CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

MASTER OF COMPUTER APPLICATION (MCA)

(2 Year Postgraduate Degree Programme)

IN

COMPUTER SCIENCE & ENGINEERING

(In Alignment with National Education Policy 2020)

[w. e. f. 2025-2026]

FACULTY OF SCIENCE AND HUMANITIES

SRM UNIVERSITY DELHI-NCR, SONEPAT

39, Rajiv Gandhi Education City,
Sonepat Haryana-131029

SRM UNIVERSITY
DELHI-NCR, SONEPAT

ENGINEERING GRADUATES EMPLOYABILITYATTRIBUTES

Problem Formulation, Analysis & Solving	A software professional should be able to identify, formulate, review research literature, and analyze complex problems reaching substantiated conclusions using principles of mathematics, natural sciences, and basic sciences
Design and Development of a Solution	A software professional must be able to design solutions for complex problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
Investigation	A software professional should use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
Modern Tools Usage	A software professional should be able to create, select, and apply appropriate techniques, resources, and IT tools including prediction and modeling to complex activities with an understanding of the limitations
The Engineer and the Society	A software professional should be able to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.
Environment and Sustainability	A software professional must understand the impact of the professional solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
Ethics	A software professional should be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the post graduate practice

Individual and Teamwork	A software professional should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
Effective Communication	A software professional should be able to communicate effectively on complex activities with the community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project Management and Finance	A software professional must demonstrate knowledge and understanding of the science and management principles and apply these to post graduate work environment, as a member and leader in a team, to manage projects and in multidisciplinary environments.
Lifelong Learning	A software professional must recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SRM UNIVERISTY DELHI-NCR, SONEPAT

FACULTY OF SCIENCE AND HUMANITIES

FACULTY OF SCIENCE AND HUMANITIES PROGRAM EDUCATIONAL OBJECTIVES (FSHPEOs)

- Advancement to a professional position by virtue of their knowledge, skills and attitude.
- Recognition for solving problems and developing design solutions that consider safety and sustainability.
- Work as successful professionals in diverse disciplines and enterprises;
- Increasing responsibilities of technical and managerial leadership in their work organizations;
- Professional development through a commitment to career-long learning.

FACULTY OF SCIENCE AND HUMANITIES PROGRAM LEARNING OUTCOMES (FSHPLOs)

- An ability to identify, formulate, and solve real time & socio-economic problems by applying principles of science, mathematics, humanities and social sciences
- An ability to use the advanced skill enhancement techniques and modern tools as per industry 4.0 necessary for practice.
- An ability to apply design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
- An ability to adapt and work with multidisciplinary teams and communicate effectively;
- An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks.
- An understanding of professional and ethical responsibility;
- An ability to acquire and apply new knowledge using appropriate learning strategies with inner quest to learn, unlearn and relearn.

MAPPING OF FACULTY OF SCIENCE AND HUMANITIES

PROGRAM EDUCATIONAL

OBJECTIVES AND FACULTY OF SCIENCE AND HUMANITIES PROGRAM LEARNING OUTCOMES

FACULTY OF SCIENCE AND HUMANITIES PROGRAM EDUCATIONAL OBJECTIVES	FACULTY OF SCIENCE AND HUMANITIES PROGRAM LEARNING OUTCOMES
Advancement to a professional position by virtue of their knowledge, skills and attitude.	• An ability to identify, formulate, and solve real time and socio-economic problems by applying principles of science, mathematics, humanities and social sciences • An ability to use the advanced skill enhancement techniques and modern tools as per industry 4.0 necessary for practice.
Recognition for solving problems and developing design solutions that consider safety and sustainability	• An ability to use the advanced skill enhancement techniques and modern tools as per industry 4.0 necessary for practice. • An ability to apply design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
Work as successful professionals in diverse disciplines	• An ability to apply design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability • An ability to adapt and work with multidisciplinary teams and communicate effectively;
Increasing responsibilities of technical and managerial leadership in their work organizations;	• An ability to adapt and work with multidisciplinary teams and communicate effectively; • An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks. • An understanding of professional and ethical responsibility;

Professional development through a commitment to career-long learning.	• An understanding of professional and ethical responsibility; • An ability to acquire and apply new knowledge using appropriate learning strategies with inner quest to learn, unlearn and relearn.

TABLE 1: MAPPING MATRIX OF FACULTY OF SCIENCE AND HUMANITIES PROGRAM EDUCATIONAL OBJECTIVES

AND FACULTY OF SCIENCE AND HUMANITIES PROGRAM LEARNING OUTCOMES (TABULAR FORMAT)

MAPPING	FSHPELO 1	FSHPLO 2	FSHPLO 3	FSHPLO 4	FSHPLO 5	FSHPLO 6	FSHPLO 7
FSHPEO1	✓	✓					
FSHPEO2		✓	✓				
FSHPEO3			✓	✓			
FSHPEO4				✓	✓	✓	
FSHPEO5						✓	✓

MCA - COMPUTER SCIENCE& ENGINEERING POST GRADUATES
EMPLOYABILITY ATTRIBUTES

EA 1: Sound Knowledge &Skill of Domain Area: Demonstrated competence in university level mathematics, basic fundamentals, and specialized knowledge appropriate to the program.

EA 2: Problem solving skills: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex problems in order to reach substantiated conclusions.

EA 3: Cognitive and Analytical skills: Cognitive & Analytical skills help post graduates to interpret data, remember team goals. These skills help them recall previous information that may relate to their organization's goals and help them make important connections between old and new information so that they can work more effectively.

EA 4: Design Thinking: An ability to design solutions for complex, open-ended problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, economic, environmental, cultural and societal considerations.

EA 5: Transferrable Skills: Transferable skills are skills and abilities that are relevant and helpful across different areas of life: socially & professionally.

- **Interpersonal skills to work in diverse group:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
- **Communication Skills:** An ability to communicate complex concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
- **Positive attitude and thinking:** An ability to have positive attitude and thinking in challenging situations.
- **Adaptability**: Adapts learning strategies to new conditions. Recognizes parallels, analogies or similarities of new situations to more familiar situations.
- **Learn to Learn:** Learn ⟹ Unlearn ⟹ Relearn: An ability to identify and to address their own educational needs in a changing world, sufficiently to maintain their competence and contribute to the advancement of knowledge.

EA6: Information technology skills: An ability to create, select, adapt, and extend appropriate techniques, resources, and modern ICT tools to a range of activities**,** from simple to complex, with an understanding of the associated limitations.

EA7: Sustainable Consumption and Production: the demands for system upgrades (domestic and commercial) as well as the move to continuous provision of service (e.g. domestic devices that are always powered and available) needs to be balanced with the views of sustainable consumption and production. Server based solutions – such as Google Docs (Google Docs, 2009) 0– can be considered as one way of addressing such concerns where individuals need not upgrade their own machines as regularly and install local applications (with subsequent updates).

MCA- COMPUTER SCIENCE& ENGINEERING PROGRAMME EDUCATIONAL OBJECTIVES

PEO1. To impart and imbibe the skillset as per industry 4.0 and make them corporate ready.

PEO2. To develop an ability in post graduates to apply skills and knowledge attained to solve real life complex problems.

PEO3. To enhance the employability attributes of post graduates by imbibing the skill set through hands on technical training in broad areas like big data, Machine Learning and soft skills.

PEO4. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.

MCA - COMPUTER SCIENCE& ENGINEERING PROGRAMME LEARNING OUTCOMES (PLOs)

PLO1- Students will be able to get practical expertise through hands on lab from industry experts on industry 4.0 skillset through industry institute interaction.

PLO2- Students will be able to identify, formulate and analyze the complex real time problems.

PLO3- Students will be able to demonstrate the professional eminence by organizing and securing top positions in events and competitions like Hackathon, call for code etc. at Nationals/ International level.

PLO4- Students will attain the ability to inculcate the group dynamics, team work, leadership traits and logical reasoning by engaging themselves into the interactive session through group discussions, role play etc.

PLO5- Students will become corporate ready for placements in IT industries like TCS, Wipro, and IBM etc. on core job profiles of professional competence attained through the experiential learning from Live Projects.

PLO6- Students will attain the qualities and get prepared for self-employment and start-ups.

TABLE 2: MAPPING MATRIX OF PROGRAM EDUCATIONAL OBJECTIVES (PEO) AND PROGRAM LEARNING OUTCOMES (PLO)

PLO / PEO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
PEO1	✓	✓				
PEO2			✓	✓		
PEO3					✓	✓
PEO4						

MCA COMPUTER SCIENCE& ENGINEERING PROGRAMME STRUCTURE

The Computer Science curriculum is geared towards providing the student with a strong foundation in the discipline and the tools and competence to address new and challenging problems that they have not seen before. The credit requirements for their program of study is comprised of the following Programme Structure:

Core Courses (CC): The Professional core courses are aimed at providing the student with a solid foundation in their chosen field of study as per Industry 4.0 skills and knowledge.

Program Electives (PE)-Programme specific Specialization Electives: The Professional electives, on the other hand, provide the student with an option to gain exposure to different specializations within the discipline, or an opportunity to study one of the subfields in some depth.

Open Electives-Courses from other Technical areas and Emerging fields (OE): The open subject elective courses provide the student wide latitude to pursue their interests, be it in humanities, arts, their chosen field of study, a related discipline, or use it towards developing a concentration in another field as a Minor.

Students have choice to select Advanced Undergraduate Subjects, from other technical areas and Emerging fields for acquiring sound holistic multidisciplinary knowledge &Skills. The students can elect to consider these additional options upon joining the university.

Skill Enhancement Courses (SEC)-Technical &Soft Skills:

- Technical Skills (SEC): Under Technical Skills Broad categories of training to be imparted to post Graduates of various disciplines with common nomenclature .The training is categorized into three categories: Elementary, Intermediate &Advanced keeping in view interdisciplinary approach.
- Soft Skills (SS): Under Soft skills training six soft skill courses with defined Nomenclature and course content common to all disciplines introduced to inculcate Group Dynamics, Team work &Leadership Traits by engaging students for interactive sessions through Role Play, Group Discussions and for improving presentation & Communication skills of post graduates.
- **Practical (P):**

The labs are fully furnished and well equipped with latest software's to conduct practical as per the requirement of the University Curriculum.

- **Live Projects (LP):**

Live Project is being introduced for post graduates from 2nd semester to 4th semester to develop an ability in post graduates to apply skills and knowledge attained to solve real life complex problems. A student will be monitored on periodic basis both by the Industry expert and Faculty- in charge.

MCACOMPUTER SCIENCE & ENGINEERING

TABLE 3: PROGRAMME STRUCTURE

Category of Courses	Category	No. of Courses
Core Courses	CC	12
Program Electives	PE	2
Open Electives-Courses from Other Areas & Emerging Fields	OE	2
Skill Enhancement Courses(Technical & Soft Skills)	SEC	5
Practical	P	8
Live Project	LP	3
TOTAL		**32**

(COMPUTER SCIENCE & ENGINEERING)

DEGREE COURSE

PROGRAMME CREDIT STRUCTURE ALONG WITH CREDITS

Table 4

SEMESTERS / COURSES	CATEGORY	I	II	III	IV	TOTAL	%AGE
CORE COURSES	CC	16	16	16	0	48	**55.8**
PROGRAM ELECTIVES-Program Specific Specialization Electives	PE	0	0	4	4	8	**9.3**
OPEN ELECTIVES-Courses from Other Technical Area & Emerging Fields	OE	3	3	0	0	6	**6.99**
SKILL ENHANCEMENT COURSES	SEC	1	2	1	1	5	**5.81**
PRACTICAL	P	3	2	4	0	9	**10.5**
PROJECT	LP	0	1	1	8	10	**11.6**
TOTAL		**23**	**24**	**26**	**13**	**86**	**100.0**

MASTER OF COMPUTER APPLICATION

(FACULTY OF SCIENCE AND HUMANITIES) POSTGRADUATE DEGREE COURSE

TABLE5: PROGRAMME COURSES CREDIT SRUCTURE SEMESTERWISE

PROGRAM COURSE'S CREDIT STRUCTURE SEMESTER WISE
SEMESTER-I

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	25MCA101	CC	Design and Analysis of Algorithm	4	0	0	4	4
2	25MCA102	CC	Essentials of Networking	4	0	0	4	4
3	25MCA103	CC	Information System Analysis & Design	3	1	0	4	4
4	25MCA104	CC	Software Engineering	4	0	0	4	4
5	SEC-FT-01	OE	Open Elective-I	3	0	0	3	3
Total Credits (Theory)				**18**	**1**	**0**	**19**	**19**
PRACTICAL								
8	25MCA151	P	Design and Analysis of Algorithm Lab	0	0	2	2	1
9	25MCA152	P	Networking Lab	0	0	2	2	1
10	25MCA153	P	Software Engineering Lab	0	0	2	2	1
11	23SS152	SEC	Teamwork & Interpersonal Skills	0	0	2	2	1
Total Credits (Practical)				**0**	**0**	**8**	**8**	**4**
TOTAL CREDITS (THEORY + PRACTICAL)				**18**	**1**	**8**	**8**	**23**

MASTER OF COMPUTER APPLICATION

(FACULTY OF SCIENCE AND HUMANITIES) POSTGRADUATE DEGREE COURSE

TABLE5: PROGRAMME COURSES CREDIT SRUCTURE SEMESTERWISE

PROGRAM COURSE'S CREDIT STRUCTURE SEMESTER WISE

SEMESTER-II

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	25MCA201	CC	Distributed Operating System	4	0	0	4	4
2	25MCA202	CC	Java Programming	4	0	0	4	4
3	25MCA203	CC	Cloud Computing	3	1	0	4	4
4	25MCA204	CC	Discrete Mathematics & Graph Theory	4	0	0	4	4
5	21xxx	OE	Open Elective II	3	0	0	3	3
Total Credits (Theory)				**18**	**1**	**0**	**19**	**19**
PRACTICAL								
8	25MCA252	P	Java Programming Lab	0	0	2	2	1
9	25MCA253	P	Cloud Computing Lab	0	0	2	2	1
10	25MCA254	LP	Live Project-I	0	0	2	2	1
11	23SS254	SEC	Professional Writing Skills & Interpersonal Skills: Strategies	0	0	2	2	1
12	23CS0301	SEC	Design thinking and Augmented Virtual Reality-Level-I	0	0	2	2	1
Total Credits (Practical)				0	0	10	10	5
Total Credits (Theory + Practical)				**18**	**1**	**10**	**29**	**24**

MASTER OF COMPUTER APPLICATION

(FACULTY OF SCIENCE AND HUMANITIES) POSTGRADUATE DEGREE COURSE

TABLE5: PROGRAMME COURSES CREDIT SRUCTURE SEMESTERWISE

PROGRAM COURSE'S CREDIT STRUCTURE SEMESTER WISE

SEMESTER – III

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	25MCA301	CC	Big Data &Analytics	4	0	0	4	4
2	25MCA302	CC	Python Programming	4	0	0	4	4
3	25MCA303	CC	Artificial Intelligence	3	1	0	4	4
4	25MCA304	CC	Network security	4	0	0	4	4
5		PE	Program Elective-I	4	0	0	4	4
Total Credits (Theory)				**19**	**1**	**0**	**20**	**20**
PRACTICAL								
8	25MCA305	P	Seminar	0	0	2	2	2
9	25MCA352	P	Python Programming Lab	0	0	2	2	1
10	25MCA353	P	Artificial Intelligence Lab	0	0	2	2	1
11	25MCA 354	LP	Live Project-II	0	0	2	2	1
12	23AR355	SEC	Aptitude and Reasoning	0	0	2	2	1
Total Credits (Practical)				0	0	10	10	6
Total Credits (Theory + Practical)				**19**	**1**	**10**	**30**	**26**

MASTER OF COMPUTER APPLICATION

(FACULTY OF SCIENCE AND HUMANITIES) POSTGRADUATE DEGREE COURSE

TABLE5: PROGRAMME COURSES CREDIT SRUCTURE SEMESTERWISE

PROGRAM COURSE'S CREDIT STRUCTURE SEMESTER WISE

SEMESTER – IV

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1		PE	Program Elective – II	4	0	0	4	4
Total Credits (Theory)				**4**	**0**	**0**	**4**	**4**
PRACTICAL								
1		LP	Major Project	0	0	16	16	8
2	23CS0302	SEC	Big Data Analytics, Tools and Techniques	0	0	2	2	1
Total Credits (Practical)				0	0	18	18	9
Total Credits (Theory + Practical)				**4**	**0**	**18**	**22**	**13**

LIST OF OPEN ELECTIVES

Subject Code	Course	Category	L	T	P	C
Open Elective -I						
SEC-FT-01	Entrepreneurship and New Venture Management	OE	3	0	0	3
Open Elective -II						
21ESUG202	Sustainable Growth and development	OE	3	0	0	3
21ESUG203	Waste Management	OE	3	0	0	3

LIST OF PROGRAM SPECIFIC ELECTIVES

Subject Code	Course	Category	L	T	P	C
Program Specific Elective -I						
25MCA306A	Distributed Systems	PE	4	0	0	4
25MCA306B	Management Information System	PE	4	0	0	4
25MCA306C	Embedded Systems	PE	4	0	0	4
25MCA306D	Internet of Things	PE	4	0	0	4
Program Specific Elective -II						
25MCA401A	Advanced Database Management System	PE	4	0	0	4
25MCA401B	Enterprise Computing In Java	PE	4	0	0	4
25MCA401C	Combinatorial Optimization	PE	4	0	0	4
25MCA401D	Machine Learning	PE	4	0	0	4

LIST OF SKILL ENHANCEMENT COURSES

Course Code	Course	Category	L	T	P	Credits
TECHNICAL TRAINING						
23CS0301	Design thinking and Augmented Virtual Reality	SEC	0	0	2	1
23CS0302	Big Data Analytics, Tools and Techniques	SEC	0	0	2	1
SOFT SKILL						
23SS152	Teamwork & Interpersonal Skills	SEC	0	0	2	1
23SS254	Professional Writing Skills & Interpersonal Skills: Strategies	SEC	0	0	2	1
23AR355	Aptitude and Reasoning	SEC	0	0	2	1

EVALUATION SCHEME

S.No.	Course	Continuous Evaluation (Internal)	End Semester
1	Core Courses (CC) : Theory	40	60
2	Discipline Specific Course (DSC) : Theory	40	60
3	Open/Generic Electives (OE/GE) : Theory	40	60
4	Practical /Workshop - Practical	60	40
5	Skill Enhancement Courses (SEC)	70	30
6	Technical Enhancement Courses (TEC)	70	30
7	Live Projects & Industry Visits (LP/IV)	60	40
8	Summer Internship Programme (SIP)	60	40

SEMESTER-I

Design and Analysis of Algorithm	
Course Code: 2 3 M C A 1 0 1	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4:0:0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To understand the fundamentals of algorithms and structured programming.
- To describe and implement advanced data structures such as threaded trees, B-trees, and heaps.
- To implement divide and conquer strategies, including merge sort, quicksort, and matrix multiplication.
- To apply backtracking methods to problems such as the 8-Queens problem, sum of subsets, graph colouring, and the 0/1 knapsack problem.
- To develop and analyze approximation algorithms, and understand polynomial-time approximation schemes.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Analyze the asymptotic behaviour of algorithms using order notations.
- Implement advanced data structures such as threaded trees, B-trees, and heaps.
- Develop the ability to apply divide and conquer strategies, including merge sort, quicksort, and matrix multiplication, to solve complex computational problems.
- Demonstrate competence in applying backtracking methods to solve optimization problems such as the 8-Queens problem and the 0/1 knapsack problem.
- Understand the concepts of NP-hard and NP-complete problems, and be able to analyze approximation algorithms and polynomial-time approximation schemes.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

Unit-I

Algorithms and structured programming, analyzing algorithms, asymptotic behaviour of an algorithm, Order notations, time and space complexities (polynomial, logarithmic and exponential), average and worst-case analysis, lower and upper bounds.

Unit-II

Advanced data structures: Threaded trees, B-trees, Heaps and heap sort, sets and relations, Graphs, Hashing. Basic search & Traversal Techniques (Breadth first and Depth first traversals of Graphs).

Unit-III

Algorithm design strategies: Divide and conquer (Merge sort, Quicksort, and matrix multiplication). Greedy method: General method, knapsack problem, job sequencing with deadlines, minimum cost spanning trees). Dynamic programming (0/1 knapsack, travelling salesman problem).

Unit-IV

Backtracking (8 - Queens Problem, Sum of Subsets, Graph coloring, 0/1 Knapsack). Branch & Bound (0/1 knapsack, Travelling salesman).

Unit-V

Approximation algorithms: Polynomial Time Approximation Schemes. Complexity: - NP-Hard and NP-complete Problems - Cook's theorem, NP completeness reductions.

TEXT BOOKS

1. E. Horowitz, S. Sahni, Fundamentals of Computer Algorithms, Galgotia Publications, 1985.
2. Aho, J.E. Hopcroft, & J.D. Ullman, Design & Analysis of Computer Algorithms, Addition Wesley, 1974.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein ,"Introduction to Algorithms".

REFERENCE BOOKS

1. P.Berlions & P. Bizard, Algorithms - The Construction, Proof & Analysis of Programs, John Wiley & Sons, 1986.
2. K. Melhorn, Data Structures and Algorithms, Vol. I & II, Springer Verlag, 1984.

ESSENTIALS OF NETWORKING	
Course Code: 25MCA102	Internal Examination: 40 Marks
Credits: 4	External Examination: 60 Marks
L T P : 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To understand the basic concepts of data communication, layered model, protocols and interworking between computer networks
- Discuss the nature, uses and implications of internet technology.
- An overview of security issues related to data communication in networks.
- To understand the computer networks and concentrates on building a firm foundation
- To understand the functioning of Frame Relay, ATM

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Have a good understanding of the OSI Reference Model and TCP/IP Model and in particular have a good knowledge of Layers.
- Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
- Have a basic knowledge of the use of cryptography and network security.
- describe and configure important network protocols and implement logical addressing schemes
- implement network architecture with basic network security, including encryption

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I INTRODUCTION

Introduction to Data Communication, Theoretical basis of data communication; analog and digital signals; asynchronous and synchronous transmission; data encoding and modulation, techniques, network topologies, broadband and baseband transmission; pulse code modulation, bandwidth, channel, baud rate of transmission; multiplexing; transmission medium; transmission errors - error handling mechanisms.

UNIT-II

Standards and the OSI and TCP/IP Model

OSI Model and its layers, TCP/IP model, OSI versus TCP/IP model **Addressing:** Logical vs. Physical addressing, Subnetting, super netting, IPv4 and IPv6, Dynamic Host Control Protocol (DHCP), Purpose and implementation of DNS (Domain Name System).

UNIT-III

Physical Layer

Bit Rate, Data rate, Frequency, Bandwidth, Baud Rate, Harmonics, Maximum data rate of a channel, Transmission Media, Multiplexing, Switching.

UNIT-IV

Datalink Layer Functions and Protocols

Framing, error-control, flow -control; slidingwindow protocol; HDLC; Data link layer of internet, Error Detection and Correction Methods - Elementary Data Link Protocols – Sliding Window Protocols – Protocol VerificationMethods – Channel Allocation – Multiple Access protocols – IEEE 802 Standards.

UNIT-V

Network Applications

File transfer protocol, electronic mail, World Wide Web, Virtual Terminals, Other application. Example Networks - Internet and Public Networks.

TEXT BOOKS

1. A.S. Tanenbaum, Computer Networks (4th ed.), Prentice-Hall of India, 2003
2. Behrouz Forouzan and S.C. Fegan, Data Communications and Networking, McGrawHill, 2006
3. W. Tomasi, Introduction to Data Communications and Networking, PearsonEducation, 2007.
4. S. Haykin, Digital Communications, John Wiley & Sons, Inc., 2005

REFERENCE BOOKS

1. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach (3rd ed.),Morgan Kaufmann, 2003
2. William Stallings, Data and Computer Communications (8th ed.), Pearson Education,2007

Information System Analysis & Design	
Course Code: 25MCA103	Internal Examination: 40 Marks
Credits: 4	External Examination: 60 Marks
L T P : 3 1 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To introduce the categories of information systems and the process of conducting feasibility studies.
- To define system problems and utilize fact-finding techniques to document procedures and decisions.
- To develop process descriptions and control mechanisms for input/output in system design.
- To introduce and differentiate test strategies for conventional and object-oriented software.
- To outline the activities related to the implementation phase and demonstrate the use of case tools and documentation importance.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of the course, students would be able to:

- Understand the various categories of information systems and conduct feasibility studies.
- Analyze and document system requirements using appropriate tools and techniques.
- Design databases and user interfaces effectively, ensuring proper input/output controls.
- Implement strategic software testing approaches for both conventional and object-oriented software.
- Execute implementation and support activities while utilizing case tools and documentation.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I

Introduction of System Analysis and Design

Categories of Information Systems, Structured analysis method, System prototype method, succeeding as system analyst. Feasibility study, Feasibility considerations, steps in feasibility analysis, Cost and Benefit analysis, Procedure for cost and benefit determination.

UNIT-II

Information Requirement Analysis

Problem definition, Identification and Investigation of system, Fact finding techniques, Tools for documenting procedures and decisions, Data Flow Diagrams, Data Dictionaries, Decision Tables, and Decision Trees.

UNIT-III

System Design

Process descriptions, Input/output controls, object modelling, Database design, and User Interface design, Design of Input and Output: Capturing data for input, input validation design of output: Output objectives, Types of output, Presentation format of output, Design of software: Top-Down Structure, Coupling, Cohesion, Span of control, Module size, Shared modules.

UNIT-IV

Testing and Object Oriented Design & Modeling

Strategic approach to software testing, Test series for conventional software, Test strategies for object – oriented software, Validation testing, System testing. Introduction to object-oriented design, Designing Object responsibilities, and Object reusability.

UNIT-V

Implementation and Documentation

Activities of the implementation and support phase. Use of case tools, Documentation – importance, types of documentation**.** Introduction to - Project management, scheduling, measurement of quality and productivity, ISO and capability maturity models, Strategic planning, system audit. Quality assurance: reviews, walkthroughs, and inspection.

TEXT BOOKS

1. Senn, J. A., Analysis and Design of Information Systems, Tata McGraw Hill (1989) 2nd ed.
2. Hoffer and Hoffer, Modern System Analysis and Design, Pearson Education.
3. Whitten, J. and Bentley, L., Introduction to Systems Analysis and Design, Tata McGraw Hill (2006).

REFERENCE BOOKS

1. "System Analysis and Design "by Harry J. Rosenblatt
2. "Modern System Analysis and Design" by Joseph S Valacich, Joey F. George

SOFTWARE ENGINEERING	
Course Code: 25MCA104	Internal Examination: 40 Marks
Credits : 4	External Examination: 60 Marks
L T P: 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To introduce software development life cycle and models for developing and effective and efficient software.
- To understand requirements of client and cost quality management.
- To illustrate the preparation of document using object oriented approach.
- To impart knowledge on testing tools and techniques to understand verification and validation.
- To illustrate skill of software maintenance and software reliability issues.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate the concept of software process and various models
- Explain the motivation regarding the requirements of project management and estimate cost accordingly.
- Apply object oriented approach using functional dependency.
- Implement testing technology to prove verification and validation.
- Understanding maintenance and reliability issues in software designing.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I

INTRODUCTION

Introduction to Software and Software Engineering, Software characteristics, software crisis, software engineering paradigms. Software Processes: Software process models, Waterfall model, the prototyping model, spiral model, RAD and Incremental model.

UNIT-II

SOFTWARE REQUIREMENTS ANALYSIS AND PROJECT MANAGEMENT

Functional and non-functional requirements, User requirements, System requirements, the software requirements document. IEEE standard of SRS, Quality of good SRS, software Project Management Size Estimation- LOC and FP Metrics, Cost Estimation- Delphi and Basic COCOMO, Staffing Level Estimation, Putnam's Model.

UNIT-III

SOFTWARE DESIGN CONCEPTS

System Design: Design Concepts, design models for architecture, Abstraction, Coupling and Cohesion, Types of Coupling and cohesion, Top Down and Bottom Up design approaches; Functional Versus Object Oriented Approach.

UNIT-IV

TESTING, VERIFICATION AND VALIDATION

Verification and Validation ,Software Testing : Testing functions, Test case design, White Box testing: cyclomatic complexity Black box testing: Boundary value Analysis, Equivalence class partitioning, Unit testing, Integration Testing, System testing, Alpha Testing, Beta Testing and Acceptance Testing .

UNIT-V

SOFTWARE MAINTENANCE & RELIABILITY ISSUES

Need for Maintenance, Categories of Maintenance: Preventive, Cor-rective and Perfective Maintenance, Cost of Maintenance, maintenance tasks, maintenance side effects Software reliability – issues- Software reliability Vs Hardware reliability – Failures and Faults - Classification of Failures, CASE tools

TEXT BOOKS

1. Richard Fairley, "*Software Engineering Concepts*", McGraw Hill, 1985.
2. Roger S. Pressman, "*Software Engineering A Practitioner Approach*" 4th edition, McGraw Hill, 1999.
3. K.K. Aggarwal and Y. Singh, *Software Engineering (revised 2nd ed.),* New Age International Publishers, 2006.

REFERENCE BOOKS

1. Ian Sommerville, *Software engineering*, Pearson education Asia, 6th edition, 2000.
2. Pankaj Jalote- *An Integrated Approach to Software Engineering*, Springer Verlag, 1997.
3. Shooman, *Software Engineering*, McGraw Hill, 1983.

DESIGN AND ANALYSIS OF ALGORITHM LAB	
Code: 25MCA151	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Practical Examination:40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- The learner is expected to be able to practically implement following basic concepts.
- To impart practical Knowledge to students.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Implementing Linear search and Binary search, Sorting and Searching Techniques
- Implementing Bubble sort, Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort and Binary tree sort and Kruskal's algorithm and KMP algorithms

MAPPING MATRIX OF LAB OBJECTIVES (CO) AND LAB LEARNING OUTCOMES (CLO)

	CLO1	**CLO2**
CO1	✓	
CO2		✓

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum 09 experiments)

1. Write a program that use both recursive and non-recursive functions for implementing the following searching methods: a) Linear search b) Binary search
2. Write a program to implement all the functions of a dictionary (ADT) using Hashing.
3. Write a program to implement Dijkstra's algorithm for Single source shortest path problem.
4. Write a programs that use recursive and non-recursive functions to traverse the given binary tree in a) Preorder b) Inorder c) Postorder.
5. Write a program for the implementation of bfs and dfs for a given graph.
6. Write a programs for implementing the following sorting methods: a) Bubble sort b) Insertion sort c) Quick sort d) Merge sort e) Heap sort f) Radix sort g) Binary tree sort
7. Write a program to perform the following operations: a) Insertion into a B-tree b) Searching in a B-tree

8. Write a program that implements Kruskal's algorithm to generate minimum cost spanning tree.
9. Find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
10. Write a program that implements KMP algorithm for pattern matching.

TEXT BOOKS

1. Cormen, Thomas, Charles Leiserson, et al. Introduction to Algorithms. 3rd ed. MIT Press, 2009. ISBN: 9780262033848.
2. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.

REFERENCE BOOKS

1. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 2006

NETWORKING LAB	
Code: 25MCA152	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Practical Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- Discuss the nature, uses and implications of internet technology.
- To understand the computer networks and concentrates on building a firm foundation.

COURSE LEARNING OUTCOMES (CLO)

After the completion of this course students will be able to:

- Configure and troubleshoot network devices effectively.
- Implement networking protocols in practical scenarios.

MAPPING MATRIX OF LAB OBJECTIVES (CO) AND LAB LEARNING OUTCOMES (CLO)

	CLO1	**CLO2**
CO1	✓	
CO2		✓

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum 9 of experiments)

1) Study of networking components: hub, switch, router, wired Ethernet.
2) Introduction to cisco packet tracer.
3) Connect the computers in Local Area Network.
4) Creating a point-to-point topology in cisco packet tracer.
5) Creating and comparing the star topology, using hub and switch, in cisco packet tracer
6) Configuring the static routes using multiple routers in cisco packet tracer.
7) Configuring the RIP information using routers in cisco packet tracer.
8) Creating hybrid topology with the use of hub, switch and router in cisco packet tracer.
9) Study of networking commands ping, arp, netstat, ipconfig, tracert.
10) Creating subnets in cisco packet tracer.

TEXT BOOKS

1. A.S. Tanenbaum, Computer Networks (4th ed.), Prentice-Hall of India, 2003
2. Behrouz Forouzan and S.C. Fegan, Data Communications and Networking, McGrawHill, 2006
3. W. Tomasi, Introduction to Data Communications and Networking, PearsonEducation, 2007.
4. S. Haykin, Digital Communications, John Wiley & Sons, Inc., 2005

REFERENCE BOOKS

1. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach (3rd ed.),Morgan Kaufmann, 2003
2. William Stallings, Data and Computer Communications (8th ed.), Pearson Education,2007

SOFTWARE ENGINEERING LAB	
Code: 25MCA154	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Practical Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To understand the concept of UML diagrams.
- To impart the knowledge of diagrams using case study.
- To understand concepts and implements the software engineering methodology.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Each UML diagram is designed to let developers and customers view a software system from a different perspective and in varying degrees of abstraction.
- The student with the opportunity to practice software development skills.
- Learn and understand the mapping and interaction among various components for an automated/smart application.

MAPPING MATRIX OF LAB OBJECTIVES (CO) AND LAB LEARNING OUTCOMES (CLO)

	CLO1	**CLO2**	**CLO3**
CO1	✓		
CO2		✓	
CO3			✓

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform 1 case study based project)

1. Use-Case Diagram – To display the relationship among actors & Use-cases.
2. Activity Diagram – To display the action states & source transition states.
3. State Machine Diagram – sequence of state response & action on the interaction.
4. Sequence Diagram – To display the time sequence of objects interactions.
5. Communication Diagram – To display the elements of frame, lifeline, messages.
6. Online course reservation system
7. Online Exam Registration
8. E-book management System
9. Online course reservation system
10. All UML diagram for one project based case study.

TEXT BOOKS

1. Richard Fairley, "*Software Engineering Concepts*", McGraw Hill, 1985.

2. Roger S. Pressman, "*Software Engineering A Practitioner Approach*" 4th edition, McGraw Hill, 1999.

3. K.K. Aggarwal and Y. Singh, *Software Engineering (revised 2nd ed.),* New Age International Publishers, 2006.

REFERENCE BOOKS

1. Ian Sommerville, *Software engineering*, Pearson education Asia, 6th edition, 2000. Shooman, *Software Engineering*, McGraw Hill, 1983.

TEAMWORK & INTERPERSONAL SKILLS	
Course Code: 23SS152	Continuous Examination: 70 Marks
Credits : 1	End Semester Examination: 30 Marks
L T P: 0 0 2	
Pre-Requisite : NIL	

Training Objectives: -

- TO1. To make the students learn & demonstrate effective teamwork, leadership & interpersonal skills.
- TO2. To equip the students with capability of handling stress and utilization of work time effectively.
- TO3. To make the students understand the importance and application of Emotional Quotient, Critical Thinking & Problem Solving Skills.

Training Learning Outcomes: -

After the completion of the training, the student will have ability:

- TLO1. To be confident working in a team and leading it as well.
- TLO2. To categories the work and achieve expected performance within the time frame & will be able to adapt himself to work under various kinds of stress and re-energies himself to bounce back from such situations.
- TLO3.To get benefitted from Emotional Quotient in building stronger professional relationships and achieving career and personal goals.
- TLO4. To face complex problems and effectively deal with it in the job due to Critical Thinking & Problem Solving Skills.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO)□□ Training Objectives (TO)□	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				
TO3				

Unit	Course Contents	Student Engagement Activity
Unit - I	**Team Management** • Team communication & team conflict resolution • Role of a team leader • Team goal setting & understanding team development • Team dynamics & multicultural team activity • Johari Window Model	Collaborative Working Game Activity
Unit-II	**Time Management** • Time management matrix • Pareto Principle (80/20 rule) • Development process of plan of action	What You Did Yesterday Activity
Unit-III	**Leadership** • Difference between leadership & management • Types of leadership style • Core leadership skills	Lead The Blindfolded Activity
Unit-IV	**Stress Management** • Sign of stress & its impact • Types of stress • Techniques of handling stress	Keeping Cool Activity
Unit - V	**Emotional Intelligence** • Emotional intelligence & emotional competence • Components & behavioral skills of emotional intelligence	Guess The Emotion Game Activity
Unit - VI	**Critical Thinking** • Types of thinking & Characteristics • Critical thinking standards • Barriers to critical thinking	Think Pair Share Activity
Unit-VII	**Problem Solving** • Types of problems & its solutions • Problem solving process & tools	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2018.
Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.

- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Teamwork & Interpersonal Skills

<table>
<tr><th>Unit No.</th><th>Unit Name</th><th>Internal Assessment Parameter</th><th>Internal Marks (70)</th><th>End Term Assessment Parameters</th><th>End Term Marks (30)</th></tr>
<tr><td>1</td><td>Team Management</td><td rowspan="3">Role Play / Group Activity</td><td>10</td><td rowspan="3">Written Test</td><td rowspan="3">10</td></tr>
<tr><td>2</td><td>Time Management</td><td>10</td></tr>
<tr><td>3</td><td>Leadership</td><td>10</td></tr>
<tr><td>4</td><td>Stress Management</td><td>Assignment</td><td>10</td><td rowspan="4">Viva</td><td rowspan="4">20</td></tr>
<tr><td>5</td><td>Emotional Intelligence</td><td rowspan="2">Written Test</td><td>10</td></tr>
<tr><td>6</td><td>Critical Thinking</td><td>10</td></tr>
<tr><td>7</td><td>Problem Solving</td><td>Case Story Telling</td><td>10</td></tr>
</table>

SEMESTER-II

DISTRIBUTED OPERATING SYSTEM	
Course Code: 25MCA201	Internal Examination: 40 Marks
Credits : 4	External Examination: 60 Marks
L T P: 3 1 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To introduce the operating system, functions, design, and implementations.
- To understand the requirements of clock synchronization and protocols.
- To illustrate real-time distributed systems.
- To understand shared memory resources and their consistency in the model.
- To illustrate the skill of software maintenance and software security.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of the course, students would be able to:

- Demonstrate the concept of client-server model and communication.
- Explain the motivation regarding the requirements of optimistic concurrent protocols.
- Impart knowledge on real-time distributed systems and their scheduling mechanism.
- Implement shared memory and other consistency models.
- Understanding security and reliability issues using high services.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I
INTRODUCTION

Definition, Characteristics of Distributed system, Design issues, Resource sharing and the Web Challenges, System models - Architectural and fundamental models - Networking and

internetworking Communication in distributed system: Layered protocols, ATM networks, Client –Server model, Remote Procedure Calls and Group Communication.

UNIT-II

CONCURRENCY CONTROL

Clock synchronization, Mutual Exclusion, Election algorithm, the Bully algorithm, a Ring algorithm, Transactions - Nested transactions - Locks - Optimistic concurrency control - Timestamp ordering - Comparison - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions

UNIT-III DEADLOCK

Deadlock in Distributed Systems, Distributed Deadlock Prevention, Distributed Deadlock Detection, Threads, and System models, Processors Allocation, Scheduling in Distributed System, Real Time Distributed Systems.

UNIT-IV

DISTRIBUTED FILE SYSTEM

Distributed file systems: Distributed file system Design, Distributed file system Implementation, Trends in Distributed file systems. Distributed Shared Memory: What is shared memory, Consistency models, Page based distributed shared memory, shared variables distributed shared memory.

UNIT-V SECURITY

Overview of security techniques, Cryptographic algorithms ,Digital signatures , Cryptography pragmatics, Replication , System model and group communications, Fault tolerant services, Highly available services , Transactions with replicated data.

TEXT BOOKS

1. Andrew S. Tanenbaum, Maartenvan Steen, Distibuted Systems, —Principles and Pardigms, Pearson Education,2002.
2. George Coulouris, Jean Dollimore and Tim Kindberg, —Distributed Systems Concepts and Design, 3rd Edition, Pearson Education,2002.

REFERENCE BOOKS

1. Tanenbaum and Steen, Distributed Systems PHI, 2002.
2. Albert Fleishman, Distributed Systems: Software Design and Implementation,

Springer Verlag, 1994.
3. SapeMullender, Distributed Systems 2nd Edition, Addison Wesley, 1993.

JAVA PROGRAMMING	
Course Code: 25MCA202	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination:60 Marks
L T P : 4 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To introduce to the basic principles of Java programming, including classes, objects, inheritance, and exception handling.
- To Explore advanced Java concepts such as packages, polymorphism, interfaces, and abstract classes.
- To Introduce to stream-based I/O operations, multithreading, and synchronization in Java.
- To Familiarize with GUI programming using Abstract Window Toolkit (AWT) and handling exceptions in Java programs.
- To Introduce to database programming using Java Database Connectivity (JDBC) for executing SQL statements and managing database transactions.

COURSE LEARNING OUTCOMES (CLO)

The syllabus adhere to all Bloom's Taxonomy Levels and has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Understand the fundamental concepts and syntax of the Java programming language, including classes, objects, inheritance, and exception handling.
- Apply Java programming concepts and techniques to develop software solutions, including implementing inheritance hierarchies, utilizing packages, and designing user interfaces.
- Demonstrate proficiency in stream-based I/O operations, multithreading, and synchronization techniques in Java programming.
- Evaluate user requirements and determine the suitability of Java programming language for meeting software functionality needs.
- Propose and implement solutions using Java programming language for various problem domains, such as GUI development, database programming, and multithreaded applications.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

Unit-I

A way of viewing world – Agents and Communities, messages and methods, Responsibilities, Classes and Instances, The Evolution of Java, Buzzwords of Java, Class Fundamentals, Declaring Objects, Overloading methods, Constructors, Parameterized Constructors - this Keyword. Class Hierarchies- Inheritance, Method binding, Overriding and Exceptions, Summary of Object-Oriented concepts. Object- Oriented Programming (OOP) Principles.

Unit-II

Inheritance– Inheritance concept, Inheritance basics, Member access, Constructors, Creating Multilevel hierarchy, super uses, using final with inheritance.

Packages: Understanding Packages, Defining a Package, Packaging up Your Classes, Adding Classes from a Package to Your Program, Understanding CLASSPATH, Standard Packages, Access Protection in Packages, Concept of Interface.

Polymorphism-ad hoc polymorphism, pure polymorphism, constructor overloading, method overriding, abstract classes, Object class, forms of inheritance specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance.

Unit-III

Stream Based I/O(JAVA.IO)

The Stream Classes-Byte streams and Character streams, reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, auto boxing, generics.

Multithreading- Differences between thread-based multitasking and process- based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication.

Unit-IV

AWT: Introduction, limitation of AWT, MVC architecture, components, containers. Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout. Event Handling- The delegation event model consists of events, event sources, event listeners, event classes, handling mouse and keyboard events, adapter classes, inner classes, and anonymous inner classes.

Exception Handling: Fundamentals of exception handling, Exception types, Termination or presumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes.

Unit-V

Database Programming: The design of JDBC, JDBC configuration, executing SQL statements, Scrollable and Updatable Result sets, Row sets, Transactions.

Basics of JSP, and Servlets.

TEXT BOOKS

1. Programming with Java A Primer, E.Balaguruswamy Tata McGraw Hill Companies.
2. Patrick Naughton and Herbertz Schildt, "Java-2: The Complete Reference", TMH, 1999.
3. Paul Dietel and Harvey Deitel, "Java How to Program", PHI, 8th Ed., 2010.

REFERENCE BOOKS

1. Decker and Hirshfield, "Programming Java: A Introduction to Programming Using JAVA", Vikas Publication, 2000.
2. Horstmann, "Computing Concepts with Java 2 Essentials", John Wiley

CLOUD COMPUTING	
Course Code: 25MCA203	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To Interpret the types and service models of any given cloud platform.
- To analyze and reveal the core issues in line with the security, privacy, and interoperability in cloud platform.
- To assess the comparative advantages and disadvantages of Virtualization technology.
- To offer the appropriate cloud computing models based on the application requirements.
- To create a cloud environment using open source software tools.

COURSE LEARNING OUTCOMES (CLO)

The syllabus adhere to all Bloom's Taxonomy Levels and has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, as well as the characteristics, advantages, and challenges brought about by the various models and services in cloud computing.
- Identify resource management fundamentals, i.e. resource abstraction, sharing, and sandboxing and outline their role in managing infrastructure in cloud computing.
- Apply the fundamental concepts in datacentres to understand the trade-offs in power, efficiency and cost.
- Analyze various cloud programming models and apply them to solve problems on the cloud.
- Enable students exploring some important cloud computing driven commercial systems and applications and expose to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNING OUTCOMES (CLSs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I

Recent trends in computing, evolution of cloud computing, Cloud computing (NIST model), properties, characteristics and disadvantages, role of open standards.

UNIT-II

Types of Cloud services: Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service- Monitoring as a Service, Communication as services. Service providers, Google App Engine, Amazon EC2, Microsoft Azure, Sales force.

UNIT-III

Basics of Virtualization, Types of Virtualization, Implementation Levels of Virtualization, Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Datacenter Automation. Introduction to MapReduce, GFS, HDFS, Hadoop Framework.

UNIT-IV

Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data: Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing

UNIT-V

Infrastructure security, Data security and storage, Identity and Access Management, Access Control, Trust and Reputation, Authentication in Cloud computing.

TEXT BOOKS

1. Cloud Computing-A Practical Approach" Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGraw-Hill.
2. Tim Mather, Subra Kumara swamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Media Inc.
3. Barrie Sosinky, Cloud Computing: Bible, 1st edition, Wiley Publishing, Inc., 2011.

REFERENCE BOOKS

1. Syed A.Ahson and Mohammed Ilyas, Cloud Computing and Software Services: Theory and Techniques, CRC Press, Taylor and Francis Group, 2010.
2. Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Cloud Computing for Dummies. Wiley- India edition, 2010

Discrete Mathematics & Graph Theory	
Course Code: 25MCA 204	Continuous Evaluation: 40 Marks
Credits : 4	End Semester Examination: 60 Marks
L T P: 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To understand the concepts of sets and relations.
- To impart the basic concepts of predicate calculus and quantifier.
- To impart the knowledge of logical reasoning and Boolean expressions along with logic circuits.
- To understand the concepts of graphs and Trees.
- To understand concepts about Matrix representation of graphs and graph theoretical algorithms.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of the course, students would be able to:

- Perform operations on various discrete structures such as set, function, and relation.
- Apply the concept of Predicate Calculus in computer science like the design of computing
- Machines, artificial intelligence, the definition of data structures for programming languages etc.
- Demonstrate the various concepts of simplifications of Boolean expressions and logic circuits.
- Apply abstract concepts of graph theory in modeling and solving non-trivial problems in different field of study.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I

SET THEORY

Definition of sets, countable and uncountable sets, Venn Diagrams, proofs of some general identities on sets.

RELATION

Definition, types of relation, composition of relations, Pictorial representation of relation, equivalence relation, partial ordering relation.

FUNCTION

Definition, type of functions, one to one, into and onto function, inverse function, composition of functions, Recursive Functions.

UNIT-II

PREDICATE CALCULUS

Proposition, Logical operators and expressions, predicates, Rules of quantifiers, Rules of Inference for propositions and predicates. The existential and universal quantifiers - Predicate calculus including theory of inference.

UNIT-III

BOOLEAN ALGEBRA AND LOGIC CIRCUITS

Fundamental concepts of Boolean algebra, laws and rules of Boolean algebra, Boolean expression and their equivalences, Min- terms and Max-terms of Boolean expressions, Canonical forms, Karnaugh map, Logic Gates- AND, OR, NOT, NAND, NOR, XOR and XNOR, logic circuits, converting Boolean expression to logic circuit.

UNIT-IV

GRAPHS AND TREES

Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, Basic properties of trees, Binary trees, Spanning and Minimal spanning trees, Planarity of graphs, Planar graphs, Multi graph, Chromatic number.

UNIT-V

MATRIX REPRESENTATIONS AND GRAPH ALGORITHMS

Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs: 1 and 2- isomorphism, Matrix representation of graphs, adjacency and incidence matrix, Graph theoretical algorithms: Dijkstra, prims and Kruskal, Traversing a graph- Breadth-First search and Depth-First search.

TEXT BOOKS

1. C.L. Liu &Mahopatra, Elements of Discrete mathematics, 2nd Sub Edition1985, Tata Mc Graw Hill.
2. Rosen, Discrete Mathematics and Its Applications, Sixth Edition
3. Narsingh Deo: Graph Theory with Applications to Engineering and Computer Science, PHI, 1974

REFERENCE BOOKS

1. Kolman, Busby Ross, “Discrete Matheamatical Structures”, Prentice Hall International.

JAVA PROGRAMMING LAB	
Code: 25MCA252	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Practical Examination:40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To comprehend fundamental concepts of OOP including classes, objects, inheritance, and polymorphism through practical implementation.
- To explore advanced Java features such as inheritance, packages, interfaces, and exception handling to develop robust and efficient Java programs.
- To understand the concepts of multithreading and synchronization in Java and apply them to simulate concurrent execution scenarios like a banking system.
- To design and implement GUI applications using AWT components, layout managers, and event handling to create user-friendly software interfaces.
- To learn database connectivity with Java using JDBC and develop web applications using Servlets and JSP for dynamic web content generation and interaction.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Able to design and implement Java classes, handle inheritance, and demonstrate polymorphic behavior to solve real-world problems effectively. Use Java programming language for various programming technologies.
- Demonstrate proficiency in core Java concepts such as inheritance, packages, interfaces, and exception handling through practical programming assignments.
- Developing multithreaded Java applications and synchronize concurrent threads to ensure thread safety and prevent race conditions.
- Design and develop GUI applications using AWT components, layout managers, and event listeners to create interactive and visually appealing user interfaces.
- cquire skills to connect Java applications to databases using JDBC, execute SQL queries, and develop dynamic web applications using Servlets and JSP for user interaction and data manipulation.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) AND COURSELEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

LIST OF EXPERIMENTS

1. Write a program to create a Java class representing a student with attributes like name, roll shapes like Circle, Square, and Triangle. Implement interfaces like "Shape" and number, and marks. Overload methods to calculate the total marks for a student with different sets of parameters.
2. Write a program to demonstrate inheritance and class hierarchies by creating a superclass "Vehicle" with attributes like make, model, and year. Then, create subclasses like "Car" and "Motorcycle" inheriting from "Vehicle" and demonstrate the use of super keyword.
3. Write a program to create a superclass "Vehicle" with attributes like make, model, and year. Then, create subclasses like "Car" and "Motorcycle" inheriting from "Vehicle" and demonstrate the use of super keyword.
4. Write a program to create a package named "geometry" containing classes for geometric
5. "Drawable" to demonstrate polymorphism.
6. Write a program to read data from a text file, manipulate it, and write the modified data back to another file. Implement serialization to save and retrieve objects to/from a file.
7. Write a program to simulate a bank where multiple threads represent multiple account holders performing deposit and withdrawal operations. Synchronize the threads to avoid race conditions.
8. Write a program to design a GUI application for a library management system using AWT components like buttons, text fields, and labels. Use different layout managers to organize the components effectively.
9. Write a program that reads an integer from the user and divides it by another integer. Implement exception handling to handle scenarios like divide by zero and invalid input. Also, handle button click events using event listeners.
10. Write a program to connect to a MySQL database, execute SQL queries to retrieve data, and display the results. Implement functionalities like inserting, updating, and deleting records using JDBC.
11. Write a program to develop a web application using Servlets and JSP to create a simple registration form. Implement functionalities to validate user inputs and store the data in a database using JDBC.

Note:

1. **Students will create a project in teams to analyse and apply the concepts learnt.** **TEXT BOOKS**

1. Programming with Java A Primer, E.Balaguruswamy Tata McGraw Hill Companies.
2. Patrick Naughton and Herbertz Schildt, “Java-2: The Complete Reference”, TMH.
3. J. Bloch, *Effective Java*, 3rd ed., Addison-Wesley Professional.
4. K. Sierra and B. Bates, *Head First Java*, 2nd ed., O'Reilly Media.
5. Paul Dietel and Harvey Deitel, “Java How to Program”, PHI.

REFERENCE BOOKS

1. Decker and Hirshfield, "Programming Java: A Introduction to Programming Using JAVA", VikasPublication, 2000.
2. Horstmann, "Computing Concepts with Java 2 Essentials", John Wiley.
3. J. Bloch, Effective Java, Addison-Wesley Professional.
4. H.Schildt, Java: The Complete Reference, McGraw-Hill Education.

CLOUD COMPUTING LAB	
Code: 25MCA253	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Practical Examination: 40 Marks
L T P : 0 0 2	
Prerequisite:	

COURSEOBJECTIVES (CO)

- To analyse and reveal the core issues in line with the security, privacy, and interoperability in cloud platform.
- To assess the comparative advantages and disadvantages of Virtualization technology.
- To offer the appropriate cloud computing solutions based on the application requirements.
- To use different prominent cloud computing technologies available in the market place.
- To create a cloud environment using open source software tools

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

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

- Explain the fundamental principles of cloud computing and its related Concepts
- Analyze Prominent Cloud computing technologies available in the marketplace.
- Discuss virtualization technologies along with the architectural models of cloud computing.
- Leverage the prominent Cloud computing technologies available in the market place.
- Demonstrate different features of cloud platforms used in Industry.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

LIST OF EXPERIMENTS

1. To study of Cloud Computing & Architecture and types of Cloud Computing.
2. To create and run virtual machines on open source OS.
3. To implement Infrastructure as a Service, Installing OpenStack and use it as Infrastructure as a Service.

4. To install Storage as Service. [Installation and understanding features of ownCloud as SaaS.]
5. To implement identity management. [installing and using identity management feature of OpenStack]
6. To write a program for web feed [PHP, HTML]
7. To simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
8. To install Hadoop single node cluster and run simple applications like wordcount.
9. To find a procedure to transfer the files from one virtual machine to another virtual machine.
10. Install Google App Engine. Create hello world app and other simple web applications using python/java.

Note:

- **Students will create a project in teams to analyse and apply the concepts learnt.**

TEXT BOOKS

1. Cloud Computing-A Practical Approach" Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGraw-Hill.
2. Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'ReillyMedia Inc.
3. Barrie Sosinky, Cloud Computing: Bible, 1st edition, Wiley Publishing, Inc.2011.

REFERENCE BOOKS

1. Syed A.Ahson and Mohammed Ilyas, Cloud Computing and Software Services: Theory and Techniques, CRC Press, Taylor and Francis Group, 2010.

2. Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Cloud Computing for Dummies.Wiley- India edition, 2010.

Live Project-I	
Course Code:25MCA254	Internal Examination: 60 Marks
Credits : 1	External Examination: 40 Marks
L T P: 0 0 2	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To make the students solve real world problems using automated solutions, while developing management and writing skills amongst them.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP).
After completion of course, students would be able to:

- Show preparedness to work independently on real time problem scenarios to be addressed using knowledge of fundamentals, techniques, programming languages and tools in the area of Computer Science.
- Use the innovative ideas and thoughts to address real life issues and provide efficient solutions for process oriented works.
- Practice and develop skills in time management and reporting within an industrial or research laboratory setting.
- Contribute to an ethical and professional work culture and also to learn to work in diverse teams.
- To build the confidence in report writing.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓	✓	✓	✓	✓

PROCESS:

The practical implementation of theoretical knowledge gained during the study in first year. Students are required to implement their original ideas, modification/enhancement of the existing engineering techniques, real time industrial problems, and current applications of their courses of study. Projects work can be of two types: Projects based on implementation of any application oriented problem which will be more or less experimental in nature and the others will be based on some innovative/ theoretical work

Each student or group of students is given an exercise which will cover all the aspects (to the extent possible) like investigation, planning, designing, detailing and estimating of a Computer Science structure in which the aspects like analysis, application of relevant codes, etc., will find a place. Alternately, a few problems also may be identified for investigation

and the use of laboratory facilities to the fullest extent may be taken as a project work. Alternately, a student is encouraged to take an industrial project with any Computer Science/IT organization or firm. A project report is to be submitted on the topic which will be evaluated.

PROFESSIONAL WRITING SKILLS & INTERPERSONAL SKILLS: STRATEGIES	
Course Code: 23SS254	Continuous Evaluation: 70 Marks
Credits : 1	End Semester Examination: 30 Marks
L T P: 0 0 2	
Pre-Requisite : NIL	

Training Objectives: -

- TO1. To encourage student to learn and apply the effective writing skills.
- TO2. To make the students learn various types of business correspondence letters, cover letters & resume.
- TO3. To encourage student to learn as to how to talk and convince people in GD & interview.
- TO4. To make the student learn to build rapport for building positive relationships professionally at workplace.

Training Learning Outcomes: -

After the completion of the training, the student will have ability:

- TLO1. To understand the importance of professional writing required in workplace.
- TLO2. To explore different formats in resume, cover letters & other business related letters.
- TLO3. To develop knowledge, skills and understanding people in-group and individually.
- TLO4. To apply communication strategies either in-group or one on one basis and will be confident to lead the discussion among them.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO) □ Training Objectives (TO)□□	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				
TO3				
TO4.	-	-	-	

Unit	Course Contents	Student Engagement Activity
Unit-I	**Email Writing** • Importance of email communication skills • Basic rules of effective email writing • Structure of email – address, subject, message text, attachments, signature	Email Practice Activity
Unit-II	**Resume Writing** • Difference between Resume, CV & Bio data • Guidelines of resume writing • Resume preparation of the student	Resume Making Activity
Unit-III	**Cover Letter Writing** • Objective of cover letter writing • Types of cover letters • Format & content of the cover letter	Cover Letter Practice Activity
Unit--IV	**Group Discussion (GD)** • Characteristics of GD & subject knowledge • Do's & Don'ts in GD • Strategies of GD • Types of GD	Group Discussion Practice Activity
Unit-V	**Interview Skills** • Preparation of the interview & company details information • Do's & Don'ts in interview • Types of Interviews • Strategies of interview	Mock Interview Practice Activity
Unit-VI	**Negotiation Skills** • Importance of negotiation skills • Four phases of negotiation skills • Barriers to negotiation & overcoming it • Win-win negotiation	Win Win Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2018.
Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019. (ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Professional Writing Skills & Interpersonal Skills: Strategies

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
1	Email Writing	Written Assignment	10	Written Test	10
2	Resume Writing		10		
3	Cover Letter Writing		10		
4	Group Discussion	Group Discussion Activity	15	Viva	20
5	Interview Skills	Mock Interview Activity	15		
6	Negotiation Skills	Role Play	10		

DESIGN THINKING AND AUGMENTED VIRTUAL REALITY-LEVEL- I	
Course Code: 23CS0301	Continuous Evaluation: 70 Marks
Prerequisite: NIL	End Semester Examination:30 Marks
L T P : 0 0 2	
Credits: 1	

TRAINING OBJECTIVES (CO)
1. To recognize the importance of DT.
2. To explain the phases in the DT process.
3. To familiarize the students with the Augmented Virtual Reality Environment.
4. To establish and cultivate a broad and comprehensive understanding of this rapidly evolving and commercially viable field of Computer Science

TRAINING LEARNING OUTCOMES (TLOS) After the completion of TRAINING the students will be able to:
1. Understand and critically apply the concepts and methods of business processes.
2. Understand and analyzing design thinking history and its various concepts.
3. Understand, analyzing and create models with users collaboration to apply design thinking concepts.
4. Understands the role and importance of graphics in VR, AR and MR.
5. Understand the technical and experiential design foundation required for the implementation of immersive environments in current and future virtual, augmented and mixed reality platforms.

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	**TLO2**	**TLO3**	**TLO4**	**TLO5**
TO1	✓				
TO2		✓			
TO3			✓		
TO4				✓	✓

TRAINING CONTENTS

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
I	**INTRODUCTION TO DT** Recognize the importance of Design Thinking, Identify the steps in the DT process, Recognize the steps in the empathize phase of DT, Identify the steps required to conduct an immersion activity	Product that you loved and hated activity.
II	**DEFINE PHASE OF DT** Conduct an immersion activity and fill up the DT question template, Recognize the steps to create personas in the define phase of DT, Recognize the steps to create problem statements in the define phase of DT, Define the problem statements in the define phase of DT.	Interview people and fill the DT Question template
III	**IDEATE PAHSE OF DT** Recognize the steps in the ideate phase of DT, Apply the steps in the ideate phase of DT, Recognize how doodling can help to express ideas, Recognize the importance storytelling in presenting ideas and protypes, Recognize the importance of the prototype phase in DT.	Ideate a solution for a Given problem.
IV	**INTRODUCTION TO VR and AR** Historical Overview, Current Trends and Future applications of Immersive Technologies, Best practices in VR, AR and Mixed Reality (MR), Categorization of VR and AR techniques, Input and Output devices used in AR and VR. Case Study : Google Lens, ARCore	To study various AR and VR based existing applications.
V	**HANDS ON ACTIVITY** This activity will help the students to identify the importance of an innovative approach : a) Discuss about a product that you like or dislike and identify what they need in a bad product to make it good. b) Design a prototype how AR and VR can be used in Education.	Designing of Solution to the Problem.

LEARNING RESOURCES

1. Hooked by Nir Eyal
2. The Art of Creative Thinking by Rod Judkins
3. Start Up nation by Dan Senor and Saul singer
4. Start with Why by Simon Sinek
5. Kelly S. Hale (Editor), Kay M. Stanney (Editor). 2014. Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13: 978-1466511842
6. Michael Madary and Thomas K. Metzinger. 2016. Real Virtuality: A Code of Ethical Conduct.Recommendations for Good Scientific Practice and the Consumers of VR-Technology. Frontiers in Robotics and AI 3, February: 1–23. http://doi.org/10.3389/frobt.2016.00003
7. Jason Jerald. 2015. The VR Book: Human-Centered Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool Publishers. http://doi.org/10.1145/2792790

SEMESTER-III

BIG DATA & ANALYTICS	
Course Code: 25MCA301	Continuous Evaluation: 40 Marks
Credits : 4	End Semester Examination: 60 Marks
L T P: 3 1 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To impart the basic concepts of analysis for growing data and its complexities.
- To understand concepts about statistical analysis and inferential statistics.
- To impart knowledge on various tools and technologies to manage and analyze the bigdata.
- To illustrate knowledge management mechanism for better decision making.
- To enable them to work on big data related applications and solve real world applicationsusing tools such as Apache Hadoop.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain the motivation for big data systems and identify the main sources of Big Data inthe real world and driver analysis of big data.
- Demonstrate an ability to use analytics efficiently store retrieve and process Big Data for inferential analysis that will help in solving real world problems.
- Implement several tools such as IBM Cognos to understand visual perception in a betterway.
- Apply several newer algorithms for Clustering Classifying and finding associations in BigData using Knowledge discovery mechanism.
- Design an ecosystem to monitor and maintain the large number of files using big data toolsApache Hadoop.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I
INTRODUCTION

Big Data and its importance, Four V's, Extended 4 to 6 V's, Drivers for Big data, big data analytics, and big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map

Reduce.

UNIT-II
STASTICAL ANALYSIS

Basic Statistics, Descriptive Statistics, Frequency Distributions, Histograms, Shapes of Distributions, Measures of Central Tendency Computing the Mean, Measuring Variability, Measuresof Relationship, Regression, Reliability Indices, Standard Scores (Z scores),Inferential Statistics, Populations and Samples. The Null Hypothesis, Chi-Square and T-Test, Statistical Decisions.

UNIT-III
DATA VISUALIZATION

Meaning and significance, Traits of Meaning full Data, Brief History of Information Visualization, Power of visual perception, Making abstract data Visible, Building Blocks of information Visualization. Analytical Techniques, Using tool IBM Cognos for understanding data visualization.

UNIT- IV OLAP

Big Data, In-Memory Processing, limitations of In Memory Processing. Big Data Privacy, Big data Visualization, Map Reduce algorithm, OLAP and its applications, Data Mining Process, Knowledge Discovery, Decision Support Systems

UNIT-V
APACHE HADOOP

Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce, Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

TEXT BOOKS

1. Stephen Few, “Now You See It: Simple Visualization Techniques for Quantitative Analysis” Publisher: Jonathan G Koomey.
2. Frank J. Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money Publisher: Wiley.

REFERENCE BOOKS

1. Gelman, Andrew, and Jennifer Hill. Data Analysis Using Regression and Multilevel/Hierarchical Models. 1st ed. Cambridge, UK: Cambridge University Press, 2006. ISBN: 9780521867061.
2. Gelman, Andrew, John B. Carlin, Hal S. Stern, and Donald B. Rubin. Bayesian Data

Analysis. 2nd ed. New York, NY: Chapman & Hall, 2003. ISBN: 9781584883883.

PYHTON PROGRAMMING	
Course Code: 25MCA302	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To outline the basics fundamental concepts of python programming including its features, history, datatypes and variables
- To acquire Object Oriented Skills in Python.
- To constructs of Python language such as control statements, functions, strings, files,and various data structures.
- To provide practical knowledge and skills in file handling, module creation and usage, iterators, and generators in Python, empowering them to manage and manipulate data efficiently.
- To Introduce the field of data science, visualization using Python (NumPy, Pandas, Matplotlib, and Seaborn) for data manipulation, analysis, and visualization.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Understand and comprehend the basics of python programming.
- Demonstrate the principles of structured programming and be able to describe, design, implement object-oriented solutions using classes, objects, inheritance, and encapsulation.
- Explain the use of the advanced Python constructs such as iterators, generators, and comprehensions, and utilize built-in data structures like lists, sets, dictionaries, and tuples effectively to solve real-world programming challenges.
- Acquire the skills to read from and write to files, handle file operations, and create and utilize modules and packages in Python, enabling them to develop modular and reusable code for various applications.
- Demonstrate proficiency in performing data analysis tasks using Python libraries such as NumPy and Pandas, visualize data using Matplotlib and Seaborn, and effectively interpret and communicate insights derived from data.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	

CO5					✓

COURSE CONTENTS

UNIT-I

Introduction of Python: History and Need for Python, Python Installation and IDLE, Python Syntax, Identifiers, and Keywords.

Data Types and Objects: Basic Data Types: Integral and Floating Point, Numerical Types and Expressions, Variables and Constants, Comments and Documentation Strings.

Branching and Iteration: Conditional Statements (if, elif, else), Looping Constructs (for, while), Control Flow Statements (break, continue, pass), Iteration Techniques.

Basic Input/Output: Reading from and Writing to the Console, Working with Strings and String Methods.

Structured Data Types: Tuples and Tuple Methods, Ranges, Lists, List Methods, Cloning, and List Comprehensions, Sets, Set Methods, Frozen sets, Dictionaries, Dictionary Methods, Default Dictionaries, Ordered Dictionaries, and Traversal.

Unit-II

Classes in Python: New Style Classes, Creating Classes, Instance Methods, Inheritance, Polymorphism, Exception Classes & Custom Exceptions.

Functions: Built-in and User-Defined Functions, Function Arguments: Positional, Keyword, Default, Variable Length, Returning Values from Functions, Scope of Variables: Local and Global, The Global Keyword and Passing Groups of Elements, Recursive Functions, Anonymous Functions(Lambda) with 'filter()', 'map()', 'reduce(), Function Decorators and Generators.

Modules: Creating and Using Modules, The Special Variable '__name__', Structured Programming Principles.

Unit-III

Exception Handling: Types of Errors (Compile- Time, Runtime, Logical), Exception Handling Using try-except Blocks, The assert Statement, User-Defined Exceptions, Logging Exceptions.

Operators and Expressions: Arithmetic, Comparison, Assignment, Logical, Bitwise Operators, Membership and Identity Operators, Complex Expressions and Precedence Rules.

Arrays in Python: Working with Arrays Using Libraries like NumPy

Unit-IV

File Handling: Reading and Writing Files, Working with CSV and JSON files, File and Directory Management.

Modules and Packages: Importing Modules, Creating and Using Packages, Standard Libraries Overview.

Iterators and Generators: Iterator Protocol, Generators and Yield Statement.

Unit-V

Introduction to Data Science: Overview of Data Science Workflow, Python Libraries for Data Science (NumPy, Pandas, Matplotlib, Seaborn)

Data Analysis and Visualization: Data Manipulation with Pandas, Data Visualization Techniques, Plotting with Matplotlib and Seaborn.

TEXT BOOKS

1. "Python Programming: A Modern Approach", Vamsi Kurama, Pearson
2. "PythonProgramming",Oxford,ReemaThareja,June2017
3. "Learning Python", Mark Lutz, Orielly
4. "Think Python", Allen Downey, Green Tea Press
5. "Python Cookbook" by David Beazley and Brian K.Jones
6. "Python for Data Analysis" by Wes McKinney

Reference Books:

1. E. Matthes, Python Crash Course, No Starch Press.
2. A. Sweigart, Automate the Boring Stuff with Python, No Starch Press.
3. L. Ramalho, Fluent Python, O'Reilly Media.
4. D. Beazley and B. K. Jones, Python Cookbook, O'Reilly Media.
5. B. Slatkin, Effective Python: 90 Specific Ways to Write Better Python, Addison-Wesley Professional.
6. M. Lutz, Learning Python, O'Reilly Media.

ARTIFICIAL INTELLIGENCE	
Course Code: 25MCA303	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination:60 Marks
L T P : 3 1 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

The goal of learning Artificial Intelligence is

- To Grasp the foundational principles of Artificial Intelligence (AI) and intelligent agents.
- To explore various knowledge representation techniques, and machine learning approaches.
- To gain proficiency in Artificial Neural Networks and Deep Learning.
- To understand different types of uncertainty and various probability constructs.
- To explore parsing techniques used in natural language processing (NLP).

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Define and explain the core concepts of AI, intelligent agents, and their environments.
- Represent knowledge using propositional logic and first-order logic, and implement supervised and unsupervised machine learning algorithms for data analysis and classification.
- Explain the architecture, learning algorithms, and deep learning techniques and their applications in specific domains.
- Apply probability theory and Bayes' theorem to reason under uncertainty in AI problems.
- Implement basic parsing techniques to understand the structure of natural language sentences.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNING OUTCOMES (CLSs)

	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**	**CLO 5**
CO 1	✓				
CO 2		✓			
CO 3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

Unit-1

Introduction and Problem Solving:

Foundations of Artificial Intelligence, Intelligent agents, their environments, heuristic search techniques, including A* search , AND/OR graphs, problem reduction & AO* algorithm, and other best-first search algorithms, Constraint Satisfaction and Reasoning, solve constraint satisfaction problems using backtracking, forward checking and other methods.

Unit-II

Knowledge representation techniques, such as Propositional, Skolemization, resolution, unification and first order logic. Probabilistic reasoning for AI, including Bayesian networks and inference algorithms, Machine Learning and Neural Networks: machine learning algorithms, such as supervised(Linear Regression, Logistic Regression, KNN, Decision trees) and unsupervised learning(PCA, LDA, K-means Clustring) techniques, and how to pre-process and analyse data, Find S, Concept learning search and Candidate Elimination Algorithm (CEA), evaluating a hypothesis, probably learning approximately correct hypothesis, and function approximation.

Unit-III

Artificial Neural Networks (ANN), including the structure and functionality of feedforward and recurrent networks. Architecture, learning and inference. Performance measures. Convolutional Neural Networks (CNN), Recurrent Neural Network (RNN), and Deep Learning techniques for tasks like image recognition, natural language processing, and reinforcement learning.

Unit-IV

Probabilistic Reasoning and Uncertainty:

Probability theory, bayes theorem and Bayesian networks, certainty factor, Different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions.

Unit-V

Natural Language Processing

Parsing techniques, context-free grammar, recursive transitions nets (RNT), augmented transition nets (ATN), case and logic grammar, semantics analysis.

TEXT BOOKS

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach (2nd ed.), Pearson Education, 2005.
2. Ivan Bratko, Prolog Programming for Artificial Intelligence.
3. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill, 2002.
4. Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers, Inc., San Francisco, California, 2000.

REFERENCE BOOKS

1. R. Akerkar, Introduction to Artificial Intelligence, Prentice-Hall of India, 2005
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, 2006.
3. Nils J. Nilson, Principles of Artificial Intelligence, Narosa Publishing House, 2001
4. Clocksin and C.S. Mellish, Programming in PROLOG, Narosa Publishing House, 2002.

NETWORK SECURITY	
Course Code:25MCA304	Continuous Evaluation: 40 Marks
Credits : 4	End Semester Examination:60 Marks
L T P: 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To impart the basic concepts and need of cryptography and cryptographic algorithms.
- To impart the knowledge of mathematical basics to cryptography.
- To understand concepts about hash function and various digital signature and standards.
- To illustrate knowledge to the network and IP security needs.
- To understand concepts about firewall and various security issues and threats.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Understand the theory of fundamental cryptography, encryption, decryption and symmetric and public key cryptographic algorithms.
- Understand the various mathematical foundations for cryptographic algorithms.
- Demonstrate the various authentication applications and its requirements.
- Comprehend different mechanisms related to network security, IP security and application privacy.
- Interpret and Apply the functionalities of firewall

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I
INTRODUCTION

Introduction to security attacks, services and mechanism, Classical encryption techniques substitution ciphers and transposition ciphers, cryptanalysis, steganography, Stream and block ciphers.
Modern Block Ciphers: Block ciphers principles, Shannon's theory of confusion and diffusion, fiestalstructure, Data encryption standard (DES), Strength of DES, Idea of differential cryptanalysis, Triple DES

UNIT-II
MATHEMATICAL FOUNDATION

Introduction to group, field, finite field of the form GF(p), modular arithmetic, prime and relative prime numbers, Extended Euclidean Algorithm, Fermat's and Euler's theorem, Advanced Encryption Standard (AES) encryption and decryption, Principals of public key crypto systems, RSA algorithm, security of RSA

UNIT-III
CRYPTOGRAPHIC HASH FUNCTIONS AND DIGITAL SIGNATURES

Message Authentication Codes: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions, Secure hash algorithm (SHA), Digital Signatures: Digital Signatures, Digital signature standards (DSS), proof of digital signature algorithm

UNIT-IV
NETWORK AND SYSTEM SECURITY

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Introduction to Secure Socket Layer, Secure electronic, transaction (SET) Authentication Applications: Kerberos
Electronic mail security: pretty good privacy (PGP), S/MIME.
System Security: Introductory idea of Intrusion, Viruses and related threats

UNIT-V FIREWALLS
IDS and Firewalls: Intruders, Intrusion Detection, Password Management, Firewalls-Characteristics, Types of Firewalls, Placement of Firewalls, Firewall Configuration, Trusted Systems.
Non-cryptographic protocol Vulnerabilities: DoS, DDoS, Session Hijacking and Spoofing, Software Vulnerabilities- Phishing, Buffer Overflow

TEXT BOOKS

1. William Stallings, "Cryptography and Network Security – Principles and Practices", Prentice Hall of India, Third Edition, 2003.
2. Behrouz A. Frouzan: Cryptography and Network Security, TMH.
3. Matt Bishop ,"Computer Security art and science ", Second Edition, Pearson Education, 2002

REFERENCE BOOKS

1. Bruce Schiener, "Applied Cryptography". John Wiley & Sons.
2. Atul Kahate, "Cryptography and Network Security", TMH.
3. M. Y. Rhee, Cryptography and Secure communication, McGraw-Hill

SEMINAR	
Course Code: 25MCA305	Internal Examination: 60 Marks
Credits : 1	External Examination: 40 Marks
L T P: 0 0 2	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

1. To enhance the skill set, student has to present at least two topics in a semester based on latest industry technology.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Simulate real life situations and impact adequate training, so that, confidence to face and tackle any problem in the field is developed.
2. Analyse the selected topic, organize the content and communicate to audience in an effective manner.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**
CO1	✓	✓

PYTHON PROGRAMMING LAB	
Code: 25MCA352	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Practical Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To outline the basics of python programming, Features, history, datatypes, variables, conditional statements, and looping.
- To acquire Object Oriented Skills, Functions, and Modules in Python.
- To constructs of Python language such as Exception Handling, Operators, Expressions, and Arrays.
- To Gain experience with File handling and data manipulation.
- To enhance problem solving skills through practical python applications.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Understand and comprehend the basics of python programming, and built-in data structures list, sets, tuples, and dictionary.
- Demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology.
- Understand and use the concept of Exception Handling, Operators, Expressions, and Arrays.
- Focuses on working with different file formats (text, CSV, JSON) and using libraries like NumPy for data analysis.
- Apply programming knowledge to solve real-world problems involving data analysis and visualization.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) AND COURSELEARNING OUTCOMES (CLO)

	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum 10 of experiments)

1. Implement basic Python programs using variables, data types, operators, and control flow statements (if, else, for, while).
2. Define and utilize functions with different argument passing mechanisms (positional, keyword, default).
3. Create custom classes in Python and demonstrate inheritance and polymorphism concepts.
4. Write a program that reads data from a CSV file containing student information (name, roll number, marks) and calculates the average mark for each student.
5. Import and utilize modules and packages for enhanced functionality in Python programs.
6. Employ exception handling techniques (try-except blocks) to manage errors in programs.
7. Work with NumPy arrays for efficient numerical computations.
8. Design and implement iterators and generators in Python.
9. Utilize Pandas library for data manipulation, cleaning, and analysis.
10. Create data visualizations using Matplotlib and Seaborn libraries.
11. Develop a program to simulate a simple ATM machine with functionalities like balance inquiry, cash withdrawal, and deposit. (Use exception handling)
12. Create a program to copy a text file to a new location with a different name. (Implement error handling for file not found)
13. Create a program that utilizes Seaborn to visualize the correlation between different features in a dataset (optional - requires understanding of data analysis concepts).
14. Develop a program that uses Matplotlib to create a bar chart showing the distribution of ages in a given dataset.
15. Develop a program to remove duplicates from a given list.

TEXT BOOKS

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. PythonProgramming,Oxford,ReemaThareja,June2017
3. Learning Python, Mark Lutz, Orielly
4. M Think Python, Allen Downey, Green Tea Press

REFERENCE BOOKS

1. Core Python Programming, W. Chun, Pearson
2. Introduction to Python, Kenneth A. Lambert, Cengage
3. W. McKinney, Python for Data Analysis, O'Reilly Media.
4. J. VanderPlas, Python Data Science Handbook, O'Reilly Media.

5. J. Zelle, Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates Inc.
6. M. Pilgrim, Dive into Python 3, Apress.

ARTIFICIAL INTELLIGENCE LAB	
Code: 25MCA353	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Practical Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To Develop Practical AI Programming Skills.
- To Enhance Problem-Solving Abilities.
- To Master Python Programming for AI.
- To Explore Cutting-Edge AI Technologies.
- To Foster Collaborative Learning Environment.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Develop the ability to implement practical AI solutions using reflex agents, search algorithms, and classification techniques to solve real-world problems.
- Demonstarte proficiency in algorithmic problem-solving by successfully implementing AI algorithms to solve pathfinding, puzzle-solving, and classification tasks.
- Acquire skills in Python Programming for AI, data manipulation, visualization, and analysis to effectively process and interpret datasets in practical scenarios.
- Gain a deeper understanding of advanced AI concepts such as neural networks, CNNs, PCA, k-Means, and Bayesian methods through hands-on experimentation and analysis.
- Develop the ability to communicate findings, insights, and results effectively through written reports, presentations, and discussions based on practical lab experiments in AI.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) AND COURSE LEARNING OUTCOMES (CLO)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum 10 of experiments)

1. Implement a simple reflex agent for a vacuum cleaner. Description: Students will create a simple reflex agent to clean a grid-based environment. The agent will perceive the status of the current cell and decide whether to clean, move, or do nothing.
2. Implement Depth-First Search (DFS) and Breadth-First Search (BFS) algorithms in Python to solve a maze problem. Description: Students will implement the DFS and BFS algorithm to find

the shortest path from the start to the goal position in a grid-based maze.

3. Implement a Constraint Satisfaction Problem (CSP) solver using backtracking to solve a Sudoku puzzle.
4. Implement A* search algorithm to solve the 8-puzzle problem. Description: Students will implement the A* search algorithm to solve the 8-puzzle problem by finding the shortest sequence of moves to reach the goal state.
5. Implement the k-Nearest Neighbors (kNN) algorithm for classification. Description: Students will implement the kNN algorithm to classify a set of data points based on their features and labels and predict the label for a new data point.
6. Implement a simple feedforward neural network with one hidden layer for classification. Description: Students will implement a simple feedforward neural network with one hidden layer to classify a set of data points based on their features and labels.
7. Construct a CNN Model for Medical Image Classification. Consider Breast Cancer dataset for Classification
8. Design a program to perform Principal Component Analysis (PCA) on a dataset to reduce dimensionality and visualize the data.
9. Implement the k-Means clustering algorithm. Description: Students will implement the k-Means clustering algorithm to group a set of data points into k clusters based on their features.
10. Develop a program to calculate conditional probabilities and utilize Bayes' theorem to solve a simple probabilistic reasoning problem.

TEXT BOOKS

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig
2. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow by Aurélien Géron
3. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach. Upper Saddle River, NJ: Pearson
4. D. L. Poole and A. K. Mackworth, Artificial Intelligence: Foundations of Computational Agents. Cambridge, England: Cambridge University Press

REFERENCE BOOKS

1. Fluent Python by Luciano Ramalho
2. Python Crash Course by Eric Matthes
3. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. Sebastopol, CA: O'Reilly Medi

Live Project-II	
Course Code: 25MCA354	Internal Examination: 60 Marks
Credits : 1	External Examination: 40 Marks
L T P: 0 0 2	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To make the students solve real world problems using automated solutions, while developing management and writing skills amongst them.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP).
After completion of course, students would be able to:

- Show preparedness to work independently on real time problem scenarios to be addressed using knowledge of fundamentals, techniques, programming languages and tools in the area of Computer Science.
- Use the innovative ideas and thoughts to address real life issues and provide efficient solutions for process oriented works.
- Practice and develop skills in time management and reporting within an industrial or research laboratory setting.
- Contribute to an ethical and professional work culture and also to learn to work in diverseteams.
- To build the confidence in report writing.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) AND COURSE LEARNING OUTCOMES (CLO)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓	✓	✓	✓	✓

PROCESS:

The practical implementation of theoretical knowledge gained during the study in first year. Students are required to implement their original ideas, modification/enhancement of the existing engineering techniques, real time industrial problems, and current applications of their courses of study. Projects work can be of two types: Projects based on implementation of any application oriented problem which will be more or less experimental in nature and the others will be based on some innovative/ theoretical work

Each student or group of students is given an exercise which will cover all the aspects (to the extent possible) like investigation, planning, designing, detailing and estimating of a Computer Science structure in which the aspects like analysis, application of relevant codes, etc., will find a place. Alternately, a few problems also may be identified for investigation

and the use of laboratory facilities to the fullest extent may be taken as a project work. Alternately, a student is encouraged to take an industrial project with any Computer Science/IT organization or firm. A project report is to be submitted on the topic which will be evaluated

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING-LEVEL-II	
Course Code: 23CS0202	Continuous Evaluation: 70 Marks
Pre-Requisite : NIL	End Semester Examination: 30 Marks
L T P : 0 0 2	
Credits: 1	

TRAINING OBJECTIVE
1. To understand the foundational knowledge of Artificial Intelligence concepts.
2. To develop problem-solving skills using AI techniques.
3. To Explore the fundamentals of Machine Learning (ML).
4. To Grasp classification algorithms for supervised learning tasks.
5. To Apply learned AI and ML concepts to practical applications.

TRAINING LEARNING OUTCOMES (TLOS): -
1. Define and explain core AI concepts like intelligent agents, problem-solving methods, and areas of application.
2. Implement various search algorithms and apply problem reduction and constraint satisfaction techniques for problem solving.
3. Describe the need for Machine Learning and its applications in various domains.
4. Explain the working principles of classification algorithms like Decision Trees, K-NN, and SVM.
5. Design and implement applications using AI and ML techniques for solving constraint satisfaction problems, robot navigation, and classification tasks.

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	**TLO2**	**TLO3**	**TLO4**	**TLO5**
TO1	✓				
TO2		✓			
TO3			✓		
TO4				✓	
TO5					✓

TRAINING CONTENTS

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
I	**INTRODUCTION:** Introduction to AI: Definitions, Historical foundations, Basic Elements of AI, Characteristics of intelligent algorithm, AI application Area**.**	Classification of AI Problems into AI task Domains
II	**PROBLEM SOLVING:** Depth-first, breadth-first search, Problem Reduction, Constraint Satisfaction , Means-End Analysis.	Solving manually constraint satisfaction problem
III	**INTRODUCTION TO MACHINE LEARNING** Machine Learning Basics, Need of Machine Learning, Application Domains, Basic Learning Techniques.	Identification of ML Model based on Application
IV	**CLASSIFICATION PROBLEM** Machine learning Algorithms for classification problem: Decision Trees, K-NN, SVM.	Design decision trees and apply K- NN algorithm
V	**HANDS ON ACTIVITY :** Students will apply the methods learnt to design applications for a) Constraint Satisfaction Problem b) Robot Traversal c) Classification problems like COVID Detection, Spam classification etc.	Implement th e given activity.

Learning Resources

1. Introduction to Machine Learning, E. Alpaydin. MIT Press
2. Machine Learning, T.M. Mitchell, Mc-Graw Hill
3. Stuart Russell, Peter Norvig, Artificial intelligence : A Modern Approach, Prentice Hall, Fourth edition, 2020.
4. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.

SEMESTER-IV

MAJOR PROJECT	
	Internal Examination: 60 Marks
Credits : 8	External Examination: 40 Marks
L T P: 0 0 16	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To make the students solve real world problems using automated solutions, while developing management and writing skills amongst them.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Show preparedness to work independently on real time problem scenarios to be addressed using knowledge of fundamentals, techniques, programming languages and tools in the area of Computer Science.
- Use the innovative ideas and thoughts to address real life issues and provide efficient solutions for process oriented works.
- Practice and develop skills in time management and reporting within an industrial or research laboratory setting.
- Contribute to an ethical and professional work culture and also to learn to work in diverse teams
- To build the confidence in report writing.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓	✓	✓	✓	✓

PROCESS:

The practical implementation of theoretical knowledge gained during the study from first semester to fourth semester. Students are required to implement their original ideas, modification/enhancement of the existing engineering techniques, real time industrial problems, and current applications of their courses of study. Projects work can be of two types: Projects based on implementation of any application oriented problem which will be more or less experimental in nature and the others will be based on some innovative/ theoretical work

Each student or group of students is given an exercise which will cover all the aspects (to the extent possible) like investigation, planning, designing, detailing and estimating of a Computer Science structure in which the aspects like analysis, application of relevant codes, etc., will find a place. Alternately, a few problems also may be identified for investigation and the use of laboratory facilities to the fullest extent may be taken as a project work. Alternately, a student is encouraged to take an industrial project with any Computer Science/IT organization or firm. A project report is to be submitted on the topic which will be evaluated.

BIG DATA ANALYTICS, TOOLS AND TECHNIQUES- LEVEL-III	
Course Code: 23CS0302	Continuous Evaluation: 70 Marks
Prerequisite: NIL	End Semester Examination: 30 Marks
L T P : 0 0 2	
Credits: 1	

TRAINING OBJECTIVE
1. To provide an overview of an exciting field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce
3. To learn the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4.To Develop Skills in achieving Scalable Big Data Analytics.

TRAINING LEARNING OUTCOMES (TLO)
After completion of TRAINING, students would be able to:
1. Understand the vision of Big Data from a global context.
2. To understand and apply Hadoop in Market perspective of Big Data.
3. To evaluate the application of Big Data in Industrial and Commercial Building Automation, evaluating Big Data performance using MapReduce and Real-World Design Constraints.
4. Applying and analyzing architecture and APIs with use of Devices, Gateways and Data Management in Big data.

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	**TLO2**	**TLO3**	**TLO4**
TO1	✓			
TO2		✓		
TO3			✓	
TO4				✓

TRAINING CONTENTS

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
I	**BIG DATA** Definition with Real Time Examples, How Big Data is generated with Real Time Generation, Use of Big Data-How Industry is utilizing Big Data, Future of Big Data.	Real life examples illustrated with discussion on Significance of Big Data
II	**HADOOP** Why Hadoop? What is Hadoop? Hadoop vs RDBMS, Hadoop vs BigData, Anatomy of a Hadoop cluster.	Students are trained on how to work on Hadoop
III	**MAPREDUCE** Theory, Data Flow (Map – Shuffle - Reduce), MapRed vs MapReduce APIs	Evaluating the application of Big Data in Industrial and Commercial Building Automation, evaluating Big Data performance using MapReduce and Real-World Design Constraints.
IV	**HIVE AND PIG** Architecture, Installation, Configuration, Hive vs RDBMS, Why Pig, Use case of Pig, Pig Components, Data Model.	Building and create state of the art architecture in Big Data. Hadoop, Creating projects and research activities based on Pig& Hive

LEARNING RESOURCES
1. Gelman, Andrew, and Jennifer Hill. Data Analysis Using Regression and Multilevel/Hierarchical Models. 1st ed. Cambridge, UK: Cambridge University Press, 2006. ISBN: 9780521867061.
2. Gelman, Andrew, John B. Carlin, Hal S. Stern, and Donald B. Rubin. Bayesian Data Analysis. 2nd ed. New York, NY: Chapman & Hall, 2003. ISBN: 9781584883883
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" by EMC Education Services

4. Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by DanielCovington.

5. Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by JasonBell.

SYLLABUS OF PROGRAM SPECIFIC ELECTIVES-I

DISTRIBUTED SYSTEMS	
Course Code: 25MCA306A	Continuous Evaluation: 40 Marks
Credits : 4	End Semester Examination: 60 Marks
L T P: 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To Understand the concept of distributed system
- To provide hardware and software issues in modern distributed systems.
- To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
- To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.
- To Gain the practical experience in designing, implementing, and debugging real distributed systems

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Identify the core concepts of distributed systems
- Examine how existing systems have applied the concepts of distributed systems when designing large systems.
- Apply distributed concepts to develop sample systems.
- Have sufficient knowledge about file access.
- Have knowledge of Synchronization and Deadlock

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I

Introduction of Distributed Systems

Definition, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models.

Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and termination detection.

UNIT-II

Distributed Mutual Exclusion

Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non-token-based algorithms, performance metricfor distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection &resolution, centralized dead lock detection, distributed dead lock detection, path pushingalgorithms, edge chasing algorithms.

UNIT-III

Agreement Protocols

Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solutionto Byzantine Agreement problem, Application of Agreement problem, Atomic Commit inDistributed Database system. Distributed Resource Management: Issues in distributed FileSystems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.

UNIT-IV

Failure Recovery in Distributed Systems

Concepts in Backward and Forward recovery, Recovery in Concurrent systems, obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols.

UNIT-V

Transactions and Concurrency Control

Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available
Services, Transactions with replicated data.

TEXT BOOKS

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Ramakrishna, Gehrke," Database Management Systems", Mc Graw hill
3. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", PearsonEducation

REFERENCE BOOKS

1. Tenanuanbaum, Steen," Distributed Systems", PHI

MANAGEMENT INFORMATION SYSTEM	
Course Code: 25MCA306B	Continuous Evaluation: 40 Marks
Credits : 4	End Semester Examination: 60 Marks
L T P: 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To get the knowledge about the important management concepts & their application, to have an insight of various functional departments in an organization.
- To discuss the designing and development as they relate to information systems.
- To identify some of the strategies employed to lower costs and improve service.
- To know about the relation between server and client.
- Role of Decision Support System in MIS, Decision Support Models.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP).After completion of course, students would be able to:

- Understand the roles and features of MIS, Structure of Management Information System and Benefits of Management Information System.
- Know about the designing and development of MIS, MIS Requirement Specification and Feasibility Analysis & Report.
- To identify MIS Security Risks, Threats & Vulnerability and Assessing Risks.
- To identify Database and Client Server Architecture. Data Warehouse: Architecture to implementation
- Know about Role of Decision Support System in MIS, Decision Support Models

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I

Introduction to Information System

Why information system, Classification of Information, Key aspects of Management, Definitions, roles and features of MIS, Structure of Management Information System, Benefits of Management Information System, Limitations of Management Information System, Management Support Systems

UNIT-II

MIS Development

Overview of design of an information system, the role and tasks of systems analysts, Tools used by system analyst in designing Information system, MIS requirement analysis, MIS Requirement Specification, Feasibility Analysis & Report, MIS Development Models, MIS Design& Development Phase

UNIT-III

Decision Support System in MIS

Managerial Decision Making, Types of Decisions, Definition and characteristics of DSS, Types of Decision Support Systems, Components of DSS, Role of Decision Support System in MIS, Decision Support Models, Risks of DSS in MIS.

UNIT-IV

Data warehousing and mining

Technology of Information Systems, Unified Communication and Networks, Database and Client Server Architecture. Data Warehouse: Architecture to Implementation E-Business Technology, Data Mining Concepts and Applications, Tools and Techniques, Text Mining, Web Mining.

UNIT-V

MIS Security

MIS Security Risks, Threats & Vulnerability, Assessing Risks. Common MIS Controls (Physical, Electronic, Software, Management Controls), MIS Threats (Natural Disasters, Employee Errors, Computer Crime, Fraud, Abuse, Program Bugs), Information Security and control concepts- Access controls, QA and QC concepts with respect to the processes of various functional areas of management, social and security issues related to MIS, Control, Audit and Security of MIS

TEXT BOOKS

1. Management Information Systems: Waman S Jawadekar, Tata Mc Graw-Hill
2. Management Information Systems S. Sadagopan, PHI learning PVT Ltd.
3. Management Information Systems, Davis, Tata Mc Graw - Hill

REFERENCE BOOKS

1. DecisionSupportandExpertSystems:ManagementSupportSystems,EfraimTurban,Prenti ceH all
2. Dr. C. B Gupta “Management concepts& practices” S. Chand & Sons,2009.

EMBEDDED SYSTEM	
Course Code: 25MCA306C	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	
Prerequisite:	

COURSE OBJECTIVES (CO)

- This course introduces the difference between Embedded Systems and General purpose systems.
- This course provides the design trade-offs made by different models of typical embedded system.
- This course familiarizes to compare different approaches in Embedded Firmware.
- To introduce the RTOS Based Embedded System Design.
- To Educate in Various Embedded Development Strategies and Task Communication.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Understand the basics of an embedded system.
- Design, implement and test an embedded system and different model of typical embedded system.
- Understand the design trade offs made by different models approaches in Embedded Firmware
- Learn how to Choose an RTOS
- Know types of operating systems and Task Communication.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNINGOUTCOMES (CLOs)

	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

Unit-1

Introduction to Embedded Systems

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History

of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit-II

Typical Embedded System

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: On-board and External Communication Interfaces

Unit-III

Embedded Firmware

A: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer. B:Embedded Firmware Design Approaches and Development Languages.

Unit-IV

RTOS Based Embedded System Design

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling

Unit-V

Task Communication

Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS

TEXT BOOKS

1. Shibu K. V, "Introduction to Embedded Systems", McGraw Hill, 2013.
2. Raj Kamal, "Embedded Systems", TMH

REFERENCE BOOKS

1. Frank Vahid, Tony Givargis, John Wiley, "Embedded System Design".
2. Lyla, "Embedded Systems", Pearson, 2013.

INTERNET OF THINGS	
Course Code: 25MCA306D	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To provide a Comprehensive Understanding of IoT Fundamentals.
- To Familiarize Students with Arduino and Raspberry Pi Platforms.
- To Explore Open Source Architectures for IoT.
- To Compare Web of Things (WoT) with IoT.
- To Analyze IoT Applications in Industry.

COURSE LEARNING OUTCOMES (CLO)

The syllabus adhere to all Bloom's Taxonomy Levels and has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate a comprehensive understanding of IoT fundamentals, including its defining characteristics, physical and logical designs, functional blocks, and communication models.
- Develop proficiency in utilizing Arduino and Raspberry Pi platforms, including installation, interfacing with external devices, and programming in Python for controlling output and reading input from pins.
- Gain insight into IoT Open Source architecture (OIC), including its design principles, deployment models, and resource models, enabling them to leverage open-source frameworks effectively in IoT projects.
- Differentiate between Web of Things (WoT) and Internet of Things (IoT), understanding architecture standardization, platform middleware, and the implications of unified multitier WoT architecture on IoT development.
- Analyze IoT applications in industry, including Future Factory Concepts, Brownfield IoT, and Smart Objects, evaluating existing IoT platforms and middleware to assess their suitability for real-world deployment scenarios.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNING OUTCOMES (CLSs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs, Machine to Machine, Difference between IoT and M2M, Software define Network

UNIT-II

Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PIwith focus on interfacing external gadgets, controlling output, and reading input from pins.

UNIT-III

IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

UNIT-IV

Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence.

UNIT-V

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

TEXT BOOKS

1. ArshdeepBahga and Vijay Madisetti, Internet of Things: Hands-on Approach, Hyderabad University Press, 2015.
2. KazemSohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks: Technology. Protocols and Application, Wiley Publications, 2010.
3. WaltenegusDargie and Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, AJohn Wiley and Sons Ltd., 2010.

REFERENCE BOOKS

1. Edgar Callaway, Wireless Sensor Networks: Architecture and Protocols, Auerbach Publications, 2003
2. Michael Miller, the Internet of Things, Pearson Education, 2015.

SYLLABUS OF PROGRAM SPECIFIC ELECTIVES-II

ADVANCDED DATABASE MANAGEMENT SYSTEM	
Course Code: 25MCA401A	Continuous Evaluation: 40 Marks
Credits : 4	End Semester Examination: 60 Marks
L T P: 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To introduce about traditional operating system, functions , design and implementations.
- To build conceptual background for manual or automated real-world systems.
- To illustrate SQL and Oracle Server architecture
- Provide students with opportunities to develop basic computing skills to design and develop distributed database system.
- To illustrate skill of client server model.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate the concept of all traditional database management system and recovery operations.
- Explain the design process using object oriented model and OLAP operations.
- Impart knowledge on SQL and Oracle server tuning.
- Implementing data fragmentation and replication using distributed DBMS.
- Understanding components of JDBC and other client server systems.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I
INTRODUCTION

Review of traditional DBMS, relational algebra and relational Calculus, design principles, normalization, transaction and concurrency control, recovery management.

UNIT-II
DESIGN PROCESS

Design process, Design Evaluation, modeling process, ER Model, Semantic data model, Object Oriented Model, models and mapping normalization and denormalization, Data Warehousing, OLAP and Data Mining.

UNIT-III
ARCHITECTURE

Architecture of SQL Server, SQL server and Oracle Server tuning, SQL server tuning, Oracle server tuning, Microsoft OS tuning.

UNIT-IV

Distributed DBMS

Distributed Database Management System, Components, levels of data & process distribution, transparency features, data fragmentation, data replication.

UNIT-V
CLIENT SERVER SYSTEMS

Client server systems, Principles, Components, ODBC, JDBC and JSQL Overview

TEXT BOOKS

1. C.J Date, "Introduction to Database Systems", AWL.
2. J.L.Warrington, " Object Oriented Database Design", Morgan Kaufman
3. T.J. Tewrey, "Database Modeling and Design", Morgan Kaufman.

REFERENCE BOOKS

1. DB2, Oracle & SQL Server Documentation.

ENTERPRISE COMPUTING IN JAVA	
Course Code: 25MCA401B	Continuous Evaluation: 40 Marks
Credits : 4	End Semester Examination: 60 Marks
L T P: 4 0 0	
Pre-Requisite : NIL	

COURSE OBJECTIVES (CO)

- To introduce students with J2EE technology so that they can develop dynamic websites. To build conceptual background for manual or automated real-world systems.
- To develops conceptual background of core JAVA.
- Provide students with opportunities to develop basic application using STRUTS framework.
- To develop technologies using J2EE.
- To compare and contrast different beans.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate the concept of servlet and J2EE application.
- Explain the design process using JSP design strategy.
- Impart knowledge on TRUTS framework.
- Implementing EJB data fundamentals and deploying application on distributed objects.
- Understanding stateless and stateful beans.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT-I INTRODUCTION

Introduction to J2EE and building J2EE applications, MVC architecture, Introduction to servlets and it's life cycle , problems with CGI-PERL interface , generic and http servlet , servlet configuration, various session tracking techniques, servlet context, servlet configuration, servlet collaboration.

UNIT-II JSP

JSP Basics and Architecture: JSP directives, Scripting elements, standard actions,

implicit objects, jsp design strategies.

UNIT-III STRUTS
Introduction of Struts and its architecture, advantages and application of Struts.

UNIT-IV
EJB FUNDAMENTALS

Motivation for EJB, EJB Echo system, J2EE technologies, Enterprise beans and types, distributed object sand middleware, developing EJB components, remote local and home interface, bean class and deployment descriptor.

UNIT-V BEANS
Introducing session beans: Session beans life time, statefull and Stateless session beans beans, lifecycle of session beans. Introducing Entity beans: persistence concepts, features of entity beans, entity context, Introduction to JMS & Message driven beans.

TEXT BOOKS

1. Ed Roman, Scott W Ambler, Tyler Jewell, "Mastering Enterprise Java Beans", Wiley, 2nd Ed., 2005.
2. Govind Sesadri , "Enterprise Java Computing: Application and Architectures", Cambridge University Publications, 1999.
3. Subrahamanyam Allamaraju, Cedric Buest, "Professional Java Server Programming, J2EE, Apress, 1.3 Ed., 2005.
4. Ivan Bayross and Sharanam Shah, "Java Server Programming" , Shroff.
5. John Hunt and Chris Loftus, "Guide to J2EE: Enterprise Java" Springer Verlag Publications.

REFERENCE BOOKS

1. Austin Sincock , "Enterprise Java for SAP" , A Press Publications.
2. Ted Neward, "Effective Enterprise Java", Eddison -Wesley, 2004.
3. Jim Farley, William Crawford, " Java Enterprise in a Nutshell", O'Reilly and Associates, 3rd Ed.
4. Joe Wigglesworth and McMilan Paula, "Java Programming: Advanced Topic", Thomson, 3rd Ed., 2003.

COMBINATORIAL OPTIMIZATION	
Course Code: 25MCA401C	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	
Prerequisite:	

COURSE OBJECTIVES (CO)

- To Introduce Optimization Techniques.
- To Explore Integer Liner Programming and Graph Algorithms.
- To Understand Graph Algorithms and Their Applications.
- To Analyze Queuing Systems and Probability Distributions.
- To Explore Queuing Theory and Stochastic Processes.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Master solving optimization problems and applying optimization algorithms effectively.
- Acquire Knowledge of advanced optimization techniques and graph algorithms.
- Apply graph algorithms to solve real-world problems effectively.
- Grasp Queuing theory, stochastic processes, and queuing system structures.
- Analyze and classify queuing models for system optimization and performance analysis.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNING OUTCOMES (CLSs)

	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 1	✓				
CO 2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

Unit-1

Introduction: Optimization problems, neighbourhoods, local and global optima, convex sets and functions, simplex method, degeneracy; duality and dual simplex algorithm, computational considerations for the simplex and dual simplex algorithms-Danzig-Wolfe algorithms.

Unit-2

Integer Linear Programming: Cutting plane algorithms, branch and bound technique and approximation algorithms for traveling salesman problem. Graph Algorithms: Primal-Dual algorithm and its application.

Unit-3

Graph Algorithms: Primal-Dual algorithm and its application to shortest path, Math-flow problems (Ford and Fulkerson labelling algorithms, Dijkstra's algorithm, Ford-War shall algorithms), networking labelling and digraph search, Max-flow problem, matching problem, bipartite matching algorithm, non-bipartite matching algorithms, weighted matching-Hungarian method for the assignment problem, non-bipartite weighted matching problem, efficient spanning tree algorithms, algorithm for matroid intersection problem.

Unit-4

Essential features of queuing systems, operating characteristics of queuing system, probability distribution in queuing systems, classification of queuing mode

Unit-5

Queuing Theory: Stochastic process, Queuing System(Basic Structure), Exponential distribution, Kendall's Notation for Representing Queuing Model, Birth-and-Death Model, Different name of Queuing Model , Classification of Queuing Model – [Model-I:(M/M/1):(/FCFS)(Birth-and-Death Model), Model- II: (M/M/1):(N/FCFS)] (Infinite and Finite Population Queue).

TEXT BOOKS

1. C.H. Papadimitriou and K. Steiglitz, Combinatorial Optimization: Algorithms and Complexity, Prentice-Hall of India, 2006 .
2. K. Lange, Optimization, Springer, 2004

REFERENCE BOOKS

1. Mokhtar S.Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, John Wiley & Sons, 2004
2. H.A. Taha, Operations Research: An Introduction (8th ed.), Prentice Hall, 2006

MACHINE LEARNING	
Course Code: 25MCA401D	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

- To introduce students to state-of-the-art methods and modern programming tools for data analysis.
- To understand complexity of Machine Learning algorithms and their limitations.
- To understand modern notions in data analysis oriented computing.
- To identify algorithms mic aspects in machine learning and data mining tasks.
- To evaluate correctness and efficiency of the used methods, and their applicability in each current situation.

COURSE LEARNING OUTCOMES (CLO)

The syllabus adhere to all Bloom's Taxonomy Levels and has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Gain knowledge of the structure and model of the Data science domain.
- Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
- Perform experiments in Machine Learning using real-world data and Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).
- Analyze a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).
- Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

MAPPING MATRIX OF COURSE OBJECTIVES (Cos) AND COURSE LEARNING OUTCOMES (CLSs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

Unit-I

Introduction to Machine Learning, Types of machine Learning: supervised, unsupervised, semi supervised and reinforcement learning, Steps in the design of learning system, Training and testing, Cross Validation, Performance prediction parameters, Applications of machine learning.

Unit-II

Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris for assessing classification.

Unit-III

Unlabelled data, Clustering and its types, Partition clustering, Hierarchical Clustering, Fuzzy clustering, Density based clustering, Model based clustering, K-means clustering, Applications of Clustering.

Unit-IV

Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly seperable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines

Unit-V

Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule. Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks.

TEXT BOOKS

1. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India, 2006.
2. T. M. Mitchell, Machine Learning, McGraw-Hill, 1997.
3. Shawe-Taylor J. and Cristianini N., Cambridge, Introduction to Support Vector Machines, University Press, 2000.

REFERENCE BOOKS

1. Building Machine Learning Systems with Python - WilliRichert, Luis Pedro Coelho
2. Shai Shalev-Shwartz, Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”

SYLLABUS OF OPEN ELECTIVE COURSES

ENTERPRENEURSHIP & NEW VENTURE MANAGEMENT	
Course Code: SEC-FT-01	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

- To learn about and get an insight of Entrepreneurs and Entrepreneurship development.
- To understand the basic of Business project report, Fund raising and SWOT analysis.

COURSE LEARNING OUTCOMES:

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

- Understand the different support system for business development.
- Gain knowledge and acquire skill for setting up an enterprise and learn how the management works.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO 1	**CLO 2**
CO1	✓	
CO2		✓

COURSE CONTENTS

UNIT NUMBER	**COURSE CONTENTS**
UNIT-I	***Entrepreneurship Development:*** Concept, definition, types, functions and competencies, stages of entrepreneurship. Barriers and challenges in entrepreneurship in India. Women entrepreneurship, rural entrepreneurship. Role of various institutions in developing entrepreneurship in India
UNIT-II	**Business Planning:** Idea generation, sensing business opportunities and assessing market potential, market research preparation of feasibility reports/business plan. Components of project report, appraising project report, pitching, angel investors, venture capital funds, technology incubators and their role, student start up, technopreneurs, social entrepreneurs and their significance.

UNIT-III	**Food Business Management : Production, Marketing and finance:** Managing Production-Organizing Production, Input-output cycle-Ensuring Quality Managing Marketing, Understandingmarkets and marketing,
	Functions of marketing,4Ps of marketing, Financial Marketing, Meaning of Finance, types and sources of finance, Estimation

REFERENCES:

- Desai,V. (2011) The Dynamics of Entrepreneurial Development and Management. Mumbai, Himalaya Publishing house Pvt. Ltd. Unit 1,2,4,6,7
- Kottler, P. (1994) Marketing Management, New Delhi, Prentice Hall of India private Limited.
- Acharya, S.S & Agagrwal. N.L (1987), Agricultural Marketing in India,New delhi, Oxford Publishing.
- David,D. & Erickson S. (1987) Principles of Agri Business Management. New Delhi. Mc Graw Hill Book Co.

SUSTAINABLE GROWTH & DEVELOPMENT	
Course Code:21ESUG202	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Basics understanding of environment and natural ecosystems	

COURSE OBJECTIVES

1. To have an increased awareness among students on issues in areas of sustainability.
2. To understand the role of engineering and technology within sustainable development.
3. To know the methods, tools, and incentives for sustainable product-service system development.
4. To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Develop an awareness about our environment and elicit collective response for its protection.
2. Understand the different types of environmental pollution problems and their sustainable solutions.
3. Work in the area of sustainability for research and education.
4. Have a broader perspective in thinking for sustainable practices by utilizing the engineering knowledge and principles gained from this course

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

COURSE CONTENTS

Unit I- Basics of Sustainable Development & Natural Resources:

Environment, ecology and economy; Economics of natural resources; Resource taxonomy, Resource scarcity; managing exhaustible and renewable resources; Natural environment as a natural resource; Irreversibility and uncertainty in environmental processes; Concept of sustainable development and intergenerational justice; Indicators of sustainability; Goals of Sustainable Development (SDGs), Sustainable development – a critical assessment of past and present view.

Unit II- Climate Change & Sustainable Development

Introduction to energy economics; Energy- environment interactions; Options to address energy related environmental problems-Regulatory approach to environmental management, economic instruments for pollution control, Assessment and selection of instruments, Nuclear energy and climate change; Promises and limits of bioenergy; Economics of climate change; Alternative options to cope with global warming - Generic options, National policy options,

Emissions trading scheme (ETS) of the EU; International climate change agreements- UNFCCC, The Kyoto Protocol.

Unit III- Corporate Social Responsibility (CSR) & Sustainable Development: Environmental Corporate Social Responsibility- Definition, concept, linkages to development Growth of CSR- historical & contemporary perspectives, National & International scenario Factors influencing growth of CSR in societies ideological, socio-economic, legal & environmental perspectives Government initiatives for promoting CSR Impact of globalization & liberalization on CSR initiatives. Ethical philosophy, Corporate reputation, the Gaia hypothesis Environmental sustainability & CSR–redefining sustainability, the Brundtland report & critique, distributable sustainability, sustainability & the cost of capital CSR.

Unit IV- Applied Field of Sustainability: Environment Laws: Environment Protection Act; Air Sustainability- need and concept, challenges, Environment acts and protocols, Global, Regional and Local environmental issues, Natural resources and their pollution, Carbon credits, Zero waste concept ISO 14000, Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Technology and sustainable development, Sustainable urbanization, Industrial Ecology.

TEXT BOOKS

1. Bhattacharya R.N., (2002). Environmental Economics. Oxford University Press
2. Bhattacharya, S.C. (2011). Energy Economics. Springer, London
3. Biswas, A.K. Anand Tortajada, Cecilia, (2005). Appraising Sustainable Development. Oxford University Press.
4. Zaleski C.P and Meritet Sophie, (2011). ―Nuclear energy and climate change‖ in

REFERENCE BOOKS

1. Sengupta Ramprasad., (2002). Ecology and Economics: An Approach to Sustainable
2. Development.Oxford University Press: New Delhi
3. Kolstad, Charles, D., (2010). Environmental Economics. Oxford University Press

WASTE MANAGEMENT	
Course Code:21ESUG203	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P C : 3 0 0	
Prerequisite: Basics understanding about Waste	

COURSE OBJECTIVES

1. To understand the fundamentals of waste generation and its environmental health impact.
2. To formulate and design engineered solutions to waste management.
3. To apply best waste management practices for sustainable development.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP).

After the completion of course, students will be able to:

1. Develop an awareness about solid waste and management practices
2. Design feasible solutions for waste management
3. Understand waste management practices, law and regulation related to solid waste management.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

	CLO 1	**CLO 2**	**CLO 3**
CO1	✓		
CO2		✓	
CO3			✓

COURSE CONTENTS

Unit 1

Solid Waste Generation and Characterization- Introduction

Definition and fundamentals of solid waste, Sources and Types ; Residential Waste, Industrial waste,Commercialwaste,Institutional Waste,Industrial Waste, and Construction and Demolition waste Characterisation of Wastes; physical and chemical composition. Solid waste management: Overview, Key components, Fundamentals of waste segregation, screening, collection, transport, disposal and processing techniques, Concepts of Integrated solid waste management,

Unit 2

Municipal Solid Waste Management

Municipal solid waste; Concept, Sources; Generation rate, composition; Segregation, collection of waste; transfer and transport of waste; disposal options; Landfill (Site selection criteria, layout,) concept of waste reduction, recycling and reuse. Impact of

waste on environmental health, Legislation on management and handling of municipal solid wastes

Unit 3

Hazardous Waste Management

Hazardous waste definition, sources, identification, characterization and classification; Collection, handling , storage and transport of hazardous waste, Environmental health impact of hazardous waste. Management of different Hazardous wastes; nuclear waste, Biomedical waste, E waste, Radioactive waste, Introduction, generation, characterisation, transport and disposal methods. Legislation on management and handling of hazardous wastes, Biomedical waste management rules, E-waste waste management rules and regulations.

Unit 4
Processing and Treatment of Solid Waste,

Thermal Treatment; Incineration, Pyrolysis, Gasification, co-combustion. Biological treatment; Composting, bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; Biomethanation, Biogas, Waste to Energy. Landfill design; Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; Geo spatial technology application in waste management.

Text Books;

1. John Pichtel (2014). *Waste Management Practices: Municipal, Hazardous and Industrial*, 2nd Ed., CRC Press, USA
2. Tchobanoglous G., Frank Kreith., (2002). *Hand Book of Solid Waste Management*, 2nd Ed.,McGraw Hill, USA.

Reference Books;

1. LaGrega, M.D. Buckingham, P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, New York, 1994.
2. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, New York,1997