and who it applies to. Career paths include Cyber security specialist, information security analyst and Chief Information Security Officer (CISO). The field has high demand and growth prospects, roughly 32% annual growth rate. Average salaries range from 10K dollars to 20K dollars per year.

Module – 1

Introduction to Cybercrime

Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws, Global Perspectives.

(08 Hours)

Module – 2

Cyber Offenses

How Criminals Plan Them: Introduction, How criminals plan the attacks, Social Engineering, Cyber Stalking, Cybersafe & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector.

(08 Hours)

Module – 3

Tools and Methods used in Cybercrime

Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyware, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attacks, Attacks on Wireless networks.

(08 Hours)

Module – 4

Phishing and Identity Theft

Introduction, Phishing: methods of phishing, phishing techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft.

(08 Hours)

Module – 5

Understanding Computer Forensics

Introduction, Historical Background of Cyber forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, Network Forensics.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Classify Cybercrime types from multiple perspectives
CO2: Analyse various Cyber offenses and Botnets
CO3: Examine tools and techniques used in Cybercrime
CO4: Evaluate the need for computer forensics by interpreting digital evidence

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Book:

1. "Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, First Edition (Reprinted 2018)

References:

1. Donaldson, S., Siegel, S., Williams, C.K., and Aslam, A. (2015). —Enterprise Cyber security -How to Build a Successful Cyber defense Program against Advanced Threat, Apress, 1st Edition.
2. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.

Alternate Assessment Tools (AATs) suggested:

- Illustration of standard case studies of cyber crime

Web links/e-resources:

- https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_
- https://www.youtube.com/playlist?list=PL_uaeekrhGzJlB8XQBxU3z__hDwT95xlk
- https://www.youtube.com/watch?v=vWD8W5elegQ&t=9s

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Robotic Process Automation (RPA)

Course Code	MMCA262	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Gain a clear understanding of RPA and benefits, understanding the limits and constraints of automation.
2. Understand the basic Automation components, features and technology.
3. Acquire the knowledge on purpose and use of the control centre.
4. Understand the various use cases and write bots.

Preamble: Robotic process automation (RPA) is a form of business process automation technology based on metaphorical software robots or on artificial intelligence /digital workers. It is sometimes referred to as software robotics. RPA involves the use of software that mimics human actions while interacting with applications in a computer and accomplishing rule-based tasks. This often requires reading from and typing or clicking on existing applications that are used to perform the given tasks.

Module – 1

RPA Foundations

What is RPA? Flavors of RPA, The Benefits of RPA- The downsides of RPA, RPA Compared to BPO, BPM and BPA, Consumer Willingness for Automation, The Workforce of the Future.

RPA Skills

On-Premise Vs. the Cloud, Web Technology, Programming Languages and Low Code, OCR, Databases, APls, Al, Cognitive Automation, Agile, Scrum, Kanban and Waterfall, DevOps, Flowcharts.

(08 Hours)

Module – 2

Components of RPA

RPA Platforms, About UiPath, The future of automation.

Record and Play

UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder.

(8 Hours)

Module – 3

Sequence, Flowchart, and Control Flow

Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow**.**

Data Manipulation

Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example).

(8 Hours)

Module – 4

Taking Control of the Controls

Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR? Types of OCR available, How to use OCR?, Avoiding typical failure points.

(8 Hours)

Module – 5

Exception Handling, Debugging, and Logging

Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting.

(8 Hours)

Course outcomes:

The students will be able to:

CO1: Analyse the problem to understand the scope and extent of process automation.
CO2: Apply the robotic process automation knowledge to automate operations.
CO3: Implement exception handling and automation strategies in real time applications.
CO4: Interpret various aspects of debugging in RPA applications.
CO5: Develop basic robots using UiPath Community Edition.

CIE

- 60% of CIE is based on Internal Assessment Tests.
- 40% of CIE is based on Alternative Assessment Methods.

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, 2020, ISBN-13 (electronic):978-7-4842-5729-6, Publisher: A press.
2. Alok Mani Tripathi, Learning Robotic Process Automation, Packt, 1st Edition, 2018.

References:

1. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and Their Benefits, CreateSpace Independent Publishing Platform, 2018.

Alternate Assessment Tools (AATs) suggested:

1. Develop a bot that can fetch details about IBM Laptop prices from Flipkart website.
2. Bring out the pros and cons of any two RPA tools and their applications.

Web links/e-resources:

1. https://www.uipath.com/

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Big Data Analytics

Course Code	MMCA263	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand the basics of analytics process model and its requirements.
2. Solve any given analytics problem by applying various algorithms for handling large volumes of data.
3. Understand the HDFS architecture and Map-Reduce techniques for solving the big data problems.
4. Explore Spark architecture and its APIs.
5. Explore advanced big data analytics concepts.

Preamble: The Big Data Analytics course teaches students key skills for analysing large datasets and understanding the entire data analytics process. With real-time applications in sectors like IT, healthcare, and marketing, the course emphasizes the growing demand for professionals who can derive actionable insights from big data. Graduates will be well-prepared for dynamic career opportunities, ready to tackle real-world challenges in data analytics.

Module – 1

Big Data and Analytics

Example applications, Basic nomenclature, Analysis Process Model, Analytical model requirements, Types of data sources, Sampling, Types of data elements, Data exploration, Exploratory statistical analysis, Missing values, Outlier detection and Treatment, Standardizing data labels, Categorization.

(08 Hours)

Module – 2

Descriptive Analytics and Data Processing

Overview of predictive and descriptive analytics, Basic descriptive analytics concepts, Association rules and Sequence rules, Segmentation techniques, Handling large-scale data.

(08 Hours)

Module – 3

The Hadoop Distributed File System (HDFS)

The Design of HDFS, HDFS architecture, HDFS concepts, Blocks, Namenodes and Datanodes, HDFS federation, HDFS high-availability.

File Operations

Anatomy of a file read, Anatomy of a file write.

MapReduce Framework

Using a sample dataset (Weather Data), Map and reduce functions, Data flow, Scaling out, Java MapReduce, Combiner functions, Input splits, Configuration files and Running distributed jobs on a cluster.

(08 Hours)

Module – 4

Introduction to Apache Spark

Spark's Architecture, Language APIs, Data frames, Partitions, Lazy evaluation, Spark's toolset, Structured API execution, Key transformations and actions.

(08 Hours)

Module – 5

Programming Hive

Hive in the Hadoop Ecosystem, Data Types and File Formats, HiveQL: Data Definition, Databases in Hive, Alter Database, Creating Tables, External Tables, Partitioned Tables, External Partitioned Tables, Dropping Tables, Alter Tables, HiveQL: Data Manipulation, Queries (till GROUP BY Clauses).

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Apply Bigdata analytics to real-world use cases.
CO2: Analyse datasets using descriptive/ predictive techniques
CO3: Demonstrate distributed data processing using Hadoop components
CO4: Design Hive queries for any given datasets.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications" Wiley.
2. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'reilly, 2012.
3. Bill Chambers, Matei Zaharia, "Spark: The Definitive Guide", O'reilly, 2018.
4. Jason R, Dean W, Edward C, "Programming Hive", O'reilly, 2012.

References:

1. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley.
2. Chris Eaton, Dirk Deroos et al., "Understanding Big data", McGraw Hill, 2012.

Alternate Assessment Tools (AATs) suggested:

1. Case study on analyzing a dataset using exploratory data analysis techniques.
2. Hands-on assignments where students apply segmentation techniques on dataset provided.

Web links/e-resources:

1. https://www.youtube.com/live/XueP_cx_rqg?si=PLRXLywCTRtr24mk
2. https://youtu.be/zez2Tv-bcXY?si=Qg96qLtwRO7QQ9Wb

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Blockchain Technology

Course Code	MMCA264	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable students to

1. Understand the fundamentals of Blockchain and Bitcoin
2. Differentiate variants of Blockchain and Cryptocurrencies
3. Apply complex methods in Blockchain for privacy and conflict resolution
4. Implement the key concepts of Bitcoin
5. Design smart contracts in real-time applications

Preamble: Securing the transactions and eliminating the third-party involvement in financial transactions is gaining importance and Blockchain technology will provide lots of use cases in multiple domains like banking, healthcare etc. Blockchain expertise will provide good career growth as businesses turn to implementation of Blockchain technology for secure transactions.

Module – 1

Introduction

Introduction to Blockchain, How Blockchain works, Blockchain vs Bitcoin, Practical applications, Public and private key basics, Pros and cons of Blockchain, Myths about Bitcoin. (08 Hours)

Module – 2

Architecture

Blockchain: Architecture, versions, variants, use cases, Life use cases of blockchain, Blockchain vs shared Database, Introduction to cryptocurrencies, Types, Applications. (08 Hours)

Module – 3

Hashing in Blockchain

Concept of Double Spending, Hashing, Mining, Proof of work.
Introduction to Merkel tree, Privacy, payment verification, Resolving Conflicts, Creation of Blocks. (08 Hours)

Module – 4

Bitcoin concepts

Introduction to Bitcoin, key concepts of Bitcoin, Merits and De Merits Fork and Segwits, Sending and Receiving bitcoins, Choosing bitcoin wallet, Converting Bitcoins to Fiat Currency. (08 Hours)

Module – 5

Smart Contract

Introduction to Smart contracts, usage, Application, working principle, Laws and Regulations, Introduction to Ethereum, Advantages and Disadvantages, Ethereum vs Bitcoin, Case Studies (08 Hours)

Course outcomes:

The students will be able to:

CO1: Articulate the significance of Blockchain features.

CO2: Analyse the Blockchain Architecture for various use cases.

CO3: Demonstrate the working of cryptocurrency networks.

CO4: Apply the design features of smart contracts in various domains.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Textbooks:

1. Bikramaditya Singhal , Gautam Dhameja, "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", APress
2. Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands-On Approach", APress

References:

1. Melanie Swan, "Blockchain", Oreilly
2. Arthu.T, "Bitcoin and Blockchain Basics: A non-technical introduction for beginners"
3. Aravind Narayan. Joseph Bonneau, "Bitcoin and Cryptocurrency Technologies", Princeton

Alternate Assessment Tools (AATs) suggested:

1. Case studies on public, private and hybrid blockchain
2. Creation of Cryptocurrency wallet

Web links/e-resources:

1. https://builtin.com/blockchain/blockchain-applications
2. Smart Contracts - https://www.youtube.com/watch?v=wT6Qa_kxM6Y

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Software Quality Assurance

Course Code	MMCA265	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Differentiate the various testing techniques.
2. Analyse the problem and derive suitable test cases.
3. Apply suitable technique for designing of flow graph.
4. Explain the need for planning and monitoring a process

Preamble: Software Testing is one of the critical aspect of software development life cycle. It deals with verification and validation of a software. Any software before its release, has to undergo rigorous testing process. Testing individual components and testing an entire system is equally important to ensure the correctness. A combination of techniques is used to test a software system. Specialized testing teams will carry-out the testing process.

Module – 1

Basics of Software Testing

Humans, Errors and Testing, Software Quality; Requirements, Behavior and Correctness, Correctness Vs Reliability; Testing and Debugging; Test Metrics; Software and Hardware Testing; Testing and Verification.

Basic Principles, Test case selection

Defect Management; Execution History; Test Generation Strategies; Static Testing; Test Generation from Predicates. Sensitivity, Redundancy, Restriction, Partition, Visibility and Feedback, Test Specification and cases, Adequacy Criteria.

(08 Hours)

Module – 2

A perspective on Testing

Basic definitions, Test cases, Insights from a Venn diagram, identifying test cases, Error and fault taxonomies, Level of testing, Examples: Generalized pseudo code, The triangle problem, the Next Date function, The commission problem, The SATM (Simple Automation Teller Machine) problem, The currency converter.

(08 Hours)

Module – 3

Boundary value testing, Equivalence class testing, Decision table based testing

Boundary value analysis, Robustness testing, Worst-case testing, special value testing, Examples, Random testing, Equivalence classes, Equivalence test cases for triangle problem, Next Date function and commission problem, Guidelines and observations, Decision tables, Test cases for triangle problem.

(08 Hours)

Module – 4

Path Testing, Data flow testing, Levels of Testing, Integration Testing

DD Paths, Test coverage metrics Basis path testing, Guidelines and observations, Definition Use testing, Traditional view of testing levels, Alternative life cycle models, Separating integration and system testing.

(08 Hours)

Module – 5

Fault Based Testing, Planning and Monitoring the Process, Documenting Analysis and Test

Assumptions in fault-based testing, Mutation Analysis, Fault-based Adequacy Criteria; Variations on mutation Analysis; From Test case specification to Test Cases, Scaffolding, Generic vs. specific Scaffolding, Test Oracles, Self-checks as oracles, Capture and Replay. Quality and Process, Test and Analysis strategies and plans, Test strategy document, Analysis and test plan, Test and analysis reports.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Demonstrate the phases of Software testing life cycle.
CO2: Differentiate between various Testing types.
CO3: Design test cases for any given use case.
CO4: Evaluate the software application using suitable testing tools.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 3rd Edition, Auerbach Publications, 2008.
2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, Wiley India, 2009.
3. Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008.

References:

1. Software testing Principles and Practices – Gopalaswamy Ramesh, Srinivasan Desikan, 2nd Edition, Pearson, 2007.
2. Software Testing – Ron Patton, 2nd edition, Pearson Education, 2004.
3. The Craft of Software Testing – Brian Marrick, Pearson Education, 1995.
4. Anirban Basu, Software Quality Assurance, Testing and Metrics, PHI, 2015.
5. Naresh Chauhan, Software Testing, Oxford University press.

Alternate Assessment Tools (AATs) suggested:

1. Take a mini project and write a test cases.
2. Take BMSIT Department of MCA page find error, faculty in it.

Web links/e-resources:

1. https://www.cypress.io/
2. https://www.selenium.dev/
3. https://www.istqb.org/
4. https://www.ministryoftesting.com/

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Machine Learning Lab

Course Code	MMCAL27	CIE Marks	50
Contact Hours (L:T:P)	0:0:2	SEE Marks	50
Total Number of Lecture Hours	28P	Exam Hours	3

Credits: 01

Course objectives:
This course will enable the students to

1. Understand the basic theory underlying machine learning.
2. Formulate machine learning problems corresponding to different applications.
3. Explore a range of machine learning algorithms along with their pros and cons.
4. Apply machine learning algorithms to solve problems of moderate complexity.
5. Optimize the models learnt and report on the expected accuracy achieved.

Sl.No.	Experiments
1.	**Web Scraping** – A method to obtain large amounts of data from websites. Most of this data is unstructured data in an HTML format which is then converted into structured data in a spreadsheet or a database so that it can be used in various applications. Beautiful Soup is a Python web scraping library that allows us to parse and scrape HTML and XML pages and prepare the dataset in the .csv format.
2.	**Data Pre-processing** - Process of cleaning, organizing, and transforming raw data before it is used for analysis or modeling. Pre-processing tasks to be included are removing incorrect or irrelevant data, handling missing values, smoothing noisy data, data transformation and data reduction.
3.	**Linear Regression** - A type of supervised machine learning algorithm that computes the linear relationship between the dependent variable and one or more independent features by fitting a linear equation to observed data. Simple Linear Regression and Multiple Linear Regression will be covered.
4.	K-NN Algorithm
5.	SVM Algorithm
6.	Naïve-Bayes Classifier
7.	Bagging Methods
8.	Boosting Methods

Course outcomes:
The students will be able to:
CO1: Analyze the various learning models.
CO2: Apply machine learning algorithms for the given problems.
CO3: Build an appropriate learning model for a given data set.
CO4: Perform statistical and probabilistic analysis of machine learning techniques.
CO5: Evaluate machine learning algorithms on various data sets.

CIE:

- 60% of CIE is based on Cumulative assessment of laboratory program execution.

• 40% of CIE is based on IA Test and Alternate Assessment Method.
SEE: • SEE will be conducted for 100 marks.
Alternate Assessment Tools (AATs) suggested: • Application of ML algorithms on any data set

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BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Mobile Application Development Lab

Course Code	MMCAL28	CIE Marks	50
Contact Hours (L:T:P)	0:0:2	SEE Marks	50
Total Number of Lecture Hours	28P	Exam Hours	3

Credits: 01

Course objectives:
This course will enable the students to

1. Understand the preliminary requirements to build mobile applications.
2. Design the GUI based activity screens using one of the tools of mobile application.
3. Analyse the flows of activities of mobile applications.
4. Apply the technologies to create mobile adaptive web applications.
5. Implement Test Builds using one of the marketing tools of mobile.

Sl.No.	Experiments
1	Views
2	Activities
3	Fragments
4	Intents
5	Graphics & Media
6	Internal & External Database
7	SMS Messaging
8	Image capturing and Location based applications

Course outcomes:
The students will be able to:

CO1: Analyze the features of mobile devices.
CO2: Design applications using Android components.
CO3: Develop mobile based application using database.
CO4: Design an application using image capturing and location details.
CO5: Create a mobile application for any given use case.

CIE:

- 60% of CIE is based on Cumulative assessment of laboratory program execution.
- 40% of CIE is based on IA Test and Alternate Assessment Method.

SEE:

- SEE will be conducted for 100 marks.

Alternate Assessment Tools (AATs) suggested:

- Design a Mobile application to track location on google maps.
- Design a Mobile application to capture image and store in mobile memory.

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – II

Communication and Soft Skills 2

Course Code	MMCAL29	CIE Marks	-
Contact Hours (L:T:P)	0:0:2	SEE Marks	-
Total Number of Lecture Hours	26P	Exam Hours	-

Credits: 0

Course objectives:

This course will enable students to

1. Identify the Common Errors in Writing and Speaking of English.
2. Achieve better technical writing and Presentation skills for employment.
3. Acquire Employment and Workplace communication skills.
4. Enhance their conversation and public speaking skills.

Module – 1

Advanced Vocabulary

Introduction, learning through speeches, Descriptions, Word formation, Synonyms, Antonyms, learning words through situations, Homonyms and Homophones, Words often confused, One word substitution, Phrasal verbs, Idiomatic expressions, Developing technical vocabulary, Eponyms

Jumbled sentences: Introduction, Steps to approach jumbled sentences, Unscrambling a paragraph.

(04 Hours)

Module – 2

Technical Reports and Proposals

Introduction, Definition, Salient Features, Significance, Types, Use of Graphic Aids/Illustrations, Preparation and Planning, Data Collection, Analyzing and Organizing the Data, Writing and Revising, Preparing an Outline, Structure of Formal Reports, Styles of Reports, Preparing a Checklist, Sample Reports, Technical Proposals - Purpose, Importance, Types and Structure.

(04 Hours)

Module – 3

Technical Writing Skills

Email and Other Writings: Introduction, Email Writing- Reasons for Popularity, Some Common Pitfalls, Guiding Principles for Composition, Maintaining Common Etiquette.

Itinerary Writing, Inter-office Memorandum (Memos), Circulars, Notice, Agenda, and Minutes, Writing Instructions, Advertising.

Blogs and Reviews: Introduction, Movie Review, Book Review, Blog Writing

(06 Hours)

Module – 4

Professional Speaking Practices

Conversations, Dialogues and Debates: Introduction, Purpose of General Conversations, Features of a Good Conversation, Tips for Improving Conversations, Short Conversations, Telephonic Skills, Debate, Situational Dialogues and Role Plays.

The Art of Negotiation: Introduction, Definition, Different Types of Negotiation Styles, Tips for Win-Win Negotiation.

(06 Hours)

Module – 5

Communication in Workplace

Public Speaking: Introduction, choosing an appropriate pattern, selecting an appropriate method, Art of Persuasion, making speeches interesting, Delivering different types of speeches.

Group Discussion: Introduction, Definition, Difference between GD and debate, Number and duration, Personality traits to be evaluated, Dynamics of Group Behaviors/Group Etiquette and mannerisms, Type, opening of a GD, summarizing a discussion, Some tips for GD

Job Interviews: Introduction, Definition, Process, Stages of Interview, Types, Desirable Qualities, Preparation, Using Proper Verbal and Non-verbal Clues, Exhibiting Confidence, Tips for Success**.**

(06 Hours)

Course outcomes:

The students will be able to:

CO1: Understand and identify the Common Errors in Writing and Speaking.

CO2: Enhance Technical Writing and Presentation skills.

CO3: Exhibit Employment and Workplace communication skills.

CO4: Analyze and apply various Techniques of Information Transfer through presentation in different levels

Textbooks

1. "Professional Writing Skills in English" published by Fillip Learning – Education (ILS), Bangalore – 2022.
2. "Functional English" (As per AICTE 2018 Model Curriculum) (ISBN-978-93-5350-047-4) Cengage learning India Pvt Limited [Latest Edition 2019]

References

1. Gajendra Singh Chauhan, Technical Communication, Cengage Learning India Pvt Limited, Latest Revised Edition, 2019.
2. N.P. Sudharshana and C. Savitha, English for Engineers, Cambridge University Press, 2018.
3. Meenakshi Raman and Sangeetha Sharma, Technical Communication – Principles and Practice, Oxford University Press, Third Edition 2017.

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Business Analytics

Course Code	MMCA3A1	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Explore the fundamental concepts of business analytics, including descriptive, predictive, and prescriptive techniques.
2. Develop proficiency in using analytics tools and visualization platforms for data analysis.
3. Apply statistical and machine learning methods to real-world business problems.
4. Enable data-driven decision-making by interpreting analytical results and presenting insights effectively to stakeholders.

Preamble: Business Analytics helps in making smart decisions using data. It combines statistics, data tools, and business knowledge to solve real-world problems. It equips with the techniques to collect, analyse, and interpret data to improve business outcomes. By the end of the course, learners will be able to use analytics to support decision-making in any industry.

Module – 1

Introduction: Data Analytic Thinking

The Ubiquity of Data Opportunities, Data Science, Engineering, and Data-Driven Decision Making, Data Mining and Data Science

Business Problems and Data Science Solutions

From Business Problems to Data Mining Tasks, Supervised Versus Unsupervised Methods, The Data Mining Process, Implications of Managing the Data Science Team, Analytics Techniques and Technologies, Answering Business Questions with these Techniques (08 Hours)

Module – 2

Introduction to Predictive Modelling

Fundamental Concepts and Exemplary Techniques, Models, Induction and Prediction, Supervised Segmentation, Visualizing Segmentations, Tress as Sets of Rules, Probability Estimation

Fitting a Model to Data

Classification via Mathematical Functions, Regression via Mathematical Functions, Class Probability Estimation and Logistic Regression, Nonlinear Functions, Support Vector Machines, and Neural Networks (08 Hours)

Module – 3

Overfitting and its Avoidance

Generalization, Overfitting, From Holdout Evaluation to Cross-Validation, The Churn Dataset, Learning Curves, Overfitting Avoidance and Complexity Control

Similarity, Neighbours, and Clusters

Similarity and Distance, Nearest-Neighbour Reasoning, Technical Details, Clustering, Solving a Business Problem Versus Data Exploration (08 Hours)

Module – 4

Decision Analytic Thinking I:
What is a Good Model? Evaluating Classifiers, Generalizing beyond Classification, A Key Analytical Framework: Expected value, Evaluation, Baseline Performance, and Implications for Investments in Data

Visualizing Model Performance
Ranking instead of Classifying, Profit Curves, ROC Graphs and Curves, The Area under ROC Curve (AUC), Cumulative Response and Lift Curves, Performance Analytics for Churn Modelling

Evidence and Probabilities
Combining Evidence Probabilistically, Applying Bayes' Rule to Data Science, A Model of Evidence Lift, Targeting Consumers with Ads (08 Hours)

Module – 5

Representing and Mining Text
Why Text is important? Representation, Beyond Bag of Words, Mining New Stories to Predict Stock Price Movement

Decision Analytics Thinking II: Towards Analytical Thinking
Targeting the Best Prospects for a Charity Mailing, Churn Example Revisited

Other Data Science Tasks and Techniques
Co-occurrences and Associations: Finding Items that Go Together, Profiling, Link Prediction and Social Recommendation, Data Reduction, Latent Information, and Movie Recommendation, Bias, Variance and Ensemble Methods, Data-Driven Causal Explanation and a Viral Marketing Example (08 Hours)

Course Outcomes:
The students will be able to:
CO1: Demonstrate the key concepts, tools, and types of analytics used in business decision-making.
CO2: Analyse real-world datasets to uncover patterns, trends, and insights for various business functions.
CO3: Apply statistical and analytical techniques to solve structured business problems using data.
CO4: Evaluate and communicate data-driven solutions to business challenges through visualizations and reports.

CIE:
- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:
- SEE will be conducted for 100 marks.

Text Book:
1. "Data Science for Business", Foster Provost & Tom Fawcett, O'Reilly, 2013

References:
1. "Business Analytics: Principles, Concepts and Applications", Marc J. Schniederjans, Data G S, Christopher M S, 2022, Pearson Education
2. "Business Analytics for Beginners", Lorraine H. Hawkins, First Edition, 2023

Alternate Assessment Tools (AATs) suggested:
- Case study on Airbnb
- Case study on Evanstone Hospitals

Web links/e-resources:
1. Business Analytics in Action: https://online.hbs.edu/blog/post/business-analytics-

examples
2. Business Analytics Case Studies: https://www.business-analysis.com.au/case-studies/

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Natural Language Processing

Course Code	MMCA3A2	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Learn the importance of natural language modelling
2. Understand the applications of natural language processing
3. Study spelling, error detection and correction methods and parsing techniques in NLP
4. Illustrate the information retrieval models in natural language processing.

Preamble: Natural Language Processing (NLP) is a subfield of Artificial Intelligence that focuses on the interaction between computers and human languages. It enables machines to read, understand, interpret, and generate human language in a valuable and meaningful way. With the rapid growth of digital data and the increasing need for automation in communication, NLP has become an essential tool for a wide range of applications including sentiment analysis, chatbots, machine translation, text summarization, and voice recognition.

Module – 1

Language Modelling: Introduction to Natural Language Processing, Language and Knowledge, Language and Grammar, NLP Applications, Various Grammar-based Language Models, Statistical Language Model. (08 Hours)

Module – 2

Word Level Analysis: Introduction, Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of-Speech Tagging. (08 Hours)

Module – 3

Syntactic Analysis: Introduction, Context-Free Grammar, Contents, Constituency, Parsing, Probabilistic Parsing, Indian Languages. (08 Hours)

Module – 4

Semantic Analysis: Introduction, Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation. (08 Hours)

Module – 5

Machine Translation: Problems in Machine Translation, Machine Translation Approaches, Direct Machine Translation, Rule-based Machine Translation, Corpus-based Machine Translation, Semantic or Knowledge-based MT systems. (08 Hours)

Course Outcomes:

The students will be able to:

CO1: Analyze the structure of natural language using grammar-based and statistical language models.

CO2: Apply word-level analysis techniques to process and extract linguistic information from text.

CO3: Evaluate syntactic structures of sentences using context-free grammar and parsing techniques.

CO4: Perform word sense disambiguation for accurate interpretation of natural language texts.

CO5: Implement basic translation models to address language translation challenges.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Tanveer Siddiqui and U.S Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2021.

References:

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

Alternate Assessment Tools (AATs):

- Generate n-grams (unigram, bigram, trigram) from a given text.
- Part-of-speech tagging using NLTK and spaCy.
- Implement regular expression patterns to find phone numbers, emails, or dates in text.
- Parse a basic sentence in an Indian language using spaCy or rule-based grammar.

Web links/e-resources for additional learning:

1. Hugging Face Transformers, https://huggingface.co/transformers/
2. NLP Specialization, https://www.coursera.org/specializations/natural-language-processing

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Data Engineering

Course Code	MMCA3A3	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand the core concepts of data ingestion, transformation, and storage across various data systems.
2. Develop skills to manage the data engineering life cycle and design good architecture.
3. Explore various data storage and ingestion techniques.
4. Equip students with the skills to design and implement efficient data transformation workflows through querying, modeling, and serving strategies.
5. Build a thorough understanding of security principles and privacy-preserving techniques in data engineering systems.

Preamble: Data Engineering is essential for building scalable systems that collect, transform, store, and manage large volumes of data efficiently. This course introduces students to modern technologies for developing reliable data pipelines and architectures. Learners will gain the foundational expertise required to support data analytics, machine learning, and business intelligence applications.

Module – 1

Data Engineering Described: Definition, Skills and Activities, Data Engineers in an organization.

Data Engineering Life Cycle: Generation, Major Undercurrents.

Designing Good Data Architecture: Definition, Principles, Major Concepts, Examples and Types. (08 Hours)

Module – 2

Choosing Technologies Across the Data Engineering Lifecycle: Team Size and Capabilities, Speed to Market, Interoperability etc., Undercurrents impacting the technology choices.

Data Generation in Source Systems: Sources of Data, Source Systems, Practical details, Undercurrents impacting source systems. (08 Hours)

Module – 3

Storage: Raw ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Big Ideas and Trends in Storage, Undercurrents.

Ingestion: Key Engineering Considerations, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data, Undercurrents. (08 Hours)

Module – 4

Queries, Modelling, and Transformation: Queries, Data Modelling, Transformations, Undercurrents

Serving Data for Analytics, Machine Learning, and Reverse ETL: General Considerations, Analytics, Machine Learning, Ways to Serve Data for Analytics and ML, Reverse ETL, Undercurrents. (08 Hours)

Module – 5

Security and Privacy: People, Processes - Active Security, The Principle of Least Privilege, An Example Security Policy etc., Technology – Patch and Update Systems, Encryption, Security for Low-Level Data Engineering.

Future of Data Engineering: Rise of Easy-to-Use Data Tools, Cloud-Scale Data OS and Improved Operability, Live Data Stack. (08 Hours)

Course Outcomes:

The students will be able to:

CO1: Demonstrate the foundational concepts of data engineering systems.

CO2: Apply data ingestion and transformation techniques to build reliable and scalable data pipelines.

CO3: Analyse the suitability of different data modelling and serving strategies for machine learning workloads.

CO4: Evaluate security and privacy requirements in data engineering workflows.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. "Fundamentals of Data Engineering: Plan and Build Robust Data Systems", Joe Reis & Matt Housley, First Edition, 2022, O'Reilly Media, Inc.

References:

1. "Data Engineering with Python", Paul Crickard, 2020, Packt Publishing.

Alternate Assessment Tools (AATs) suggested:

- Build complete data pipeline for a given use case

Web links/e-resources:

1. 7 best data pipeline automation tools: https://www.cdata.com/blog/what-is-a-data-pipeline-tool
2. Data Consolidation: How to merge multiple data sources seamlessly: https://www.cdata.com/blog/data-consolidation
3. An introduction to Data Pipelines: https://www.datacamp.com/tutorial/introduction-to-data-pipelines-for-data-professionals

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Agile Software Development

Course Code	MMCA3B1	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Explore basics of Agile methodology.
2. Learn how Scrum can be implemented.
3. Compare Scrum with other Agile frameworks.
4. Demonstrate Scrum Cycle with a case study.

Preamble: Agile software development is the most widely accepted practice in the software industry to help develop a quality software. Scrum is an Agile method which is ideally suited for development of software in iterative manner.

Module – 1

Software Engineering: Introduction to Software Engineering**,** Attributes of good software, SDLC, Process activities, Process models.

Agile Software Development: Agile methodology frameworks for software Development Scrum Framework: What is Agile software Development? What is Scrum? Why should you choose Scrum? Foundation of Scrum, Pillars of Empiricism, Scrum Values, identifying a Scrum Team; Introducing the Scrum Master; Working with the Product Owner. (08 Hours)

Module – 2

Scrum Events- Scrum Events: Sprint planning, Implementation and review, Getting ready to Sprint; Deciding on the Sprint duration; Setting the Sprint Goal, Defining Done as working and potentially shippable software; Starting the Sprint with Sprint Planning- for the Scrum Master, Product Owner and Developers. Keeping on the right track with the Daily Scrum, Inspecting the product during a Sprint Review, Inspecting the team with the Sprint Retrospective. (08 Hours)

Module – 3

Scrum artifacts- Understanding the value of the Scrum Artifacts, Creating, Managing and refining product backlog; Making a commitment- the Product Goal- Creating backlog items as user stories, Creating Product backlog items as features, Refining the Product Backlog, Creating and Managing the Sprint Backlog; Producing a Product Increment (08 Hours)

Module – 4

Scrum in Action - Planning and Estimating with Scrum: Choosing an Estimation Scale, Creating a Baseline. Playing Planning poker, Estimating backlog items using a Bucket method, Envisioning the product journey with a product roadmap; Sprint Journey: Refining the Product Backlog, learning how to apply order to the product backlog. Scrum master duties for Product Backlog Refinement. Tracking progress with a Scrum Board, Defects in Sprint (08 Hours)

Module – 5

Kanban: What is Kanban, Kanban values, Kanban agendas, foundational principles, describing flow systems**,** Kanban Pull system, When should you use Kanban, Kanban vs Scrum, benefits of Kanban, example Project (08 Hours)

Course Outcomes:

The students will be able to:

CO1: Apply Agile practices in managing real-world projects

CO2: Analyse project scenarios to select the most appropriate Agile framework for optimal delivery of business value

CO3: Assess performance using Agile metrics to ensure project alignment with objectives

CO4: Decide when to use Scrum and Kanban models for different use cases

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Fred Heath, The Professional Scrum Master (PSM I) Guide, Packt Publishing 2021.
2. David J. Anderson, Andy Carmichael, Essential Kanban Condensed, Lean Kanban University Press, 2015-16.
3. Software Engineering, Ian Sommerville, 9th Edition, O' Reilly Media

References:

1. Clinton Keith, Agile Game Development with Scrum, Addison-Wesley Professional, 2020.
2. Susheela Hooda Vandana Mohindru Sood Yashwant Singh, Sandeep Dalal and Manu Sood, Agile Software Development, Trends, Challenges and Applications Wiley Publications,2023.
3. Mike Cohn, Succeeding with Agile: Software Development using Scrum, Addison Wesley, 2010.

Alternate Assessment Tools (AATs) suggested:

- Take a small problem statement and its requirements. Demonstrate how to implement Scrum process for the same, assuming you have team of developers/testers.

Web links/e-resources:

1. What is Scrum? | Scrum.org
2. What is Scrum? Understanding the Agile Framework for Project Management - GeeksforGeeks
3. Four agile ceremonies, demystified | Atlassian (Module 5)

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Object Oriented Analysis and Design

Course Code:	MMCA3B2	CIE Marks	50
Contact Hours(L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand the concepts of objects and modelling.
2. Acquire the knowledge of design principles and apply for the any given real-time problem.
3. Analyse the requirements for the given system.
4. Describe the real-world problem with suitable patterns
5. Implement the design models with the tools.

Preamble: Object-Oriented Analysis and Design equips students with the principles, methodologies, and practices essential for designing robust and maintainable software systems. The course introduces object-oriented concepts such as encapsulation, inheritance, and polymorphism, and emphasizes modeling techniques using UML (Unified Modeling Language). Students gain a deep understanding of analyzing requirements, designing system architecture, and implementing solutions that are scalable and reusable. The course prepares learners to approach complex software development projects with a systematic and structured object-oriented mindset.

Module – 1

Introduction: What is Object Orientation? What is Object Oriented Development? Object Oriented themes, Evidence for usefulness of Object-Oriented Development, Object Oriented Modeling History.

Modeling Concept: Modeling, Abstraction, The three models. (08 Hours)

Module – 2

Class modelling: Object and class Concepts, Link and Association, Generalization and Inheritance, class model, Navigation of class model.

Advanced Class modelling: Advanced object and class concepts, Association ends, N-ary association, Aggregation, abstract classes, Multiple Inheritance, Metadata, Reification, constraints derived Data, Packages. (08 Hours)

Module – 3

State Modeling: Events, states, transition and conditions, state diagrams, state diagram behavior, Nested state diagrams, nested states, signal generalization, concurrency, Sample state model.

Interaction Modeling: Use case models, sequence models, Activity models, use case relationships, procedural sequence models, special constructs for activity models. (08 Hours)

Module – 4

Domain Analysis: overview of analysis, Domain class model, domain state model, domain interaction model, iterating the analysis**.**
Application analysis: Application interaction model, application class model, application state model, adding operations.
Implementation: Overview of Implementation, Fine-Tuning classes, Fine-tuning Generalizations, realizing association, testing. (08 Hours)

Module – 5

Design Patterns: What is Pattern and what makes a pattern? Pattern Categories; Relationships between patterns; Pattern Description. Introduction to Design Pattern, Structural decomposition, Organization of work, Model View Controller; Communication patterns; Forward-Receiver; Client-Dispatcher-server, Publisher-Subscriber; Management Patterns: Command processor; whole-part, Master Slave, ViewHandler. (08 Hours)

Course Outcomes:
The students will be able to:
CO1: Apply the objects-oriented concepts for the given use case.
CO2: Analyze the requirements through modeling.
CO3: Design UML model for any real-time problem.
CO4: Implement patterns for various use cases.

CIE:
- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:
- SEE will be conducted for 100 marks.

Text Books:
1. MichelBlaha, James Rumbaugh: Object-Oriented Modelling and Design with UML, 2nd edition, Pearson, 2007.
2. Frank Bushmann, RegineMeunier, Hans Rohnert, Peter Sommerland, MichaelStal: Pattern-Oriented Software Architecture, A system of Patterns, Volume 1, John Wiley and Sons,2006.

References:
1. GradyBoochetal: Object-Oriented Design with Applications, 3rd Edition, Pearson, 2007.
2. MarkPriestley: Practical Object-Oriented Design with UML, 2nd Edition, Tata Mcgraw-Hill, 2003.

Alternate Assessment Tools (AATs) suggested:
1. Case study questions to analyze the requirements.
2. For the given problem applying design models using tools.

Web links/e-resources:
1. UML Models: https://ieeexplore.ieee.org/document/7474471
2. OOAD and OOP: https://medium.com/@o.khaled6789/object-oriented-analysis-and-design-ooad-5c6e97240444
3. System behavior: https://www.technologyuk.net/software-development/systems-analysis/intro-to-ooad.shtml
4.OOAD and ORM Tools: https://medium.com/@mussarrat.khatoon/object-oriented-analysis-and-design-ooad-and-object-relational-mapping-orm-tools-db018ae5dd3f

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Enterprise Resource Planning

Course Code	MMCA3B3	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:
This course will enable the students to

1. Describe the concept, importance, architecture, and benefits/risks of ERP systems.
2. Analyze key ERP modules—Finance, HR, SCM, CRM, Quality, Production, and Distribution.
3. Evaluate implementation strategies, life-cycle phases, and change management factors.
4. Compare major ERP vendor platforms and emerging trends (cloud, AI, mobile ERP).

Preamble: Enterprise Resource Planning (ERP) systems integrate key business functions into a unified platform to improve efficiency and decision-making. This course introduces ERP concepts, architecture, and core modules (Finance, HR, SCM). It covers implementation strategies, vendor solutions (SAP, Oracle), and emerging technologies like Cloud ERP. Students will develop both theoretical understanding and practical skills in ERP analysis and implementation.

Module – 1

ERP Fundamentals & Related Technologies
Enterprise – An Overview, Introduction to ERP, Basic Concepts, Justifying ERP Investments, Risks, Benefits.
ERP and Related Technologies including BI, E-Business, BPR, Data Warehousing, Data Mining, OLAP, PLM, SCM, CRM, and ERP Security. (08 Hours)

Module – 2

ERP Modules and Functionality
Finance; Manufacturing (Production Planning), Human Resources, Plant Maintenance, Materials Management, Quality Management, Marketing, Sales, Distribution & Service (08 Hours)

Module – 3

ERP Implementation
Decision to go ERP, Implementation Challenges & Strategies, Life Cycle, Pre-implementation & Requirement Definition, Methodologies, Package Selection, Project Teams, Process Definition, Training, Data Migration, Project Management, Post-Implementation, Success and Failure Factors. (08 Hours)

Module – 4

ERP Systems and Market Landscape
ERP Marketplace & Dynamics; Vendor Overviews – SAP, Oracle, PeopleSoft, JD Edwards, QAD, SSA Global, Lawson, Epicor, Intuitive. (08 Hours)

Module – 5

Trends in ERP and Future Scope

Turbo-charging ERP, EAI, ERP & E-Business (ERP-II), TQM linkages, Future Directions and Trends, Focus on Cloud ERP, AI & Analytics, Mobile ERP, Security, Internet Integration and emerging technologies. (08 Hours)

Course Outcomes:

The students will be able to:

CO1: Demonstrate the fundamental concepts, architecture, and components of ERP systems.
CO2: Analyse the feature implications of various ERP systems.
CO3: Implement the core functions of ERP modules.
CO4: Evaluate ERP implementation strategies and their influencing factors.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Book:

1. ERP Demystified by Alexis Leon (TMH)

Reference:

1. Concepts in Enterprise Resource Planning (4th Edition) Author: Bret J. Wagner & C. James Coulter

Alternate Assessment Tools (AATs) suggested:

- **ERP Module Mapping Exercise**

Students map business functions (HR, Sales, Inventory, etc.) to respective ERP modules. Helps visualize how ERP integrates processes across departments.

Web links/e-resources:

- SAP Official Website – Comprehensive resource on SAP ERP modules, implementation, and latest solutions https://www.sap.com
- Oracle ERP Cloud – Overview of Oracle ERP systems, features, and cloud-based solutions: https://www.oracle.com
- ERP.com – General information on ERP systems, vendors, and industry updates: https://www.erp.com
- Open ERP / Odoo Documentation – For understanding open-source ERP systems: https://www.odoo.com/documentation/15.0/

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Augmented and Virtual Reality

Course Code	MMCA3C1	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable students to

1. Learn the fundamentals about ARVR
2. Understand about programming with Unity
3. Describe the design tools for Virtual Reality.
4. Learn the concepts of Augmented Reality.
5. Demonstrate various ARVR case studies and its applications.

Preamble:

Augmented Reality (AR) and Virtual Reality (VR) are immersive technologies that blend real and virtual environments to enhance user experiences. AR overlays digital content on the physical world, while VR creates fully virtual spaces. This course introduces students to AR/VR concepts, tools, and platforms like Unity and ARCore. Through hands-on projects, learners gain practical skills to design and develop interactive applications, preparing them for careers in education, gaming, healthcare, and smart industries.

Module – 1

Introduction to Immersive Technologies: Fundamentals of AR, VR, MR, and XR, History and evolution of AR and VR, Key differences: AR vs VR vs MR, Hardware and software components, Applications: Gaming, Education, Healthcare, Retail, Training, Limitations and ethical considerations. (08 Hours)

Module – 2

Virtual Reality Systems: Types of VR systems: non-immersive, semi-immersive, fully immersive, VR hardware: HMDs (Oculus Rift, HTC Vive), motion tracking, input devices, VR software platforms: Unity, Unreal Engine, OpenXR, 3D scene design and modelling, Motion tracking, depth perception, and rendering pipeline. (08 Hours)

Module – 3

Augmented Reality Systems: Types of AR: Marker-based, Markerless, SLAM-based, Location-based, Hardware for AR: mobile devices, AR glasses (HoloLens, Magic Leap), AR SDKs: ARCore, ARKit, Vuforia, Tracking techniques: GPS, IMU, Visual Odometry, Design and development of mobile AR apps. (08 Hours)

Module – 4

Mixed Reality: Introduction to mixed reality, MRTK, Project Setup, Configure Unity for Windows Mixed Reality. Interaction Model- Hands and Motion Controllers model, Hands-free model, Gaze and Commit.

WebXR using Unity: Introduction to WebXR, set up the environment, Plugin. (08 Hours)

Module – 5

Industry Applications and Future Trends: AR/VR in: Smart Cities, Healthcare, Military, Retail, Industry 4.0, WebXR and immersive web apps, Integration with AI, IoT, Cloud, and Edge Computing, Ethical, legal, and privacy issues, The future of Metaverse and Brain-Computer Interfaces. (08 Hours)

Course Outcomes:

The students will be able to:

CO1: Demonstrate immersive effects of AR/VR environment.
CO2: Apply the VR concepts to story board the application requirements.
CO3: Analyze the MR/WebXR applications using different case studies.
CO4: Develop applications of societal/environmental relevance using AR/MR.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", O'Reilly Media, 2015.
2. Dieter Schmalstieg & Tobias Hollerer, "Augmented Reality: Principles and Practice", Addison-Wesley, 2016.
3. Alan B. Craig, "Understanding Augmented Reality: Concepts and Applications", Morgan Kaufmann, 2013.

References:

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016.
2. AR and VR Using the WebXR API, Rakesh Baruah, 2021.

Alternate Assessment Tools (AATs) suggested:

- Implement object interaction using raycasting in VR, Tools: Unity, Input System.
- Display 3D model using AR (marker-based), Tools: Vuforia + Unity
- Develop markerless AR app using ARCore, Tools: ARCore SDK + Unity.
- Build and deploy AR app to Android device, Tools: Unity Build, APK export
- WebAR experience using 8thWall / WebXR, Tools: JavaScript / Unity WebGL.

Web links/e-resources:

1. **Unity (AR/VR Engine)**
   https://unity.com/solutions/ar
   https://unity.com/unity/features/xr
2. **Unreal Engine (Epic Games)**
   https://www.unrealengine.com/en-US/vr
   https://www.unrealengine.com/en-US/ar
3. **Google ARCore**
   https://developers.google.com/ar
4. **Apple ARKit**
   https://developer.apple.com/augmented-reality/
5. **Vuforia AR SDK**
   https://developer.vuforia.com/
6. **Meta (Oculus) VR Development**
   https://developer.oculus.com/

7. **Microsoft HoloLens / Mixed Reality**
   https://learn.microsoft.com/en-us/windows/mixed-reality/
8. **WebXR (for browser-based AR/VR)**
   https://immersive-web.github.io/webxr

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Industrial IoT

Course Code	MMCA3C2	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Provide students with good depth of knowledge of Designing Industrial IoT Systems for various application.
2. Apply the knowledge of IIoT to design and analyse Industry 4.0 Systems.

Preamble: An application of Internet of Things (IoT) technologies in industrial settings, helps focus on the connection of machines, devices, and sensors within industrial processes. It revolutionizes industrial operations by enabling real-time data monitoring, predictive maintenance, process optimization, and data-driven decision-making.

Module – 1

Introduction to Industrial IoT (IIoT) Systems: Introduction to Industrial IoT (IIoT) Systems: The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories. (08 Hours)

Module – 2

Implementation systems for IIoT: Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems. (08 Hours)

Module – 3

IIoT Data Monitoring & Control: IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology. (08 Hours)

Module – 4

Cyber Physical Systems: Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis. (08 Hours)

Module – 5

Industrial IoT- Applications: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. (08 Hours)

Course Outcomes:

The students will be able to:

CO1: Identify various use cases of industry related IoT systems.

CO2: Analyze scenarios that requires Industrial IoT based solutions.

CO3: Implement IoT solutions for automation in industries.

CO4: Apply the concepts of AR/VR in Industrial IoT.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress

2. Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics," Springer Publication, First Edition, 2017.

References:

1. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

2. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

Alternate Assessment Tools (AATs) suggested:

Group project to design and automate any existing manually operating industry using IoT.

Web links/e-resources:

1. https://api.pageplace.de/preview/DT0400.9781000283068_A41015361/preview-9781000283068_A41015361.pdf
2. https://www.bing.com/videos/search?q=how+iot+and+industrial+iot+connected+to+each+other&qpvt=how+iot+and+industrial+iot+connected+to+each+other&FORM=VDRE

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Wireless Networks & Mobile Computing

Course Code	MMCA3C3	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand overview of Wireless Communication networks area and its applications in communication engineering.
2. Appreciate the contribution of Wireless Communication networks to overall technological growth.
3. To explain various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.
4. To enable students to compare multiple division techniques, mobile communication systems, and existing wireless networks.
5. Analyze the efficiency of various algorithms

Preamble: In the rapidly evolving digital era, wireless networks and mobile computing have become the backbone of modern communication and information access. These technologies enable seamless connectivity, data exchange, and computing capabilities across vast distances and diverse environments—anytime and anywhere. The study of Wireless Networks and Mobile Computing focuses on understanding the principles, protocols, architectures, and challenges of mobile and wireless communication systems. It encompasses a wide range of topics, including wireless LANs, cellular networks, ad hoc and sensor networks, mobile IP, and emerging paradigms such as 5G .

Module – 1

Introduction-Mobile Computing – Mobile Computing Vs Wireless Networking – Mobile Computing Applications –Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes. (08 Hours)

Module – 2

GSM-Services and System Architecture - Radio Interfaces of GSM, Protocols of GSM Localization, Call Mobile Internet Protocol and Transport Layer-Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IPAdaptation of TCP Window – Improvement in TCP Performance. (08 Hours)

Module – 3

Mobile Telecommunication System - Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Tele communication System (UMTS). (08 Hours)

Module – 4

Mobile Ad-Hoc Networks - Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET –Security. (08 Hours)

Module – 5

Mobile Transport Layer - Overview of Traditional TCP and implications of mobility control. Improvement of TCP: Indirect TCP, Snoop TCP, Mobile TCP, other methods of Mobile TCP layer Transmission. Wireless Application Protocol: Introduction of WAP, WAP applications, WAP Architecture, WAP Protocol Stack. (08 Hours)

Course Outcomes:

The students will be able to:

CO1: Demonstrate the importance of data synchronization in mobile computing.

CO2:Design and evaluate mobile communication system considering handoff, mobility management and QoS.

CO3: Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks

CO4: Apply knowledge of TCP/IP extensions for mobile and wireless networking.

CO5: Demonstrate the use of mobile application platforms and frameworks to develop basic mobile applications.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi 2012.
2. Raj kamal: Mobile Computing, 2ND EDITION, Oxford University Press, 2007/2012

References:

1. Wireless Communications & Networks, Second Edition, William Stallings by Pearson.
2. Ashok Talukder, RoopaYavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.
3. TCP/IP Protocol Suite by Behrouz A Forouzan, Third Edition,TMH.

Alternate Assessment Tools (AATs) suggested:

- Hand over problems
- Handoff problems
- 3 MANET Network Analysis problems

Web Links:

1. https://journals.stmjournals.com/jomccmn/
2. https://gsnetworks.org/wp-content/uploads/2013/10/Williams-Mobile_Computing.pdf
3. https://www.techtarget.com/searchmobilecomputing/resources/Mobile-application-strategy

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Web Security

Course Code	MMCA3D1	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand the core security challenges associated with web applications, including the potential risks posed by user input.
2. Learn the essential defence mechanisms for securing web applications, including authentication, session management, and handling user input securely.
3. Recognize the vulnerabilities associated with session management in web applications and understand techniques used by attackers to exploit them.
4. Explore common web security threats such as XSS, CSRF, and injection attacks, and understand strategies for defending against them.
5. Understand advanced web security threats such as DoS attacks and session hijacking, and explore comprehensive strategies for securing modern web applications.

Preamble: Web Security is a critical domain that focuses on identifying, analysing, and mitigating vulnerabilities in web applications. This course equips students with foundational and advanced skills to secure applications against threats such as injection, XSS, CSRF, and session hijacking. Emphasis is placed on real-world attack simulation, secure coding practices, and modern defence strategies.

Module – 1

Web Application (In)security: The Evolution of Web Applications, Common Web Application Functions, Web Application Security, The Core Security Problem: Users Can Submit Arbitrary Input, HTTPS, HTTP Authentication.

Web Functionality: Server-Side Functionality, Client-Side Functionality, State and Sessions.

Encoding Schemes: URL Encoding, HTML Encoding. (08 Hours)

Module – 2

Core Defence Mechanisms: Handling User Access-Authentication, Session Management, Access Control, Handling User Input- Approaches to Input Handling, Boundary Validation, Handling Attackers-Handling Errors, Maintaining Audit Logs.

Mapping the Application: Identifying Entry Points for User Input, Mapping the Attack Surface. (08 Hours)

Module – 3

Attacking Session Management: Predictable Tokens, Encrypted Tokens, Disclosure of Tokens on the Network, Vulnerable Mapping of Tokens to Sessions, Vulnerable Session Termination, Securing Session Management.

Securing Authentication: Use Strong Credentials, Handle Credentials Secretively, Validate Credentials Properly, Prevent Brute-Force Attacks. (08 Hours)

Module – 4

Cross-Site Scripting (XSS): XSS Discovery and Exploitation, Stored XSS, Reflected XSS, DOM-Based XSS.
Cross-Site Request Forgery: Query Parameter Tampering, Alternate GET Payloads, CSRF Against POST Endpoints. (08 Hours)

Module – 5

Injection: SQL Injection, code injection, command injection
Defending Against Injection: Mitigating SQL Injection
Denial of Service (DoS): Logical DoS Vulnerabilities, Distributed DoS
Defending Against DoS: Protecting Against Logical DoS and DDoS. (08 Hours)

Course Outcomes:
The students will be able to:
CO1: Illustrate web application architecture, protocols, and input-related risks.
CO2: Analyse web threats and injection attacks for a given use case.
CO3: Implement secure authentication and session management for web applications.
CO4: Apply defensive techniques against advanced attacks to ensure security.

CIE:
- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:
- SEE will be conducted for 100 marks.

Text Books:
1. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws Authors: Dafydd Stuttard and Marcus Pinto, Second Edition, 2011.
2. Web Application Security, Andrew Hoffman, First Edition, 2020, O'Reilly Media, Inc.

References:
1. Web Application Security, A Beginner's Guide: Bryan Sullivan and Vincent Liu, McGrawHill,2012.
2. Hacking Web Apps, Detecting and Preventing Web Application security Problems, Mike Shema,Syngress,2012.

Alternate Assessment Tools (AATs) suggested:
1. Develop and test a simple web application vulnerable to SQL injection, and then secure it using prepared statements and input sanitization.

Web links/e-resources:
1. Core Defence Mechanisms:: https://www.youtube.com/watch?v=smgXHNQwpQU
2. Find SQL injection in any website: https://youtu.be/GoYbIrwV3y0?feature=shared
3. DoS attack real world example: https://youtu.be/CKpJVAAagh4?feature=shared

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
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SEMESTER – III

Ethical Hacking

Course Code	MMCA3D2	CIE Marks	50
Contact Hours (L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	SEE Hours	3

Credits: 03

Course objectives:

This course will enable the students to

1. Understand Vulnerability Assessment and Penetration Testing using various tools.
2. Gain exposure to Metasploit exploitation tool and Linux exploit.
3. Acquire knowledge on SCADA Attacks

Preamble: This comprehensive course in ethical hacking and penetration testing equips students with the skills to identify and exploit vulnerabilities, preparing them for careers in cybersecurity. With applications in penetration testing, security research, and incident response, this course is highly relevant to the industry. Graduates can pursue opportunities as penetration testers, security consultants, or incident responders, high demand in the industry.

Module – 1

Introduction to Ethics of Ethical Hacking: Why You Need to Understand Your Enemy's Tactics, Recognizing the Gray Areas in Security, Vulnerability Assessment, and Penetration Testing.

Penetration Testing and Tools: Social Engineering Attacks: How a Social Engineering Attack Works, conducting a Social Engineering Attack, Common Attacks Used in Penetration Testing, Preparing Yourself for Face-to-Face Attacks, Defending Against Social Engineering Attacks. (08 Hours)

Module – 2

Physical Penetration Attacks: Need of Physical Penetration, conducting a Physical Penetration, Common Ways into a Building, Defending Against Physical Penetrations.

Insider Attacks: Conducting an Insider Attack, Defending Against Insider Attacks.

Metasploit: The Big Picture, Getting Metasploit, Using the Metasploit Console to Launch Exploits, Exploiting Client-Side Vulnerabilities with Metasploit, Penetration Testing with Metasploit's Meterpreter, Automating and Scripting Metasploit, Going Further with Metasploit. (08 Hours)

Module – 3

Linux Exploits: Stack Operations, Buffer Overflows, Local Buffer Overflow Exploits, Exploit Development Process, Format String Exploits, Memory Protection Schemes. (08 Hours)

Module – 4

Vulnerability Analysis: Passive Analysis-Ethical Reverse Engineering, Source Code Analysis, Binary Analysis, Advanced Reverse Engineering. (08 Hours)

Module – 5

Supervisory Control and Data Acquisition (SCADA) Attacks: SCADA Fuzzing, Stuxnet Malware, how to Protect Against SCADA Attacks.

Malware Analysis: Collecting Malware and Initial Analysis: Malware, Latest Trends in Honeynet Technology, Catching Malware: Setting the Trap, Initial Analysis of Malware.

(08 Hours)

Course Outcomes:

The students will be able to:

CO1: Demonstrate the legal implications of conducting ethical hacking.

CO2: Illustrate application security vulnerabilities.

CO3: Analyze social engineering, physical penetration, and insider attacks using penetration testing.

CO4: Perform penetration tests that bypass memory protections.

CO5: Apply SCADA security knowledge and malware analysis techniques to mitigate potential threats.

CIE:

- 60% of CIE is based on Internal Assessment Tests.
- 40% of CIE is based on Alternate Assessment Methods.

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. Gray Hat Hacking - The Ethical Hackers Handbook, Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams, 3rd Edition, Tata McGraw-Hill. (Chapters: 1,4,5,6,8, 9,11,15, 17,20,23,28).
2. Hands-On Ethical Hacking and Network Defense, Michael T. Simpson, Kent Backman, James Corley, Cengage Learning, 2nd Edition.

References:

1. The Web Application Hacker's Hand Book - Discovering and Exploiting Security flaws, Dafydd Suttard, Marcuspinto,1st Edition, Wiley Publishing.
2. Penetration Testing: Hands-on Introduction to Hacking, Georgia Weidman, 1st Edition, No Starch Press.
3. The Pen Tester Blueprint - Starting a Career as an Ethical Hacker, L. Wylie, Kim Crawly,1st Edition, Wiley Publications.

Alternate Assessment Tools (AATs) suggested:

Activity-Based Learning (Suggested Activities in Class)/Practical-Based learning

- **Group Activity: Identify Vulnerabilities**
  - Scenario Setup: Provide groups with a simulated web application or network diagram.
  - Task: Each group identifies potential vulnerabilities based on the provided documentation and visual cues.
  - Tools: Use a checklist or framework (e.g., OWASP Top Ten) to guide their assessment.
- **Presentation: Tools for Vulnerability Assessment**
  - Overview of Tools: Nessus, OpenVAS, Burp Suite, Nmap
  - Demo: Show how to use one of these tools (e.g., running a scan with Nmap)

Web links/e-resources:

1. From this youtube link, you can expect Vulnerability Assessment and Penetration Testing (VAPT) - link - https://www.youtube.com/watch?v=fgdcE4kfQBc
2. From this weblink you can earn certification course of IITM Pravartak Technologies Foundation Technology Innovation Hub (TIH) of IIT Madras and Internshala - https://digitalskills.pravartak.org.in/course_details.php?courseID=158&cart=
3. From this youtube link, you can expect the course offered by NPTEL by Prof. Indranil Sen Gupta, IIT Kharagpur - https://youtu.be/kpM4GopdXm0
4. From this youtube link, you can expect the understanding of SCADA Systems - https://youtu.be/JCGGeUxIs_I

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – III

Cryptography and Network Security

Course Code	MMCA3D3	CIE Marks	50
Contact Hours(L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40L	Exam Hours	3

Credits:03

Course objectives:

This course will enable the students to

1. Explain the objectives of information security
2. Explain the importance and application of each of confidentiality, integrity, authentication and availability and to understand various cryptographic algorithms.
3. Understand the basic categories of threats to computers and networks
4. Describe public-key cryptosystem, IPv4 and Intrusion detection
5. Generate and distribute a PGP key pair and use the PGP package to send an encrypted e-mail message.

Preamble: The Cryptography and network security course covers fundamental concepts, techniques, and best practices to protect computer systems, networks, and data. It has various real-time applications including secure online transactions and data protection. Career paths include Cryptography and network security, Cyber security specialist, information security analyst and Chief Information Security Officer. The field has high demand and growth prospects.

Module – 1

Introduction - Security Concepts: The need for security, Security approaches, Principles of security, Types of Security attacks, Security services

Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, steganography, key range and key size.

(08 Hours)

Module – 2

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange. (08 Hours)

Module – 3

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512)

Message authentication codes: Authentication requirements, HMAC, Digital signatures, Elgamal Digital Signature Scheme.

Quantum Cryptography: Introduction, Quantum Cryptography Works, Importance of Quantum cryptography, Types of quantum cryptography, Quantum Key Distribution (QKD) (08 Hours)

Module – 4

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure (08 Hours)

Module – 5

E-Mail Security: Pretty Good Privacy (PGP), S/MIME.

IP Security: IP Security overview, IP Security architecture, Authentication Header, encapsulating security payload, Combining security associations, Internet Key Exchange. (08 Hours)

Course Outcomes:

The Student will be able to

CO1: Demonstrate basic cryptographic techniques.
CO2: Apply various cryptographic algorithms for any given use case.
CO3: Differentiate various layers and principles of network security.
CO4: Analyse security techniques for any given application.

CIE:

- 60% of CIE is based on Internal Assessment Tests
- 40% of CIE is based on Alternate Assessment Methods

SEE:

- SEE will be conducted for 100 marks.

Text Books:

1. "Cryptography and Network security: Principles and Practice", William Stalling, 7th Edition.
2. "Cryptography and Network Security" S. Bose/P. Vijayakumar, Pearson Education.

References:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, WileyIndia, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
3. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

Alternate Assessment Tools (AATs) suggested:

- Develop a comprehensive Cryptography and Network Security framework for a hypothetical organization.

Web links/e-resources:

1. Cryptography: https://www.nist.gov/cryptography
2. Cryptography and network security: https://spectralops.io/blog/cryptography-and-network-security-the-quick-and-short-guide/
3. Introduction to network security [electronic resource]: https://opac.library.strathmore.edu/bib/106983

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(An Autonomous Institution, Affiliated to VTU, Belagavi)

MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – IV

Online Course on Emerging Technology/Professional Certification

Course Code	MMCA41	CIE Marks	100
Contact Hours (L:T:P)	0:3:0	SEE Marks	-
Contact Hours per week	06	Exam Hours	-

Credits: 03

Course objectives:

This course will enable the students to

1. Enrich students' learning with industry-recognized certifications / MOOCs in emerging technologies
2. Promote self-paced and lifelong learning.
3. Enhance career opportunities and bridge the gap between academia and industry.

Guidelines

Each student must complete Professional Certification / MOOC(s) equivalent to 3 credits during the MCA program.

- Credit Mapping:
  - 3 Credits = Minimum 60–75 hours of learning.
- Students need to complete one long-duration course **(≥ 12 weeks)**.

Eligible Platforms & Bodies

Courses must be taken from recognized and reputed providers**,** such as:

- Global Certification Providers**:** AWS, Microsoft, Oracle, Cisco, Google, RedHat, CompTIA, Tableau, SAP, etc.
- MOOC Platforms: NPTEL/SWAYAM.

Course Selection Process

- Students should select a course on emerging technologies which is not covered by the MCA curriculum
- Students must obtain **prior approval** from the Head of Department (HoD) forwarded by the Online Course Coordinator using the Approval Form including Course Title, Duration, Provider, Hours, and Relevance
- Course must be approved before enrollment to ensure relevance and credit equivalence.

Completion & Documentation

- Students must complete all modules, quizzes, assignments, and final assessments.

- Certificate of Completion / Passing from the provider is mandatory.
- After completion, students should submit:
  - Certificate copy.
  - Summary Report (3–5 pages) covering:
    - Key concepts learned.
    - Tools/Technologies used.
    - Note of Relevance to MCA curriculum.

CIE:

- Certificate of successful completion (with grade/score) – 100 Marks (awarded in accordance with the score obtained)

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
(Effective from the Academic year 2024-25)

SEMESTER – IV

Internship

Course Code	MMCA42	CIE Marks	50
Contact Hours (L:T:P)	0:0:11	SEE Marks	50
Contact Hours per week	22	Exam Hours	3

Credits: 11

Course objectives:

This course will enable the students to

1. Provide students with exposure to real-time software development processes, IT practices, and emerging technologies used in industry.
2. Enable students to apply concepts, methods, and tools learned to practical problem-solving in professional settings.
3. Develop technical, analytical, problem-solving, and project management skills relevant to industry demands.
4. Instil professional ethics, teamwork, communication skills, and workplace discipline through industry experience.
5. Prepare students for employability by bridging the gap between academic learning and industrial requirements, enhancing adaptability to diverse roles.

Industry / Research Internship

All the students must undergo mandatory internship of 4 to 6 months during the III & IV semesters which will be evaluated in IV Semester. The students get exposure to corporate culture and atmosphere by working on real-time projects. Experts from the industry guide the students during the industry internship and in turn are evaluated by the internal guides.

Eligibility & Approval

- Internships must be carried out **only in Private and Public Limited companies, Startups (registered under MSME/Startup India Portal), Government organizations, Public Sector Undertakings, R&D labs, or reputed academic institutions.**
- Freelancing firms, unregistered agencies, or purely training institutes issuing internship certificates **will not be accepted.**
- Internship Coordinator must verify **authenticity of the company** via official website, LinkedIn, GSTIN, etc.
- Students must obtain **prior approval** from the Head of Department (HoD) forwarded by the Internship Coordinator before joining the internship.
- Work must be directly related to **MCA curriculum areas** while interning in roles like HR Manager, Floor Manager, Business Development Associate, etc. are discouraged.
- Each student will be assigned an **Industry Mentor** and an **Academic Mentor**.

Discipline & Conduct

- Students must maintain professional behavior and uphold the reputation of the college at the internship location.
- All company rules, regulations, dress codes, and work ethics must be strictly followed.
- Misconduct or violation of rules may lead to cancellation of internship and disciplinary action.
- Random checks will be conducted with the host company to verify student attendance and work.
- Any falsification of documents will attract **strict disciplinary action** including failure in internship evaluation leading to undergo the internship again.

Proposal Submission

- Internship Proposal Form to include:
  - Company details, project title / domain.
  - Objectives & scope of internship.
  - Expected deliverables.

Reporting & Documentation

- Students should maintain a weekly internship diary or logbook signed by the Industry Mentor.
- **Four Periodic Evaluations** (every 4 weeks) will be conducted by the Academic Mentor via presentation on the progress of the work.
- At the end of the internship, students must submit:
  - Internship Completion Certificate from the company
  - Detailed Internship Report as per prescribed format

Evaluation

- Certificate from industry partner confirming successful completion.
- Submission of **Final Internship Report** (around 50–70 pages, as per institute format).
- Final presentation & viva-voce before examiner panel constituting one internal and one external member.

CIE:

- Continuous Evaluation – 10 Marks /evaluation
- Internship Report – 10 marks

SEE:

- SEE is conducted for 100 marks

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
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SEMESTER – III

Project Phase - I

Course Code	MMCA34	CIE Marks	50
Contact Hours (L:T:P)	0:0:10	SEE Marks	50
Contact Hours per week	20	Exam Hours	3

Credits: 10

Phase – I: Core / Basic Working Model (Proof of Concept)

Objective: To develop a **basic working model** that demonstrates feasibility, aligns with at least one **Sustainable Development Goal (SDG)**, and provides a clear direction for Phase-2.

Guidelines:

1. Problem Statement & SDG Mapping

- Identify a **real-world problem** that is meaningful and practical.
- Select **one or more relevant SDGs**.

2. Literature Review & Gap Analysis

- Review at least **3–5 existing solutions/research papers** related to the problem.
- Identify limitations of current approaches.
- Justify why your project idea is relevant, unique and innovative.
- Clearly **state the problem, aims and objectives of the work** and explain **how solving it contributes to the chosen SDG target**.
- Methodology to be followed
- Example: *"Designing a waste segregation system → contributes to SDG 11: Sustainable **Cities and Communities."***

3. Define Scope & Requirements

- Clearly outline the **core features** of the project for Phase-1.
- Focus on Minimum Viable Product (MVP) – the smallest version that works.

4. Data Collection / Input Preparation

- Decide the type of data or input required.
- For Phase-1: use sample, small, or synthetic datasets**.**
- Ensure data is relevant, clean, and properly formatted**.**
- Cite the source if public datasets are used.

5. System Design (Basic Architecture)

- Prepare a simple block diagram or flowchart of your system.
- Show the flow from **input → processing → output**.
- Keep it modular to allow upgrades in Phase-2.

6. Technology Selection

- Choose tools, languages, and frameworks that are **easy to implement for Phase-1**.
- Example:
  - Programming: Python, Java, C++, or Web stack.
  - Database: CSV/Excel, SQLite, or Firebase (basic).
  - Interface: Simple web/mobile page, or console-based.

7. Prototype Development

- Build the **working model** with all essential features.
- Keep the code **clean, modular, and documented**.

8. Testing

- Perform unit, integration, system and user acceptance testing.

9. User Interface and Experience

- Develop a **user-friendly interface** (web or mobile).
- Ensure good design, accessibility, and responsiveness.

10. Proof of Concept

- Conduct **functionality testing** (does the model give expected output?).
- Document the **limitations** so that they can be addressed in Phase-II.
- Demonstrate that the **idea works in principle**.

11. Linking Outcomes to SDG

- Explain how the **prototype output contributes to your chosen SDG**.
- Even a small working demo must connect back to the **larger sustainable goal**.
- Example: *A basic chatbot that gives mental health tips → supports SDG 3 (Good Health & Well-being).*

12. Documentation & Presentation

- Prepare a **report** covering:
  - Title, Problem statement, and SDG mapping.
  - Literature review summary.
  - System design (diagrams).
  - Technology used.
  - Screenshots / outputs of the working model.
  - Feedback from domain experts and intended users (field work).
  - Limitations and scope for Phase-2.

CIE: 50 Marks

- Synopsis submission – 10
- Interim Presentation - 10
- Interim Demonstration - 10
- Final Demonstration - 10
- Project Report - 10

SEE:

- SEE will be conducted for 100 marks.

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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MASTER OF COMPUTER APPLICATIONS
Scheme of Teaching and Examination
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SEMESTER – IV

Project Phase - II

Course Code	MMCA43	CIE Marks	50
Contact Hours (L:T:P)	0:0:6	SEE Marks	50
Contact Hours per week	12	Exam Hours	3

Credits: 06

Phase – II: Enhanced / Industry-Ready Version

Objective: To transform the prototype into a **scalable, optimized, and industry-ready solution** with advanced features, deployment, and usability improvements.

Guidelines:

1. **Requirement Refinement**
   - Expand Phase-1 scope by adding **advanced features**.
   - Incorporate Guide/Domain Experts/Peer feedback from Phase-1.

2. **Scalable & Robust Architecture**
   - Upgrade system design for **scalability and robustness**.
   - Use **layered / modular design** if needed.

3. **Data Management (as applicable)**
   - Work with large, real-world datasets.
   - Ensure data cleaning, preprocessing, and validation pipelines.

4. **Optimization & Performance**
   - Improve algorithm efficiency, accuracy, and response time.
   - Optimize code and database handling.

5. **Add modern tools/technologies**
   - AI/ML models
   - Cloud computing
   - IoT devices
   - APIs for external integration

6. **User Interface & Experience**
   - Develop a **user-friendly interface** (web or mobile).
   - Ensure good design, accessibility, and responsiveness.

7. **Testing & Quality Assurance**
   - Perform unit, integration, system, and user acceptance testing.
   - Include stress/load testing for industry-readiness.

- Follow standards/regulations if applicable.

8. Deployment & Monitoring

- Deploy on cloud or hosting platform.

9. Documentation and Final Presentation

Submit a **detailed report** including:

- Full system design & architecture
- Dataset details & methodology
- Implementation & results (with evaluation metrics)
- SDG alignment and impact analysis
- Limitations & future work
- Prepare a **final presentation & live demo** for evaluation.

10. Outcomes of the Work Expected (any of the below, but not limited to)

- Research Publication
- IPR Generation
- Product Commercialization
- Establishing a Start-up

CIE: 50 Marks

- Synopsis submission – 10
- Interim Presentation - 10
- Interim Demonstration - 10
- Final Demonstration – 10
- Project Report - 10

SEE:

- SEE will be conducted for 100 marks.