Learning Outcomes based Curriculum Framework (LOCF)

for

Master of Computer Applications

(MCA)

(Duration 2 Years)

(w.e.f. 2022-23)

Department of Computer Science and Information Technology

School of Technology

MAULANA AZAD NATIONAL URDU UNIVERSITY

1. Vision and Mission

1.1 Vision

To meet the requirements of the society by imparting knowledge, ethics and moral values with a holistic approach.

1.2 Mission

To impart quality education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens embedded with ethical values.

1.3 Strategies for Attaining the Vision and Fulfilling the Mission

Following strategies will be used to ensure the accomplishment of the stated vision and mission:

1. To create an ambiance for healthy teaching-learning process and attract the motivated students to the Department of Computer Science and Information Technology
2. Ensure that the curriculum followed is comparable to the relevance of local, national, regional and global development
3. To motivate the potential faculty members/ educators who are constantly upgrading their pedagogical approaches to motivate students and to enhance learning among them
4. Provide opportunities to students for global exposure, industrial internships, project based and research-based learning

2. Program Educational Objectives

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that CS&IT Department is preparing its graduates to achieve during the graduation. Following four PEOs are defined as:

PEO 1. To train the graduates to acquire in depth knowledge of fundamental concepts and programming skills for holistic development.

PEO 2. To prepare the graduates for productive careers in software industry, corporate sector, Government Organizations.

PEO 3. To prepare graduates to acquire excellent computing ability so that they can analyze, design and create Solutions for real time problems.

PEO 4. To apply the current tools and techniques to create systems for solving Industry oriented problems.

3. Program Outcomes (POs)

Program outcomes are the narrower statements that describe what students are expected to know and be able to do upon graduation. POs represent the knowledge, skills and attitudes the students should have at the end of a program. Following are the statements for POs for computer application program. At the time of completing their degree requirements, students will be able to:

PO_1: Apply the knowledge of Mathematics, Science, and Engineering fundamentals, and an engineering specialization to solution of complex engineering problems **(Engineering Knowledge)**.

PO_2: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (**Problem analysis**).

PO_3: Design of solutions for complex engineering problems and design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations (**Design/development of solutions)**.

PO_4: Use research-based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions **(Conduct investigations of complex problems**).

PO_5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling complex engineering activities with an understanding of limitations (**Modern tool usage**).

PO_6: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The engineer and society)**.

PO_7: Understand the impact of the professional engineering solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments (**Environment and sustainability**).

PO_8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (**Ethics**).

PO_9: Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and team work**).

PO_{10}: Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentation, make effective oral presentations, and give and receive clear instructions (**Communication**).

PO_{11}: Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments (**Project management and finance**).

PO_{12}: 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 (**Life-long Learning**).

4. Program Specific Outcomes (PSOs)

Program Specific Outcomes (PSOs) are the statements that define outcomes of a program which make students realize the fact that knowledge and techniques learnt in a specific course has direct implication for the betterment of society and its sustainability.

PSO 1: The ability to design and develop applications using the knowledge of Mathematics, Science and Engineering fundamentals.

PSO 2: Ability to test and analyze the quality of developed applications and to integrate them in order to evolve a larger computing system.

PSO 3: Apply appropriate techniques, resources, and modern engineering and IT tools to address societal, health, safety, legal, and cultural issues.

PSO 4: To analyze and assess various functional and technical security challenges in protecting various digital assets and infrastructure in the internet era and to design and develop innovative technological solutions for the same

PSOs have to be attained by the students in due course of the two years program either as part of their Core, Discipline Specific Electives, Tools and techniques or as part of their various levels of seminar/ internship and project work.

5. Mapping between PEOs, POs and PSOs

The following Table lists the relationships between the PEOs, POs. and PSOs. The attainment of POs can be viewed as a strategy for attaining the PEOs. Each PEO is supported by multiple POs to ensure strength in compliance. Also, the relationship between individual PO and PEOs can vary between **Reasonable (1)** and **Strong (3)**.

PEOs	POs												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
PEO1	2	3	1	3	1	2	1	1	1	2	1	2	2	1	1	2
PEO2	1	1	2	1	3	1	2	1	2	1	2	1	1	2	3	1
PEO3	2	2	3	3	2	2	1	2	1	2	1	3	2	1	2	1
PEO4	2	2	2	3	3	2	1	1	3	2	1	2	1	2	1	3

1 – Reasonable

2 – Significant

3 – Strong

6. Course Outcomes (COs)

Course Outcomes are narrower statements that describe what students are expected to know and be able to do at the end of the course. Course outcomes are defined for all courses as part of the syllabus for the course and are measured through performance on assignments, written and oral presentation reports related to individual and team projects and through the mid-term and semester end examinations. Detailed syllabi for each course associated with Course Objectives and Course Outcomes has been for specific outcomes associated with the course. Attaining the COs is at the heart of the educational activity. If COs of individual courses are successfully attained and the curriculum has been designed to achieve the Program Outcomes, then attainment of the POs is also ensured. An effective Assessment Plan has been devised to meet the objective, quantitative and independent measures to demonstrate that all POs and PEOs are being attained by the program.

7. Continuous Quality Improvement and Assessment Plan

The purpose of the Assessment Plan is to ensure attainment of all Program Outcomes (POs) and also the attainment of the Program Educational Objectives (PEOs) and to independently confirm that the POs and PEOs are being attained. Periodic monitoring of progress allows faculty members and the leadership to take corrective actions where the POs and PEOs are not meeting established targets. The process consists of assessing and evaluating the extent to which the student outcomes are being attained. The results of these assessments and evaluations are subsequently used as the primary inputs for making improvements to the program.

MAULANA AZAD NATIONAL URDU UNIVERSITY

SCHOOL OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & IT

Master of Computer Applications (MCA)

General, Course structure & Theme & Semester-wise credit distribution

A. Definition of Credit:		
1	1 Hr. Lecture (L) per week	1 credit
2	1 Hr. Tutorial (T) per week	1 credit
3	2 Hours Practical (Lab)/week	1 credit

B. Range of credits:
A student requires to complete total 88 credits to be eligible to get Post Graduate degree in Computer Applications.

C. Structure of Post graduate Computer Applications program:			
S. No.	Course Type	Abbreviation	Credit Breakup for MCA Students
1	Program Core Course	PCC	54
2	Discipline Specific Elective	DSE	9
3	Generic Elective (Interdisciplinary)	GE	4
4	Foundation Course	FC	3
5	Ability Enhancement Course	AEC	2
6	Projects	PROJ	16
Total			**88**

MAULANA AZAD NATIONAL URDU UNIVERSITY

DEPARTMENT OF CS&IT

SCHEME OF INSTRUCTIONS, EXAMINATION & EVALUATION

(Effective for Batch Admitted from 2022-23 Academic Year)

Master of Computer Applications (MCA)

Total Credits (2 Year Course): 88

I. **INDUCTION PROGRAM (PLEASE REFER APPENDIX-A FOR GUIDELINES)**	
Induction Program (mandatory)	3 Weeks duration (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	▪ Physical activity ▪ Creative Arts ▪ Universal Human Values ▪ Literary ▪ Proficiency Modules ▪ Lectures by Eminent People ▪ Visits to local Areas ▪ Familiarization to Dept./Branch & Innovations

Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

Initial Phase

Time	Activity
Day 0	
Whole day	Students arrive - Hostel allotment. (Preferably do pre-allotment)
Day 1	
09:00 am - 03:00 pm	Academic registration
04:30 pm - 06:00 pm	Orientation
Day 2	
09:00 am - 10:00 am	Diagnostic test (for English etc.)
10:15 am - 12:25 pm	Visit to respective depts.
12:30 pm - 01:55 pm	Lunch
02:00 pm - 02:55 pm	Director's address
03:00 pm - 05:00 pm	Interaction with parents
03:30 pm - 05:00 pm	Mentor-mentee groups - Introduction within group. (Same as Universal Human Values groups)

Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

3.2.1 Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

Sessn.	Time	Activity	Remarks
Day 3 onwards			
	06:00 am	Wake up call	
I	06:30 am - 07:10 am	Physical activity (mild exercise/yoga)	
	07:15 am - 08:55 am	Bath, Breakfast, etc.	
II	09:00 am - 10:55 am	Creative Arts / Universal Human Values	
		Half the groups do Creative Arts	
III	11:00 am - 12:55 pm	Universal Human Values /	
		Creative Arts	Complementary alternate
	01:00 pm - 02:25 pm	Lunch	
IV	02:30 pm - 03:55 pm	Afternoon Session See below.	
V	04:00 pm - 05:00 pm	Afternoon Session See below.	
	05:00 pm - 05:25 pm	Break / light tea	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	Rest and Dinner	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off and Saturdays have the same schedule as above or have outings.

Afternoon Activities (Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	Session	Remarks
Familiarization with Dept/Branch & Innovations	IV	For 3 days (Day 3 to 5)
Visits to Local Area	IV, V and VI	for 3- days
		For 3 days - interspersed (e.g., 3 Saturdays)
Lectures by Eminent People	IV	As scheduled - 3-5 lectures
Literary (Play / Book Reading / Lecture)	IV	For 3-5 days
Proficiency Modules	V	Daily, but only for those who need it

Closing Phase

Time	Activity
Last But One Day	
08:30 am - 12 noon	Discussions and finalization of presentation within each group
02:00 am - 05:00 pm	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations (if any). May be expanded to last 2 days, in case needed.

II. **SEMESTER WISE STRUCTURE OF CURRICULUM**
[L= Lecture, T= Tutorials, P=Practical, C= Credits]

PROGRAM		**YEAR**					**SEMESTER**			
MCA		I					I			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
MMCA111FCT	FC	Statistical Analysis	3	1	0	3	30	70	3 Hrs.
MMCA111PCT	PCC	Software Engineering	3	1	0	4	30	70	3 Hrs.
MMCA112PCT	PCC	Computer Network	3	1	0	4	30	70	3 Hrs.
MMCA113PCT	PCC	Operating Systems	3	1	0	4	30	70	3 Hrs.
	GE	Generic Elective	3	1	0	4	30	70	3 Hrs.
MMCA160AEP	AEC	English Language & Communication Lab	0	0	4	2	50	50	3 Hrs.
Total Credits per semester						**21**	**600**		
Mandatory Induction Program- 3 Weeks Duration									
Note: End Semester Examinations of the subject(s) weighted more than 2 credits will be for three Hrs. duration with maximum 100 marks score (30+70)									

PROGRAM		**YEAR**				**SEMESTER**			
MCA		I				II			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
MMCA211PCT	PCC	Data Structure & Algorithms	3	1	0	4	30	70	3 Hrs.
MMCA212PCT	PCC	Database Management System	3	1	0	4	30	70	3 Hrs.
MMCA213PCT	PCC	Java Programming	3	1	0	4	30	70	3 Hrs.
MMCA214PCT	PCC	Computer System Architecture	3	1	0	4	30	70	2 Hrs.
MMCA211PET	DSE	DSE – 1	3	1	0	4	30	70	3 Hrs.
MMCA260PCT	LAB	Data Structure & Algorithms Lab	0	0	4	2	50	50	3 Hrs.

MMCA261PCP	LAB	Database Management System Lab	0	0	4	2	50	50	3 Hrs.
MMCA262PCP	LAB	Java Programming Lab	0	0	4	2	50	50	3 Hrs.
		Total				**25**	**800**		

PROGRAM		**YEAR**				**SEMESTER**			
MCA		II				III			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
MMCA311PCT	PCC	Data Science	3	1	0	4	30	70	3 Hrs.
MMCA312PCT	PCC	Formal Language & Automata Theory	3	1	0	4	30	70	3 Hrs.
MMCA313PCT	PCC	Blockchain Technology	3	1	0	4	30	70	3 Hrs.
MMCA314PCT	PCC	Machine Learning	3	1	0	4	30	70	3 Hrs.
MMCA311PET	DSE	DSE – 2	3	1	0	3	30	70	2 Hrs.
MMCA321PET	DSE	DSE – 3	3	1	0	3	30	70	3 Hrs.
MMCA360PCP	LAB	Data Science Lab	0	0	4	2	50	50	3 Hrs.
MMCA361PCP	LAB	Blockchain Technology Lab	0	0	4	2	50	50	3 Hrs.
		Total				**26**	**800**		

PROGRAM		**YEAR**				**SEMESTER**			
MCA		II				IV			
Course Code	**Description**	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
			L	T	P		Internal	External	
MMCA470PCP	PROJ	Industrial/Major Project	0	0	32	16	200	200	Viva-voce & Demonstration
		Total				**16**	**400**		

DISCIPLINE SPECIFIC ELECTIVES (DSE)-I IN SECOND SEMESTER								
Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
MMCA211PET	Digital Forensics	3	1	0	3	30	70	3 Hrs.
MMCA212PET	Component based Software Engineering	3	1	0	3	30	70	3 Hrs.
MMCA213PET	Cryptography & Cyber Security	3	1	0	3	30	70	3 Hrs.
MMCA214PET	Software Testing & Quality Assurance	3	1	0	3	30	70	3 Hrs.

DISCIPLINE SPECIFIC ELECTIVES (DSE)-2 IN THIRD SEMESTER								
Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
MMCA311PET	Cloud Computing and Virtualization	3	1	0	3	30	70	3 Hrs.
MMCA312PET	Distributed Systems	3	1	0	3	30	70	3 Hrs.
MMCA313PET	Computer Graphics	3	1	0	3	30	70	3 Hrs.
MMCA314PET	Artificial Intelligence	3	1	0	3	30	70	3 Hrs.
MMCA315PET	Data Mining	3	1	0	3	30	70	3 Hrs.
MMCA316PET	Digital Marketing	3	1	0	3	30	70	3 Hrs.
MMCA317PET	Internet of Things	3	1	0	3	30	70	3 Hrs.
MMCA318PET	Compiler Design	3	1	0	3	30	70	3 Hrs.
MMCA319PET	Pattern Recognition	3	1	0	3	30	70	3 Hrs.

DISCIPLINE SPECIFIC ELECTIVES (DSE)-3 IN THIRD SEMESTER								
Course Code	**Course Title**	**Hours/Week**			Credits	**Score**		**End Exam Duration**
		L	T	P		Internal	External	
MMCA321PET	Web Technology	3	1	0	3	30	70	3 Hrs.
MMCA322PET	Artificial Neural Network	3	1	0	3	30	70	3 Hrs.
MMCA323PET	Semantics Web	3	1	0	3	30	70	3 Hrs.
MMCA324PET	PHP Programming	3	1	0	3	30	70	3 Hrs.
MMCA325PET	Soft Computing	3	1	0	3	30	70	3 Hrs.
MMCA326PET	Deep Learning	3	1	0	3	30	70	3 Hrs.
MMCA327PET	Web Mining	3	1	0	3	30	70	3 Hrs.
MMCA328PET	Natural Language Processing	3	1	0	3	30	70	3 Hrs.

Course Code	Course Title	Lecture			
MMCA111FCT	Statistical Analysis	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Mathematics

Course Objectives:

1. To provide students with the foundations of statistical analysis, probability and modeling the real-life problems.
2. To understand probability distributions and their properties.
3. To learn the statistical parameters for different distributions, correlation and regression.
4. To understand the concept of hypothesis and significance tests.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Apply different statistical measures on data.	PO_1, P02
CO_2	Analyze statistical tests in testing hypotheses on data.	P05
CO_3	Apply concept of probability and statistics to translate and solve real world problems.	PO2
CO_4	Develop problem solving techniques needed to accurately calculate probabilities.	PO4

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2					2							
CO_3		2										
CO_4				2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Basic Statistics: Frequency Distribution, Frequency curve and histogram, Measures of Central Tendencies (Mean, Median, Mode, Range, Standard Deviation, Coefficient of Variation, Quartiles), Measures of Dispersion, Skewness, moments and kurtosis.
Unit: 2	Regression Analysis: Correlation and Regression: Karl Pearson's coefficient of Correlation, Correlation of ranks, Tied Ranks, Curve of regression, lines of regression, properties of regression coefficients and angle between two regression lines Curve fitting – Method of least square, Linear and reducible to linear curves.
Unit: 3	Random Variables and Probability Distribution: Random Variable – Discrete and Continuous, Probability Distribution of a Random Variable, Probability Mass Function, Probability Density Function, -evaluation of statistical parameters for these distributions, Distribution Functions, Bivariate Random Variable- Discrete and Continuous Bivariate Random Variables with examples, Joint probability distribution, Marginal and conditional distributions and applications, Probability
Unit: 4	Distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions and applications.
Unit: 5	Sampling Distribution: Test of significance for large & small samples: test for single proportion, difference of proportions, single mean, difference of means,

	and difference of standard deviations Sampling Distributions: t- distribution, Chi-square distribution, F-distribution, Standard and Probable errors, Different Methods of Estimation, Testing of Hypothesis -Type I and Type II errors, classification of hypothesis tests; large & small sample tests.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Third Edition, Elsevier Academic Press.
2	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics – 1st Edition S Chand
Reference Books:	
1	Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill
2	J. Susan Milton, Jesse C. Arnold, Introduction to Probability & Statistics – 4th Edition, Tata McGraw Hill

Course Code	Course Title	Lecture			
MMCA111PCT	Software Engineering	L	T	P	**Semester:** I
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Structure & Algorithms

Course Objectives:

1. To understand the importance, limitations and challenges of processes involved in software development.
2. To gain knowledge of various software models as waterfall and evolutionary models and software design activities.
3. To learn about software requirements analysis and specification.
4. To learn cost estimation, software testing, maintenance and debugging.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the difference between software engineering discipline with the other engineering disciplines	PO_1, PO_2
CO_2	Elaborate knowledge of various software models	PO_2
CO_3	Analyze about software requirements analysis and specification	PO_4
CO_4	Able to get the knowledge of various software design activities.	PO_3

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3				2								
CO_4			2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Software Engineering Fundamentals: Definition of software product and process, Software Characteristics, Components, Applications, Layered Technologies, Processes and Product, Methods and Tools, Generic View of Software Engineering, Software Crisis, Software development paradigms, Techniques of Process Modelling, Software Process and lifecycle models.
Unit: 2	Software Requirements Analysis & Specification: System specification, Software requirements specification (SRS) standards, Analysis and Design Modelling: ER Diagram, Dataflow Model, Control Flow Model, Control and Process Specification, Data Dictionary.
Unit: 3	Software Design: Software architecture, Modular Design-cohesion and coupling, Process-oriented design, Process and Optimization, Data-oriented design, User-interface design, Real-time software design, Architectural Designing, Interface Design, Procedural Design, Object Oriented Design. CASE Tools: Computer-aided software engineering, Introduction to CASE, Building Blocks of CASE, Relevance of CASE tools, High-end and low-end CASE tools, automated support for data dictionaries, DFD, ER diagrams, Integrated Case Environment, CASE workbenches.
Unit: 4	Coding and Testing: Choice of Programming languages, Coding standards for Software. User Interface Design: Concepts of Ui, Interface Design Model, Internal and External Design, Evaluation, Interaction and Information Display Testing

	Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing.
Unit: 5	Configuration Management: Concepts in Configuration Management, The Configuration Management Process: Planning and Setting up Configuration Management, Perform Configuration Control, Status Monitoring and Audits. Software Maintenance: What is software maintenance, Maintenance Process & Models, Reverse Engineering, Software re-engineering, Configuration Management issues and concept, Configuration planning & techniques, Software versions and change control process, Documentation.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Hennessey and Patterson, "Computer Architecture: A quantitative Approach", Morgan Kaufman.
2	Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hill international Edition.
Reference Books:	
1	Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill
2	El-Rewini, H., & Abd-El-Barr, M. (2005). Advanced computer architecture and parallel processing (Vol. 42). John Wiley & Sons.

Course Code	Course Title	Lecture			Semester: I
MMCA112PCT	Computer Networks	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic knowledge of Mathematics and Physics

Course Objectives:

1. To understand the computer networks and concentrates on building a firm foundation.
2. To provide the fundamental knowledge of the various aspects of computer networking.
3. To familiarize with the standard models for the layered approach to communications between machines in a network and the protocols of the various layers.
4. To acquire the knowledge of cryptography and its uses in data communication over the internet.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understanding of the OSI Reference Model and TCP/IP Model	**PO_1**
CO_2	Able to know about Physical Layer and Data Link Layer	**PO_3**
CO_3	Understand the concept of Network Layer	**PO_3**
CO_4	Demonstration of Transport and Application Layer	**PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2			2									
CO_3			2									
CO_4					1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction To Networks and Communication Media: Uses – Network Hardware – Network Software – Reference Models – Example Networks – Network Standardization. Basis for data communication - Transmission media – Wireless Transmission – Telephone Systems – Satellite Communication.
Unit: 2	Physical Layer: Bit Rate, Data rate, Frequency, Bandwidth, Baud Rate, Harmonics, Maximum data rate of a channel. The Data Link Layer: Data Link Layer design issues – Error Detection and Correction Methods - Elementary Data Link Protocols – Sliding Window Protocols – Protocol Verification Methods – Channel Allocation – Multiple Access protocols – IEEE 802 Standards.
Unit: 3	The Network Layer: Network Layer design issues – Routing algorithms – Congestion Control algorithms – Internetworking – Network Layer in Internet.
Unit: 4	The Transport Protocols: Transport Service – Transport Protocols – Internet Transport Protocols UDP – TCP - Performance issues.
Unit: 5	The Application Layer: Application Layer design issues – Domain Name System - Electronic Mail – World Wide Web – Multimedia - Other Applications – Network Security - Basic Cryptography.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Andrews S. Tanenbaum, “Computer Networks”, Prentice Hall of India Private Limited, (4th Edition), 2003.
2	Leon Garcia and Widjaja, "Communication Networks - Fundamental concepts and key architecture", Tata McGraw Hill, 2001
Reference Books:	
1	Internetworking with TCP/IP Volume 1: Principles Protocols, and Architecture, Douglas Comer and Prentice Hall, fifth edition, 2006.
2	Network Protocols: Signature Edition, Matthew G. Naugle. Mcgraw-Hill Signature Series

Course Code	Course Title	Lecture			Semester: I
MMCA113PCT	Operating Systems	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Theory & Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer fundamentals

Course Objectives:

1. To understand overall functionality of Operating System.
2. To provide sufficient understanding of operating system design.
3. To understand the impact of operating system on application systems design and performance.
4. To understand concepts of Memory management and disc management.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Exhibit familiarity with the fundamental concepts of operating systems.	**PO_1, PO_2**
CO_2	Apply understanding of operating system design and its impacts on application systems design and performance.	**PO_3**
CO_3	Exhibit competence in recognizing operating systems features and issues.	**PO_3**
CO_4	Understanding the various concepts associated with memory management	**PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2									
CO_4				1								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction: Operating system and functions, Classification of Operating systems- Batch, Interactive, Time-sharing, Real-Time System, Multiprocessor Systems, Multiuser Systems, Multiprocessor Systems, Multithreaded Systems, PC systems; System Calls types, Operating System Structure, Operating System services, Kernel and its types.
Unit: 2	Concurrent Processes: Process Concept, Principle of Concurrency, Producer /Consumer Problem, Mutual Exclusion, Critical Section Problem, Deker's solution Peterson's solution, Semaphores, Test and Set operation; Classical Problem in Concurrency- Dining Philosopher Problem, Sleeping Barber Problem; Inter Process Communication models and Schemes, Process generation.
Unit: 3	CPU Scheduling: Scheduling Concepts, Performance Criteria, Process States, Process Transition Diagram, Process Control Block (PCB), Threads and their management, Scheduling Algorithms, Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, banker's algorithm.
Unit: 4	Memory Management: Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Protection schemes, Paging, Segmentation, Virtual memory concepts, Page replacement algorithms, Thrashing, File system Structure, File organization and aces mechanism, File directories, and File sharing, allocation methods, free space management, Directory implementation.
Unit: 5	I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID. **UNIX:** Essential commands and

	utilities, Unix files, directory structure, file security, Bourne shell programming features, systems call classification and basics, **Linux:** System components, Networking software layers.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley
2	Sibsankar Halder and Alex A Aravind, "Operating Systems", Pearson Education
Reference Books:	
1	Harvey M Dietel, "An Introduction to Operating System", Pearson Education
2	D M Dhamdhere, "Operating Systems: A Concept based Approach", McGraw Hill

Course Code	Course Title	Lecture			Semester: I
MMCA160AEP	English Language & Communication Lab	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): No Prerequisite

Course Objectives:

1. To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm.
2. To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
3. To improve the fluency of students in spoken English and neutralize their mother tongue influence
4. To train students to use language appropriately for public speaking and interviews.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand, comprehend and analyze the professional and soft communication skills, Strengthen general comprehending skills and present lucid skills in free writing	PO_6, PO_9, PO_{10}
CO_2	Understand the basic grammar techniques and utilize it in enhancing language development.	PO_9, PO_{10}, PO_{12}
CO_3	Proficiency in writing technical articles and presenting papers on any topic of any genre.	PO_9, PO_{10}, PO_{12}
CO_4	Enable the development in sharing information about family and friends.	PO_{10}, PO_{12}

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1									2	2		
CO_2									2	2		2
CO_3									2	2		2
CO_4										2		2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Phonetics – Speech Sounds – Vowels & Consonants
Unit: 2	Structure of Syllables – weak forms & strong forms
Unit: 3	Minimal pairs – word accent and stress shifts
Unit: 4	Intonation and common errors in pronunciation
Unit: 5	Conversation practice – oral presentation skills a. Greeting and leave taking, introducing oneself and others b. Apologizing, interrupting, requesting and making polite conversation c. Giving instructions and directions: speaking of hypothetical situations d. Narrating, expressing opinions and telephone interactions

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	"Enjoying Every day English", Published by Sangam Books, Hyderabad.
2	Innovate with English: A Course in English for Engineering Students, edited by T Samson, Foundation Books.

Reference Books:

1	English Grammar Practice, Raj N Bakshi, Orient Longman
2	Technical Communication by Daniel Riordan. 2011. Cengage Publications. New Delhi

Course Code	Course Title	Lecture			
MMCA211PCT	Data Structures and Algorithms	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To learn to implement ADTs such as lists, stacks, queues, trees, graphs, search trees in C/ C++ to solve problems.
2. To make students know about the concepts of searching and sorting techniques.
3. To enable them to write and compare the algorithms for solving problems with the help of data structures.
4. To understand the complexity theory.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand and analyze the algorithms to determine the time and computation complexity and justify the correctness.	**PO_1, PO_2, PO_4**
CO_2	Identify the alternative implementations of data structures with respect to its performance to solve a real-world problem.	**PO_2, PO_3**
CO_3	Ability to devise novel solutions to small scale programming challenges involving data structures and recursion.	**PO_5, PO_9**
CO_4	Examine the notations used to analyze the performance of algorithms	**PO_3, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	1		2								
CO_2		2	2									
CO_3					1				1			
CO_4			2	1								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Data Structure, Algorithm, Performance Analysis-Space complexity, Time complexity, Asymptotic Notations, Time-Space trade-off. Abstract Data Types (ADT). Arrays: Definition, Single and Multidimensional Arrays, Derivation of Index Formulae for 1-D,2-D,3-D and n-D Array Application of arrays. Linked lists: Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal.
Unit: 2	Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Tail recursion. Tradeoffs between iteration and recursion. Queues: Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues, Dequeue and Priority Queue. Trees: Binary tree representation, tree traversal, complete binary tree, heap, AVL tree, Huffman Tree, B Tree, B+ Tree.
Unit: 3	Searching with Analysis: Concept of Searching, Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used

	in Hashing. Sorting with Analysis: Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort and Heap Sort
Unit: 4	Greedy method: Knapsack problem, Graphs, Graph Traversal: DFS & BFS. Spanning Trees: Prim's and Kruskal's algorithm. Dijkstra's algorithm. Dynamic programming: Multistage Graphs, Floyd–Warshall algorithm, Optimal Binary Search Trees, O/1 Knapsack problem, Travelling Sales Person Problem.
Unit: 5	Back tracking: n-Queen Problem, Graph Colouring, Hamiltonian cycles. Branch and Bound: LIFOBB and FIFOBB. NP-Hard and NP-Complete problems: Basic Concepts, Non-Deterministic Algorithms, NP - Hard and NP-Complete Classes, Cook's theorem
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Fundamentals of Data Structures, Horowitz and Sahani, Galgotia Publications Pvt Ltd Delhi India.
2	Algorithms, Coreman, Rivest, Lisserson, PHI, Third Edition
Reference Books:	
1	Design and Analysis of Algorithms, Manas Ranjan Kabat, PHI.
2	Data Structures, Lipschutz, Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.

Course Code	Course Title	Lecture			
MMCA212PCT	Database Management Systems	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data structure & Algorithms

Course Objectives:

1. To describe the fundamental elements of database management systems and structure of databases.
2. To understand Query processing and decomposition in a database system.
3. To explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
4. To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Learn to design a database for a given set of requirements	**PO_1, PO_2**
CO_2	Demonstrate query processing in a database system	**PO_3, PO_5**
CO_3	Apply normalization techniques on given database	**PO_3, PO_5**
CO_4	Analyze the database storage structures and access techniques.	**PO_2, PO_3**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2		1							
CO_3			2		1							
CO_4		2	2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Data base System Applications, data base System VS file System – View of Data – Data Abstraction – Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor. History of Data base Systems. Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.
Unit: 2	Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views. Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus. Schema refinement – Problems Caused by redundancy Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.
Unit: 3	Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries Correlated Nested Queries Set – Comparison Operators –

	Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases.
Unit: 4	Transaction Concept- Transaction State- Implementation of Atomicity and Durability Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Based Protocols- Validation- Base Protocols – Multiple Granularity.
Unit: 5	Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems. Introduction of No SQL Database
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2	Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition
Reference Books:	
1	Fundamentals of Database Systems, Elmasri Navrate Pearson Education
2	Introduction to Database Systems, C.J.Date Pearson Education

Course Code	Course Title	Lecture			
MMCA213PCT	Java Programming	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To elaborate JAVA programming language with object-oriented principles.
2. To introduce the principles of inheritance and polymorphism.
3. To demonstrate the concept of Packages, exception & Threads.
4. To develop Java application with MySQL Database.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Demonstrate object-oriented paradigms: abstraction, encapsulation, inheritance, and polymorphism.	**PO_1, PO_2**
CO_2	Elaborate java concepts like exception handling, interfaces, object classes and various libraries.	**PO_3, PO_4**
CO_3	Design object-oriented solutions for real world problems.	**PO_3, PO_5**
CO_4	Develop the applications using the learnt concepts.	**PO_3, PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	2								
CO_3			2		2							
CO_4			2		2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Java Basics - Review of OOP concepts, C++ vs Java, History of Java, Java buzzwords, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow-block scope, conditional statements, loops, break and continue statements, simple java program, arrays, input and output, formatting output classes, objects, constructors, methods, parameter passing, static fields and methods, access control, this keyword, overloading methods and constructors, recursion, garbage collection, String Handling. Object oriented analysis, modeling and design: Structural modeling, Behavioral modeling.
Unit: 2	Inheritance – Inheritance concept, benefits of inheritance, Super classes and Sub classes, Member access rules, Inheritance hierarchies, super keyword, preventing inheritance: final classes and methods, casting, polymorphism - dynamic binding, method overriding, abstract classes and methods, the Object class and its methods. Packages-Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.
Unit: 3	Interfaces – Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface, method definition in interface: default, private & static methods, lambda expressions, BigInteger: class hierarchy and example.Inner classes – Uses of inner classes, local inner classes, anonymous inner classes, static inner classes, Diamond Operator.
Unit: 4	Exception handling – Dealing with errors, benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and

	unchecked exceptions, usage of try, catch, throw, throws and finally, re-throwing exceptions, exception specification, built in exceptions, creating own exception sub classes, Guide lines for proper use of exceptions. Multi-threading - Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter-thread communication, thread groups, daemon threads.
Unit: 5	APPLETS, JAVA GUI AND DATABASE CONNECTIVITY, Networking - Applets – Applet life cycle methods – Applets based GUI – AWT Introduction - GUI components – Basics of Swings –Accessing database with JDBC basics- Types of Drivers – Basics of Networks Programming, Addresses, Ports, Sockets, Simple Client and Server Program, Multiple Clients and Single Server.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Java; the complete reference, 9th editon, Herbert schildt, TMH.
2	Understanding OOP with Java, updated edition, T. Budd, Pearson education.
Reference Books:	
1	Head First Java, Kathy Sierra, Bert Bates, O'Reilly Media; 2 edition (9 February 2005)
2	Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education.

Course Code	Course Title	Lecture			Semester: II
MMCA214PCT	Computer System Architecture	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Digital Electronics

Course Objectives:

1. To introduction of digital components of the computer and their circuits.
2. To elaborate idea about the different registers and micro-operations carried out.
3. To understanding of the CPU Organization and Input-Output Organization.
4. To learn the architecture of microprogrammed control unit, Memory Organization, I/O systems, and multiprocessors.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Define the basic organization and design of a digital computer system and its operations	PO_1
CO_2	Explain the design of Arithmetic & Logic design circuit and Illustrate the Control unit operations.	PO_2, PO_3
CO_3	Analyze the different ways of communication in Input-Output devices, Standard Interfaces and their functioning.	PO_2, PO_{10}
CO_4	Illustrate the hierarchical memory system, cache memory and virtual memory	PO_4, PO_{10}

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2		2	2									
CO_3		2								1		
CO_4				2						1		

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Digital Logic Circuits:** Digital Computers, Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuits, Flip Flops, Sequential Circuits. Digital Components, Decoder, Multiplexers, 'Registers.
Unit: 2	**Register Transfer and Micro operations:** Register Transfer language, register transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations and Arithmetic logic shift. Instruction codes, Computer Registers, Instructions, Instruction Cycles, Input, Output and Interrupts.
Unit: 3	**CPU Organization:** Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control Organization of a control unit. Operations of a control unit, Hardwired control unit, Micro programmed control unit.
Unit: 4	**Input Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA controlled I/O, Direct Memory Access, Input-Output Processor
Unit: 5	**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	M. Morris Mano: Computer System Architecture, Pearson Asia / Prentice Hall, Third edition.
Reference Books:	
1	William Stallings: "Computer Organization & Architecture", Pearson Education, Sixth: Edition, 2003.
2	P Dandamudi: Fundamentals of Computer Organization and Design, Springer/ Dream Tech Publishers, 2003.

Course Code	Course Title	Lecture			
MMCA260PCP	Data Structures and Algorithms Lab	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To develop skills to apply appropriate data structures and algorithms in problem solving.
2. To apply various techniques with data such storing, inserting, deleting and traversing of data.
3. To practice with programming skill and improve the programming logic.
4. To utilize of various data structures such as Linked List Structures, Stack, Queues, Trees and Graphs to implement the algorithms.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Write the code for a large program after overcoming the time and space complexity.	**PO_1, PO_3**
CO_2	Develop programs that use arrays, records, linked structures, stacks, queues, trees, and graphs.	**PO_3**
CO_3	Compare alternative implementations of data structures with respect to performance.	**PO_4, PO_5, PO_9**
CO_4	Implementation of various algorithms such as searching, sorting, Greedy, Dynamic, Back-Tracking and Branch & Bound.	**PO_2, PO_3, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3				2	2				1			
CO_4		2	2		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Write a Program to implement a stack using array.
2. Write a Program to implement a stack using linked list.
3. Write a Program to implement a queue using array.
4. Write a Program to implement a queue using linked list.
5. Write a Program to implement a circular queue using array.
6. Write a Program to implement a circular linked list.
7. Write a Program to implement a doubly linked list.
8. Write a Program to implement a reversed a linked list.
9. Write a Program to implement the following Searching Algorithms:
   i. Sequential search
   ii. Index Sequential Search
   iii. Binary Search
10. Write a Program to implement the following Sorting Algorithms:
    i. Insertion Sort
    ii. Selection
    iii. Bubble Sort
    iv. Quick Sort
    v. Merge Sort
    vi. Heap Sort
11. Write a program to implement the Minimum Spanning Tree using:

i. Kruskal's Algorithm ii. Prim's Algorithm 12. Write a program to implement the TSP problem.	
Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Data Structures and Program Design in C, R. Kruse et al, Pearson Education.
2	Data Structure Using C, Thareja, Oxford Higher Education
Reference Books:	
1	Data Structure Using C, AK Sharma, Pearson Education India.
2	Data Structures, Lipschutz, Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.

Course Code	Course Title	Lecture			
MMCA261PCP	Database Management Systems LAB	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Structure

Course Objectives:

1. To understand the structure of databases.
2. To learn how to create a database.
3. To analyze Query processing and decomposition.
4. To handling different user views of the same stored data, combining interrelated data.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Design a database for a given set of requirements.	PO_1, PO_2
CO_2	Create relational database system by writing SQL.	PO_3, PO_5
CO_3	Apply normalization techniques on given database.	PO_3, PO_4, PO_5
CO_4	Analyze the database storage structures and access techniques	PO_2, PO_4, PO_9

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2		1							
CO_3			2	2	1							
CO_4		2		2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Write the queries for Data Definition and Data Manipulation Language.
2. Write SQL queries using logical operations (=, <,>, etc.)
3. Write SQL queries using SQL operators
4. Write SQL query using character, number, date and group functions
5. Write SQL queries for relational algebra
6. Write SQL queries for extracting data from more than one table
7. Write SQL queries for sub queries, nested queries
8. Write program by the use of PL/SQL
9. Concepts for ROLL BACK, COMMIT & CHECK POINTS
10. Create VIEWS, CURSORS and TRIGGERS

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	SQL, PL/SQL the Programming language of Oracle by Ivan Bayross 4th edition
2	SQL & PL/SQL for Oracle 11g Black Book by P.S. Deshpande

Reference Books:

1	Oracle PL/SQL Training Guide Ben Forta
2	Oracle Database 12c PL/SQL Programming McLaughlin

Course Code	Course Title	Lecture			Semester:
MMCA262PCP	Java Programming Lab	L	T	P	II
Version: 1.2	**Date of Approval:**	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Programming for Problem Solving

Course Objectives:

1. To illustrate Object Oriented Programming Language using java.
2. To understand how to design applications with in Java.
3. To write programs using multithreading concepts and handle exception
4. To design and program stand-alone Java applications.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Write programs using objects and inheritance in Java Language.	**PO_1, PO_2, PO_3**
CO_2	Develop console application Using Java programming language.	**PO_3, PO_4, PO_5**
CO_3	Design and implement GUI programs using components in Java Language.	**PO_2, PO_4, PO_9**
CO_4	Develop real life applications using Java programming	**PO_2, PO_3, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2									
CO_2			2	1	2							
CO_3		2		1					1			
CO_4		2	2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

List of Experiments:

1. Write a program to print the Fibonacci series up to a given number.
2. Write a Java Program to find the maximum of two numbers using command line args.
3. Write a Java Program to demonstrate the operation of super keyword in Java.
4. Write a Java Program to demonstrate the concept of method overriding.
5. Write a Java Program to describe about abstract class.
6. Write a Java Program to demonstrate about the final method.
7. Write a Java Program to define and implements an interface.
8. Write a Java Program to describe about try and catch blocks for handling exceptions.
9. Write a Java Program to demonstrate about throw and throws keywords.
10. Write a Java Program to raise and handle custom or user defined exceptions in java.
11. Write a Java Program to demonstrate about switch case.
12. Write a Java Program to find whether the given number is palindrome or not.
13. Write a Java Program on the operation of this keyword.
14. Write a Java Program on concept of method overloading.
15. Write a Java Program to explain single inheritance concept.
16. Write a Java program to demonstrate the operation of Scanner class.
17. Write a Java Program to create threads in java by extending Thread Class.
18. Write a Java Program to create threads in java by implementing Runnable Interface.
19. Write a Java Program to define and import the user defined package.
20. Write a Java program to print a message using applet concept.
21. Write a Java Program to pass the parameters using applet concept.

22. Write a program to generate random numbers sequence in Java. 23. Write a program to swap the numbers without using third variable in Java. 24. Write a Java Program to find the sum and product of digits of a given number. 25. Write a Java Program to display multiplication of an array. 26. Write a java program to perform arithmetical operations using BigInteger class.	
Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech Publishers.
2	Elements of Workshop Technology (Volume - 1): Hajra Choudhury.
3	Workshop Manual / Venkat Reddy/ BS Publications/Sixth Edition.
Reference Books:	
1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2	Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3	Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Code	Course Title	Lecture			Semester:
MMCA311PCT	Data Science	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	4	End Semester	:	50
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Mathematics, Statistics

Course Objectives:

1. To make the students to know about data, data science process and big data challenges in different domains including social media.
2. To make the student to learn the concept of MAP-REDUCE programming and Machine learning. model for better scalability and performance.
3. To analyze the capability of regression, classification problem No-SQL Data base systems
4. To apply algorithms on Applications of Data Science & Machine learning.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concepts of data science process, data science toolkit, Types of data, Data collection and management	**PO_1, PO_2**
CO_2	Demonstrate the concept and importance of Big Data, Big Data Architecture, Hadoop Ecosystem, Hadoop Distributed File System (HDFS) HBase, Hive and PIG, Map Reduce Framework and Machine Learning	**PO_3**
CO_3	Apply the regression and classification problem and create the NoSQL Databases	**PO_3, PO_4, PO_5**
CO_4	Analyze the data, Applications of Data Science, Technologies for data visualization	**PO_2, PO_4, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2	1	2							
CO_4			2	1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources
Unit: 2	Introduction to Big Data: Big Data - Definition, overview of Big Data, Big Data Characteristics – Volume, Velocity, Variety and other Vs, Issues and challenges of Big Data, Stages of analytical evolution, State of the Practice in Analytics, Big Data Architecture – space of Big Data: Transactions, Interactions, Observations; Big data Technological approaches and Potential use cases for Big Data. The Hadoop Ecosystem–Distributed File Systems basics, Advantages of Hadoop, Query languages for Hadoop, Hadoop Distributed File System (HDFS), Overview of HBase, Hive and PIG. Map Reduce Framework, Introduction to Machine Learning.
Unit: 3	Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.
Unit: 4	NoSQL Databases – Review of traditional Databases, need for NoSQL Databases,

	Columnar Databases, Failover and reliability principles, working mechanisms of NoSQL Databases – HBase, Cassandra, Couch DB, Mango DB.
Unit: 5	Applications of Data Science, Technologies for visualization, recent trends in various data collection and analysis techniques, various visualization techniques, application development methods in data science using g R, Spreadsheet-like analytics.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Dinesh Kumar, Business Analytics, Wiley India Business analytics: The Science
2	V.K. Jain, Data Science & Analytics, Khanna Book Publishing, New Delhi o
Reference Books:	
1	Data Science for Dummies by Lillian Pierson, Jake Porway
2	Doing Data Science by Cathy O'Neil, Rachel Schutt Released October 2013 Publisher(s): O'Reilly Media, Inc

Course Code	Course Title	Lecture			Semester:
MMCA312PCT	Formal Language & Automata Theory	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Discrete Mathematics

Course Objectives:

1. To provide introduction to some of the central ideas of theoretical computer science from the perspective of formal languages.
2. To introduce the fundamental concepts of formal languages, grammars and automata theory.
3. To classify machines by their power to recognize languages and design various types of automata and write regular expressions for regular languages.
4. To examine deterministic, non-deterministic machines and the differences between decidability and undecidability.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concept of abstract machines and their power to recognize the languages.	**PO_1, PO_2**
CO_2	Develop the finite state machines for modelling, write regular expressions for regular languages. And solving computing problems.	**PO_3, PO_4**
CO_3	Define, analyze, and design context free grammars for context free languages	**PO_2, PO_3, PO_4**
CO_4	Design and analyze Turing machines and to distinguish between decidability and undecidability.	**PO_3, PO_4, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	1								
CO_3		2	2	1								
CO_4			2	1	1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Fundamentals: Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non-deterministic finite automaton, transition diagrams and Language recognizers. Finite Automata: NFA with ϵ-transitions - Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without ϵ- transitions, NFA to DFA conversion, minimisation of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Melay machines.
Unit: 2	Regular Languages: Regular sets, regular expressions, identity rules, constructing finite Automata for a given regular expression, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets. Grammar Formalism: Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, and sentential forms. Right most and leftmost derivation of strings.
Unit: 3	Context Free Grammars: Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greibach normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL. Push Down

	Automata: Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion.
Unit: 4	Turing Machine: Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines
Unit: 5	Computability Theory: Chomsky hierarchy of languages, linear bounded automata and context sensitive language, LR(0) grammar, decidability of problems, Universal Turing Machine, undecidability of posts correspondence problem, Definition of P and NP problems, NP complete and NP hard problems
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Introduction to Automata Theory Languages and Computation. Hopcroft H.E. and Ullman J. D. Pearson Education
2	Theory of Computer Science – Automata languages and computation -Mishra and Chandrashekaran, PHI.
Reference Books:	
1	Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan Rama R.
2	Michael Sipser, "Introduction to the Theory of Computation ",Thomson Learning, PWS publishing company
3	Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.

Course Code	Course Title	Lecture			Semester:
MMCA313PCT	Blockchain Technology	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Human Resource Development and Organizational Behavior and Discrete Mathematics

Course Objectives:

1. To understand the function of Blockchain as a method of securing distributed ledgers.
2. To familiarize the functional/operational aspects of cryptocurrency ecosystem.
3. To demonstrate about wallets and learn their utilization of wallet during transaction.
4. To analyze and apply that how to write and apply the Smart Contracts.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the blockchain Technology in real life	PO_1, PO_2
CO_2	Apply the smart contracts on Ethereum platform.	PO_3, PO_5, PO_6
CO_3	Develop the use cases on Hyperledger.	PO_3, PO_4, PO_5, PO_6, PO_7
CO_4	Analyze the major research challenges and technical gaps existing between theory and practice in Blockchain	PO_2, PO_4, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2		2	1						
CO_3			2	1	2							
CO_4		2		1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Cryptography, Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, Euclid's Algorithm, RSA algorithm, Diffie-Hellman key exchange algorithm, ElGamal Encryption, Elliptic curve cryptography, SHA 256, Digital Signature, Zero Knowledge Proof (ZKP)
Unit: 2	Introduction from barter system to Cryptocurrency, fundamental of Blockchain, Block structure, Genesis Block, Orphaned Blocks, Stale Block, Uncle Block, Distributed Ledger Technology (DLT), peer-to- peer network, Merkle Tree, Lifecycle of Blockchain, Evolutions of Blockchain, Fork, double spending money, Transactions and UTXO's, Types of Blockchain. Need of Blockchain, Benefits of Blockchain.
Unit: 3	Cryptocurrencies: BitCoin (BTC), Ethereum (ETH), Ripple (XRP), LiteCoin (LTC), Bitcoin Cash (BCH), Mining pools, Mining, Difficulty Level, Current Target, Nonce, how miners picks transactions, How do mempools work, 51% attack.Consensus Algorithms: Proof of Work (PoW), Asynchronous Byzantine Agreement, Proof of Stake (PoS), Hybrid models (PoW + PoS),
Unit: 4	Wallets, Types of wallets-Hardware, Software, Paper, Web, Desktop. Ethereum - Ethereum network, Ethereum Virtual Machine (EVM), Wallets for Ethereum, Solidity - Smart Contracts, Truffle, Web3, some attacks on smart contracts, Design and issue Cryptocurrency ICO, Mining, Gas - Transactional Fee & Incentivisations, DApps, Decentralized Autonomous Organizations (DAO).

Unit: 5	Hyperledger- Introduction to Hyperledger, Utilization of Hyperledger, Hyperledger Architecture, Membership, Blockchain, Transaction, Chaincode, Hyperledger Fabric, Features of Hyperledger, Fabric Installation of prerequisite, Architecture of Hyperledger Fabric, Transaction, Ledger, Nodes, Peer, Endorser, Ordering Nodes, Channels, Certificate Authority, Transaction Flow.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Mastering Blockchain, Imran Bashir, Packt Publishing
2	Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten,Andrew Miller, Steven Goldfeder, Princeton University Press. https://bitcoinbook.cs.princeton.edu/
Reference Books:	
1	Grokking Bitcoin, Kalle Rosenbaum, Manning Publications.
2	Blockchain Basics, Daniel Drescher, Apress Publication

Course Code	Course Title	Lecture			Semester:
MMCA314PCT	Machine Learning	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Artificial Intelligence

Course Objectives:

1. To understand the basic building blocks and general principles that allow one to design machine learning algorithms.
2. To become familiar with specific, widely used machine learning algorithms.
3. To apply methodology and tools on various machine learning algorithms to real data and evaluate their performance.
4. To apply the Regression and clustering techniques to solve various problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concepts of computational intelligence like machine learning.	**PO_1, PO_2**
CO_2	Apply machine learning techniques to address the real time problems in different areas.	**PO_3, PO_5**
CO_3	Perform evaluation of learning algorithms and model selection.	**PO_3, PO_4**
CO_4	Analyze and appreciate the applications which can use Machine Learning Techniques.	**PO_2, PO_4, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2		2							
CO_3			2	1								
CO_4		2		1	2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to Machine Learning** - Defining learning systems, Goals and applications of machine learning in different fields such as health care, banking, telecommunication, and so on. Aspects of developing a learning system: : training data, concept representation, function approximation, A general overview of supervised, semi supervised, unsupervised learning algorithm and the usage of each algorithm.
Unit: 2	**Basics of Python:** Introduction to Python, Why learn Python, Keywords and identifiers, comments, indentation and statements, Variables and data types in Python, Operators, Standard Input and Output, Introduction to IDE such as Sublime, pycharm, spyder and relevant packages installations such anaconda. **Control structure and function:** if-elif-else, while loop, for loop, break and continue, Introduction to function, Types of functions, Function arguments, Lambda functions, File Handling, packages and modules.
Unit: 3	Python Data Structures: Lists, Tuples, Dictionary, Sets, strings, Numpy: Numpy operation, Array and its operation, Matrix and associated operations, Linear algebra and related operations using python. Understand the advantage of using Python libraries for implementing Machine Learning models. Types of data sets.
Unit: 4	**Pandas data frame and data frame related operations on dataset:** Reading data files, pandas dataframes, Exploratory data analysis, Data preparation and preprocessing (Dealing with missing value, cross-validation, classification,

	performance measure), **Data visualization on dataset using matplotlib and seaborn libraries:** Scatter plot, Line plot, Bar plot, Histogram, Box plot, Pair plot.
Unit: 5	**Introduction to Regression** - Linear, Non-linear, Simple and Multiple regression, and their applications, Introduction to Classification technique - KNN, ANN, Decision Trees and SVM. Pros and cons of each method, and different classification accuracy metrics. **Introduction to clustering approaches** - Types of clustering, including Partitioned-based Clustering, Hierarchical Clustering, and Density-based Clustering.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Mastering Python for data science, Samir Madhavan
2	Introduction to Machine Learning with Python, Andreas C. Mueller
Reference Books:	
1	Machine Learning using Python, U Dinesh Kumar Manaranjan Pradhan

Course Code	Course Title	Lecture			Semester:
MMCA360PCP	Data Science Lab	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Prerequisite(s): Mathematics and Statistics

Course Objectives:

1. To understand the python libraries, basic Statistical measures for data science.
2. To learn descriptive analytics on the benchmark data sets.
3. To apply correlation and regression analytics on standard data sets.
4. To present and interpret data using visualization packages in Python.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Make use of the python libraries, basic Statistical measures for data science.	PO_1, PO_2
CO_2	Perform descriptive analytics on the benchmark data sets.	PO_3, PO_4, PO_5
CO_3	Perform correlation and regression analytics on standard data sets.	PO_3, PO_5, PO_9
CO_4	Present and interpret data using visualization packages in Python.	PO_4, PO_5, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	1	2							
CO_3			2		2				1			
CO_4				1	2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2. Working with Numpy arrays
3. Working with Pandas data frames.
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set. CS3361 Data Science Laboratory.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
   a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
   b. Bivariate analysis: Linear and logistic regression modeling
   c. Multiple Regression analysis
   d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets.
   a. Normal curves
   b. Density and contour plots
   c. Correlation and scatter plots
   d. Histograms
   e. Three-dimensional plotting
7. Visualizing Geographic Data with Basemap

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Dinesh Kumar, Business Analytics, Wiley IndiaBusinenalytics: The Science
2	V.K. Jain, Data Science & Analytics, Khanna Book Publishing, New Delhi o
Reference Books:	
1	Data Science For Dummies by Lillian Pierson , Jake Porway
2	Doing Data Science by Cathy O'Neil, Rachel Schutt Released October 2013 Publisher(s): O'Reilly Media, Inc

Course Code	Course Title	Lecture			Semester:
MMCA361PCP	Blockchain Technology Lab	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Discrete Mathematics

Course Objectives:

1. To learn the tools: Python, VS Code, POSTMAN, FLASK, Node.js, Ganache, MyEtherWallet.
2. To understand the concept of Blockchain.
3. To demonstrate the Cryptocurrencies.
4. To apply and analyze the concept of smart contract.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the functional or operational aspects of cryptocurrency ecosystem.	PO_1, PO_2, PO_8
CO_2	Demonstrate the emerging abstract models for Blockchain Technology.	PO_3
CO_3	Able to work with Web Wallets, Mobile Wallets, Desktop Wallets, Paper Wallets.	PO_6, PO_8
CO_4	Apply Blockchain in use cases like Real state, Supply chain, voting, ICO, etc.	PO_3, PO_4, PO_8, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2						2				
CO_2			2									
CO_3						2		2				
CO_4			2	2				2	1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

1. Create a Blockchain
   - 1.1 Create new blocks and add to the chain
     - 1.1.1 Structure of a block: Index, Timestamp, Transaction List, Proof, Previous Block Hash
   - 1.2 Initialize Blockchain
   - 1.3 Adds new transaction
   - 1.4 Hashing a block
   - 1.5 Registering a node to the network
   - 1.6 Validates the chain
   - 1.7 Validates block before submission chain
   - 1.8 Implement Proof of Work Consensus
2. Create a Cryptocurrency
3. Create a Smart Contracts
   hadcoins_ico , Calculator, simplewallets
4. Supply chain smart contract
5. Voting Smart Contract
6. Hands-on Wallets Hardware, Web Wallets, Mobile Wallets, Desktop Wallets, Paper Wallets
7. Hands-on Hyperledger Fabric Blockchain Platform
8. Hands-on IBM Blockchain Platform: Docker, Docker Compose

9. Hands-on Relictum Pro Blockchain 5.0 Platform, Blockchain Security 2Go starter kit	
Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.	
Text Books:	
1	Hands-on Blockchain for Python Developers, Arjuna Sky Kok, Packt Publication
2	Solidity Programming Essentials, Ritesh Modi, Packt Publication
Reference Books:	
1	Ethereum for Web Developers, Santiago Palladino, Apress Publication.
2	Learn Blockchain Programming with JavaScript, Eric Traub, Packt Publication

Course Code	Course Title	Lecture			Semester:
MMCA470PCP	Industrial/ Major Project	L	T	P	IV
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	0	0	32	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	40 Hrs.	Maximum Score	:	400
Lab Hours/ Week	:	40	Internal Evaluation	:	200
Credits	:	16	End Semester	:	200
Instruction Mode	:	Practical	Exam Duration	:	-

Prerequisite(s): Software Engineering and Programming Language

Course Objectives:

1. To understand Software requirement specification and designing methodology.
2. To familiarize of the syntax, semantics, data-types and library functions of any programming languages.
3. To apply ER Diagram, DFD, UML for designing the software application.
4. To implement the specified problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Applying SRS, techniques	**PO_2, PO_3, PO_8, PO_9, PO_{11}**
CO_2	Apply Design methods for given SRS	**PO_3, PO_5, PO_9, PO_{11}**
CO_3	Write the codes as per SRS and designed Framework	**PO_3, PO_5**
CO_4	Able to implement real world problem into software solution	**PO_3, PO_5, PO_9, PO_{11}, PO_{12}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1		2	2					2	2		2	
CO_2			2		2				2		2	
CO_3			2		2							
CO_4			2		2				2		2	2

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

- Based on real-time/ in-house/ problem specific

Examination and Evaluation Pattern: It include both internal evaluation (200 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (200 marks) which is mainly end semester examination.

Text Books:

1	
2	

Reference Books:

1	
2	

Discipline Specific Elective

Course Code	Course Title	Lecture			Semester: II
MMCA211PET	Digital Forensics	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data Structure and Algorithm

Course Objectives:

1. To understand the process of Digital Forensics.
2. To understand the Environment of forensics & learn process of collecting evidences.
3. To gain working knowledge of analyzing evidences using tools.
4. To use of various tools and applications.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the hardware and software components responsible for seeking evidence.	PO_1, PO_2
CO_2	Analyze the need for cybercrime investigation.	PO_2, PO_4, PO_8
CO_3	Demonstrate the knowledge of the techniques used for collecting evidences.	PO_4, PO_8
CO_4	Analyze and apply the evidence through suitable tools.	PO_2, PO_3

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2		1				2				
CO_3								2				
CO_4		2	2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	DIGITAL FORENSICS PROCESS: Forensic Science, Digital Forensics, Digital Evidence, Digital Forensics Process – Identification, Collection, Examination, Analysis, Presentation Phases. Cyber Crime Law- International Legal Framework of Cybercrime Law, Digital Crime, Investigation Methods for Collecting Digital Evidence.
Unit: 2	FORENSICS ENVIRONMENTS: Hardware and Software Environments – Storage Devices, Operating System, File Systems, and Metadata, Locating evidence in file systems-Password security, Encryption, and Hidden files. Case study – linking the evidence to the user, Data Analysis using forensics tool ILookIX
Unit: 3	COLLECTING EVIDENCES Use of Digital Evidence, File Metadata and Correlation with Other Evidence, Technical Complexities of Digital Evidence. Data carving, Date and time problems, Physical Acquisition and Safekeeping of Digital Evidence. Forensic Imaging Processes. Case Study – IXImager, Understanding. ASB Container
Unit: 4	ANALYZING DIGITAL EVIDENCE: Selecting and Analyzing Digital Evidence - Locating digital evidence, categorizing files, eliminating superfluous files, and Validating the Evidence. Case study – illustrating the recovery of deleted evidence held in volume shadows.
Unit: 5	OTHER SOURCES OF EVIDENCES: Windows and Other Operating Systems as Sources of Evidence, Examining Browsers, E-mails, Messaging Systems, and Mobile Phones, Internet and Cloud. -Challenges in Digital Forensics.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Richard Boddington, Practical Digital Forensics, PACKT publishing, First Edition, 2016ANDRÉ ÅRNES.
2	Practical Mobile Forensics, PACKT publishing, 2014 Satish Bommisetty, Rohit Tamma, Heather Mahalik
Reference Books:	
1	"Guide to Computer Forensics and Investigations" 4e, Nelson, Phillips Enfinger, Steuart, Cengage Learning.
2	Android Forensics Investigation, Analysis, and Mobile Security for Google Android, Andrew Hoog, John McCash.

Course Code	Course Title	Lecture			
MMCA212PET	Component based Software Engineering	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data structure and algorithm

Course Objectives:

1. To understand the idea of decomposing the given problem into Analysis, Design, Implementation, Testing and Maintenance phases.
2. To provide an idea of using various process models in the software industry according to given circumstances
3. To gain the knowledge of how Analysis, Design, Implementation,
4. To test and maintain processes of a software project.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Decompose the given project in various phases of a lifecycle. Knowledge, Understand	**PO_1, PO_2, PO_3, PO_{11}**
CO_2	Selection of appropriate process model depending on the user requirements apply the knowledge, techniques, and skills in the development of a software product	**PO_2, PO_5, PO_6, PO_{11}**
CO_3	Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.	**PO_3, PO_4, PO_5**
CO_4	Analyze various processes used in all the phases of the product.	**PO_2, PO_6**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2	2								1	
CO_2		2			1	1					1	
CO_3			2	1	1							
CO_4		2				1						

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Component Based Development: Definition of Software Component and its Elements, The Component Industry Metaphor, Component Models and Component Services: Concepts and Principles, An Example Specification for Implementing a Temperature Regulator Software Component.
Unit: 2	Case for Components: The Business Case for Software Components, COTS Myths and Other Lessons Learned in Component-Based Software Development, Roles for Component-Based Development, Common High Risk Mistakes in Component-Based Software Engineering, CBSE Success Factors: Integrating Architecture, Process, and Organization.
Unit: 3	Software Component Infrastructure: Software Components and the UML, Component Infrastructures: Placing Software Components in Context, Business Components, Components and Connectors: Catalysis Techniques for Defining Component Infrastructures, an Open Process for Component-Based Development, Designing Models of Modularity and Integration.
Unit: 4	Management of CBD: Measurement and Metrics for Software Components, The Practical Reuse of Software Components, Selecting the Right COTS Software: Why Requirements are important, Build vs. Buy, Software Component Project Management Processes, The Trouble with Testing Software Components,

	Configuration Management and Component Libraries, The Evolution, Maintenance and Management of Component-Based Systems
Unit: 5	Component Technologies: Overview of the CORBA Component Model, Transactional COM+ Designing Scalable Applications, The Enterprise JavaBeans Component Model, Choosing Between COM+, EJB, and CCM, Software Agents as Next Generation Software Components.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Component Software, Clemens Szyperski, Addison-Wesley Professional; 2 edition, 2002, ISBN-10: 0201745720, ISBN-13: 978-0201745726
Reference Books:	
1	Component-Based Software Engineering: Putting the Pieces Together by George T. Heinemann and William T. Council, Addison-Wesley Professional, 2001 ISBN 1`0: 0201704854, ISBN- 13:9780201704853

Course Code	Course Title	Lecture			Semester: II
MMCA213PET	Cryptography and Cyber Security	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No Prerequisite

Course Objectives:

1. To understand fundamentals of Cryptography and Cyber Security.
2. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
3. To acquire the concept of various protocols and cryptographic algorithms for network security to protect against the threats in the networks.
4. To analyze the emerging technologies in the cyber security areas and assess their current capabilities, limitations and potential applications.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand fundamentals of Cryptography and Cyber Security.	**PO_1, PO_2**
CO_2	Know about how to maintain the Confidentiality, Integrity and Availability of a data.	**PO_3, PO_4**
CO_3	Demonstrate various protocols and cryptographic algorithms for network security to protect against the threats in the networks.	**PO_2, PO_3**
CO_4	Able to analyze the concept of emerging technologies in the cyber security areas and assess their current capabilities, limitations and potential applications	**PO_2, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	1								
CO_3		2	2									
CO_4		2		1								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to the Concepts of Security: The need for security, Security Approaches, Principles of Security, Types of Attacks. Symmetric and Asymmetric Key Cryptography, Key Range and Key Size. Classical encryption techniques: substitution ciphers and transposition ciphers, cryptanalysis, stenography, stream and block ciphers. Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard (DES), AES.
Unit: 2	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffie-Hellman key exchange algorithm, ElGamal Encryption, Elliptic curve cryptography,
Unit: 3	Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MAC, MD5, Secure hash algorithm (SHA). Digital Signatures.
Unit: 4	Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.
Unit: 5	IP Security: Architecture, Authentication header, encapsulating security payloads, Combining security associations, key management. Web Security: Secure socket

	layer and transport layer security, secure electronic Transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Cryptography and Network Security by Behrouz A. Forouzan, 2nd Edition TMH.
2	Cryptography and Network Security, W. Stallings, Prentice Hall, 5th Edition, 20102.
Reference Books:	
1	Network Security Essentials, William Stallings, Prentice Hall, 5th Edition, 2013.
2	Network Security and Cryptography, Bernard Menezes, Cengage Publication.

Course Code	Course Title	Lecture			
MMCA214PET	Software Testing and Quality Assurance	L	T	P	**Semester:** II
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Software Engineering

Course Objectives:

1. To understand the fundamental concepts in software testing.
2. To describe the principles of system and component testing.
3. To analyze the strategies for generating system test cases.
4. To apply the essential characteristics of tool used for test automation.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Use testing tools to test software in order to improve test efficiency and Assess software quality and assurance based on standards.	**PO_1, PO_3**
CO_2	Choose of software testing techniques in commercial environments and Test software to meet requirements of quality.	**PO_2**
CO_3	Identify the inputs and deliverables of the testing process and work together as a team in preparing a report.	**PO_3, PO_5, PO_8**
CO_4	Match attributes and assess the quality, reliability and security of software. Apply software testing knowledge and engineering methods.	**PO_3, PO_6, PO_8, PO_{11}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2		2									
CO_2		2										
CO_3			2		2			2				
CO_4			2			1		2			2	

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction: Software Quality, Role of testing, Verification & Validation, objectives and issues of testing, Testing activities and levels, Sources of Information for Test Case Selection, White-Box and Black-Box Testing, Test Planning and Design, Monitoring and Measuring Test Execution, Test Tools and Automation, Test Team Organization and Management. Unit Testing: Concept, Static Unit Testing, Defect Prevention, Dynamic Unit Testing, Mutation Testing, Debugging.
Unit: 2	Control Flow & Data Flow Testing: Outline of CFT, CF Graph, and Paths in a Control Flow Graph, Path Selection Criteria, Generating Test Input, and Examples of Test Data Selection. Overview of Dynamic Data Flow Testing, Data Flow Graph, Data Flow Testing Criteria, Comparison of Testing Techniques, Functional Testing.
Unit: 3	System Integration Testing & Test Design: Concept of Integration Testing, Different Types of Interfaces and Interface Errors, Granularity of System Integration Testing, System Integration Techniques, Test Plan for System Integration, Off-the-Shelf Component Testing, System Test Categories.
Unit: 4	System Test Planning, Automation & Execution: Structure of a System Test Plan, Test Approach, Test Suite Structure, Test Environment, Test Execution Strategy, Test Effort Estimation, Scheduling and Test Milestones, System Test Automation, Selection of Test Automation Tools, Test Selection Guidelines for Automation, Structure of an Automated Test Case, Test Automation Infrastructure Metrics for Tracking System Test, Metrics for Monitoring Test Execution, Beta Testing, System Test Report, Measuring Test Effectiveness. Acceptance Testing:

Unit: 5	Software Quality: Five Views of Software Quality, McCall's Quality Factors and Criteria, Quality Factors Quality Criteria, Relationship between Quality Factors and Criteria, Quality Metrics, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard ISO 9000:2000 Fundamentals, ISO 9001:2000 Requirements Maturity Models: Capability Maturity Model, Test Process Improvement, Testing Maturity Model
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Software Testing and Quality Assurance theory and practice by Kshira Sagar Naik and Priyadarshi Tripathy.
Reference Books:	
1	Stephen H.Khan, Metrics and Models in Software Quality Engineering Pearson Education, India.
2	Shari Lawrence Pfleeger,"Software Engineering Theory and Practice Pearson Education ,India

Course Code	Course Title	Lecture			Semester: IV
MMCA311PET	Cloud Computing and Virtualization	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Network and Distributed System

Course Objectives:

1. To present a comprehensive understanding of cloud architecture and cloud computing methodology.
2. To understand the different types of cloud computing services namely.
3. To demonstrate the architecture of cloud services and the trusted cloud computing system.
4. To apply virtualization, security and privacy issues.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Identify the architecture, infrastructure and delivery models of cloud computing	**PO_1, PO_2**
CO_2	Analyze cloud, data center, hypervisor, CPU, and memory management concerns.	**PO_2, PO_3, PO_4, PO_5, PO_7**
CO_3	Apply suitable virtualization concept.	**PO_3, PO_5**
CO_4	Handle the cloud computing, virtualization, security, and privacy issues.	**PO_4, PO_5, PO_8**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2	1	2		1					
CO_3			2		2							
CO_4				1	2			1				

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Cloud Computing Fundamentals: overview of Cloud Computing, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing, Applications cloud computing, Business models around Cloud–Major Players in Cloud Computing Titans-Issues in Cloud
Unit: 2	Cluster Computing, Grid Computing, Grid Computing Versus Cloud Computing, Key Characteristics of Cloud Computing. Cloud Models: Benefits of Cloud Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Shared Private Cloud, Dedicated Private Cloud, and Dynamic Private Cloud.
Unit: 3	Cloud Services and File System: 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, Salesforce.
Unit: 4	Virtualization: Basics of Virtualization – Need of Virtualization- Benefits of Virtualization- Limitation of Virtualization- Approaches to Virtualization - Virtualization Structures -Types of Virtualization – Virtual machine - Types of virtual Machine- Virtual Machine software - Virtualization of CPU, Memory, I/O Devices - Resource Virtualization- Virtualization Tools (VMware, Citrix, Microsoft, Oracle virtual Box) – Advance concepts in cloud computing : Data center for cloud, Cloud management . Introduction to MapReduce, GFS, HDFS, Hadoop Framework.

Unit: 5	Security in the Cloud: Security Overview – Cloud Security Challenges and Risks –Identified cloud security Issues-Categorization of cloud security issues– State of the Art solutions, Integrated Solutions: Amazon as Case study– Cloud computing Security Reference Architecture –Identity and Access Management Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
2	John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
Reference Books:	
1	Cloud Computing" A Practical Approach" Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGraw-Hill.
2	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012

Course Code	Course Title	Lecture			Semester:
MMCA312PET	Distributed Systems	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Basic networking concepts and Basic OS

Course Objectives:

1. To understand the overview of the principles, architectures, algorithms and programming models used in distributed systems.
2. To acquire the concept of distributed system design.
3. To gain the knowledge in synchronization, consistency and replication, fault tolerance and security.
4. To apply and analysis of the current popular distributed systems such as peer-to-peer (P2P) systems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the characteristics, issues and importance of distributed systems	**PO_1, PO_2**
CO_2	Demonstrate the architecture and processes of Distributed System.	**PO_3, PO_4**
CO_3	Analyze the concept of synchronization processes.	**PO_2, PO_4**
CO_4	Apply and analyze the importance of security in distributed systems	**PO_2, PO_3**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	1								
CO_3		2		1								
CO_4		2	2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Motivation, objectives, characterization & classification of distributed systems. Distributed system architecture. Hardware & software issues. Communication: Layered protocols, Client server protocols, RPC, group communication. Coordination, synchronization & consistency: Logical clocks, Physical clocks, mutual exclusion, election algorithms, atomic broadcast, sequential consistency transaction distributed consensus, Threads: Thread synchronization, implementation issues, and threads vs. RPC
Unit: 2	**Models of distributed computing:** Client server and RPC, RPC architecture, exceptions, underlying protocols, IDL, marshalling etc. Group models and peer to peer: Groups for service replication/ reliability, groups for parallelism / performance, client/ server vs. peer-to-peer, multicast, atomic broadcast.
Unit: 3	**Inter-process Communication:** API for Internet protocols. External data representation and Marshalling. Client-Server communication and Group communication. Distributed Objects and Remote Invocation- Communication between distributed objects, Remote procedure call, Events and notifications.
Unit: 4	**Distributed file system:** Security, Naming/ location transparency, R/W semantics, cache coherence, replication. Distributed shared memory: DSM architecture, consistency models and relation to caching, release consistency, comparison with message passing and RPC. Advanced Distributed Computing Paradigms: Message Queuing, Mobile agents, Network services, Object spaces
Unit: 5	**Fault tolerant distributed systems:** Introduction, dependability, faults vs. errors vs. failure, space time and value redundancy, fault tolerant architecture, failure

	detection algorithms, partitioning, FT consensus. Distributed multimedia system: Introduction, characteristics, and resource management stream adaptation
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Jean Dollimore, Tim Kindberg, George Coulouris, Distributed Systems: Concepts and Design, 4th Edition, Addison Wesley, 2005
2	A. Taunenbaum, Distributed Systems: Principles and Paradigms
Reference Books:	
1	G. Coulouris, J. Dollimore, and T. Kindberg, Distributed Systems: Concepts and Design, Pearson Education
2	Sape Mullender : Distributed system, 2nd Edition, Addison Wesley.

Course Code	Course Title	Lecture			Semester:
MMCA313PET	Computer Graphics	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Data structure & Algorithms

Course Objectives:

1. To understand interactive computer graphics, two-dimensional system and mapping.
2. To acquire the knowledge of drawing algorithms and techniques of 2D transformations.
3. To analysis the concept of clipping and filling algorithms.
4. To apply 3-D objects representation concepts.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the various graphics systems and the output primitive techniques	**PO_1, PO_2**
CO_2	Demonstrate the different 2D Geometric transformations and viewing functions	**PO_3**
CO_3	Illustrate the Structure and Modeling concepts	**PO_3, PO_4**
CO_4	Apply the 3D transformations and surface detection methods	**PO_3, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2	2								
CO_4			2						1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Overview of Graphics Systems** – Video display devices, raster-scan systems. Random–scan system, graphics monitors and workstations. Input devices, Hardcopy devices, Graphics software. Output primitives: Line drawing algorithms, Circle generation algorithms, ellipse generating algorithms, pixel addressing, Filled area primitives, Fill area functions, cell array and character generations.
Unit: 2	**Attributes of output primitives:** Line attributes, curve attributes color and Gray-scale level, Area fill attributes, character attributes, and Bundled attributes Enquiry functions. **Two dimensional Geometric transformations:** Basic transformations, Homogenous co-ordinates, affine transformations, transformation functions. Raster methods for transformations.
Unit: 3	**Two dimensional viewing:** Viewing pipeline, viewing transformation, viewing functions, line clipping – Cohen Sutherland line clipping, Liang Barsky line clipping. Polygon, clipping:Sutherland–Hodgman polygon clipping, Wiler Atherton polygon clipping.
Unit: 4	**Structures and Hierarchical Modeling:** Structure concepts, editing structures, Basic modeling concepts, hierarchical modeling with structures. Graphical user interfaces and **Interactive input methods:** The user Dialogue, logical classification of input devices, Input functions and Models Interactive picture construction techniques.
Unit: 5	**Three – Dimensional object representations:** Poly-surfaces curved lines and surfaces, spline representation, Bezier curves and surfaces, B-Spline curves and surface, CSG Methods: Octrees, BSP Trees.

	Three Dimensional Transformation: Three dimensional viewing: Viewing coordinates, projections, Visible surface detection methods: Back-face Detection, Depth-buffer methods, scan line methods, Depth-sorting methods, BSP – Tree Methods, Arc sub division methods, Basic illuminations models – Gourand shading phong shading.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Heanry Donald, Pauline Baker M: Computer Graphics, PIH 2nd edn., 1995.
Reference Books:	
1	Harrington S: Computer Graphics A Programming Approach 2nd Edn. McGraw Hill,1987.

Course Code	Course Title	Lecture			Semester:
MMCA314PET	Artificial Intelligence	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Discrete Mathematics

Course Objectives:

1. To understand the area of artificial intelligence and designing intelligent machines.
2. To learn thinking and intelligence in ways that enable the construction of computer systems that works in uncertain environments.
3. To develop the intelligent machines using various approaches.
4. To distinction between Conventional Systems and an Intelligent System.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Able to choose the appropriate representation for an AI Problem and construct in that representation.	**PO_1, PO_2**
CO_2	Selection of appropriate Algorithm and implementation	**PO_2**
CO_3	Design and Analyze the Performance of an AI System	**PO_3, PO_4**
CO_4	To able to analyses research in artificial intelligence	**PO_2, PO_4, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2	1								
CO_4		2		1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.
Unit: 2	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.
Unit: 3	**Knowledge Representation & Reasoning:** Propositional logic, Theory of first order logic, Inference in first order logic, Resolution, Unification, Forward & Backward chaining, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.
Unit: 4	**Machine Learning:** Supervised and unsupervised learning, Decision trees, Statistical learning models, learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning.
Unit: 5	**Pattern Recognition:** Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, K–means clustering algorithms.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Russell S. and Norvig P., "Artificial Intelligence – A Modern Approach", Pearson Education

2	Rich E. and Knight K., "Artificial Intelligence", Tata McGraw Hill.
Reference Books:	
1	Patterson D. W., "Artificial Intelligence and Expert Systems", Prentice Hall of India.
2	Russell S. and Norvig P., "Artificial Intelligence – A Modern Approach", Pearson Education

Course Code	Course Title	Lecture			Semester:
MTCS315PCT	Data Mining	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): DBMS

Course Objectives:

1. To introduce data mining principles and techniques.
2. To acquire the concept of critical thinking, problem solving and DECISION-MAKING skills with respect to Data warehouse and data mining.
3. To demonstrate various schema model and the Star Schema to design a Data Warehouse.
4. To apply different data mining techniques and algorithms.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand a data warehouse or data mart to present information needed by the manager and can be utilized for managing clients	**PO_1, PO_2**
CO_2	Demonstrate a quality data warehouse or data mart effectively and administer the data resources in such a way that it will truly meet management's requirements	**PO_3, PO_4**
CO_3	Evaluate standards and new technologies to determine their potential impact on your information resource for a large complex data warehouse/data mart.	**PO_4, PO_9**
CO_4	Apply the emerging technologies in Data mining.	**PO_3, PO_4, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2	1								
CO_3				2					1			
CO_4			2	1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Fundamentals of Data Mining, Kinds of Patterns can be mined, Technologies Used, Applications and Issues in Data Mining. **Types of Data:** Attribute types, Basic Statistical descriptions of Data, Measuring data Similarity and Dissimilarity. **Data Preprocessing:** Need of Preprocessing, Data Cleaning, Data Integration, Data Reduction, Data Transformation.
Unit: 2	**Data Warehouse and OLAP:** Data Warehouse, Data Warehouse Modeling, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-oriented induction
Unit: 3	**Mining Frequent Patterns, Associations and Correlations:** Market Basket Analysis, Association rule mining, Frequent Item set mining methods, Pattern Evaluation methods, Constraint based frequent pattern mining, Mining Multilevel and Multidimensional patterns.
Unit: 4	**Classification:** General approach to classification, Classification by Decision Tree Induction, Bayes Classification methods, Bayesian Belief Networks, Classification by Back-propagation, Lazy Learners, Other Classification methods, Classification using Frequent patterns, Model Evaluation and selection
Unit: 5	**Cluster Analysis:** Basic Clustering methods, Partitioning methods, Density – Based Methods, Grid- based methods, and Evaluation of Clustering, Outlier Analysis and Detection methods.

	Data Mining Trends and Research Frontiers: Mining Complex Data Types, Data Mining Applications, Data Mining Trends and usage of Data Mining Tools.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Han J & Kamber M, "Data Mining: Concepts and Techniques", Harcourt India, Elsevier India, Second Edition.
2	Pang-Ning Tan. Michael Steinback, Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2008.
Reference Books:	
1	Margaret H Dunham,S.Sridhar, "Data mining: Introductory and Advanced Topics", Pearson Education, 2008
2	Humphires,hawkins,Dy, "Data Warehousing: Architecture and Implementation", Pearson Education, 2009.

Course Code	Course Title	Lecture			Semester:
MMCA316PET	Digital Marketing	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No Prerequisite

Course Objectives:

1. To understand digital marketing, important conceptual insights and perspectives.
2. To demonstrate the use of tools required for effective digital marketing.
3. To analyze the market impact from digital marketing,
4. To apply the tools of digital marketing to get best visibility in market.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understanding digital marketing along with technical acumen will be an added tool as a problem solver and solution provider.	**PO_1, PO_2**
CO_2	Demonstrate the use of search engine optimization keyword planner Tools	**PO_2, PO_3, PO_7**
CO_3	Assist and advice the marketer to take right decision	**PO_4, PO_6, PO_9**
CO_4	Apply various social media platform for marketing such as Facebook, Twitter, LinkedIn etc.	**PO_3, PO_5, PO_{10}**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2				2					
CO_3				1		1			1			
CO_4			2		2					2		

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Digital Marketing and its Significance Traditional Marketing Vs Digital Marketing Digital Marketing Process. Website Planning and Development: Types of websites Website Planning and Development, Understanding Domain and Webhosting Building Website/Blog using CMS Word Press, Using Word Press Plug-ins
Unit: 2	Introduction to Search Engine Optimization Keyword Planner Tools on Page SEO Techniques-Indexing and Key Word Placement, On Page SEO Techniques-Content Optimization on Page SEO: Yoast, SEO Plug-in, Off –Page SEO Techniques, Email Marketing- Introduction and Significance, Designing e-mail marketing campaigns using Mail Chimp
Unit: 3	Building E-mail List and Signup Forms, Email Marketing Strategy and Monitoring Email –Atomization. Pay Per Click Advertising: Introduction Pay Per Click Advertising: Google Ad word, Types of Bidding strategies Designing and Monitoring search campaigns, Designing and Monitoring Display campaigns
Unit: 4	Designing and Monitoring Video campaigns Designing and Monitoring Universal App Campaigns Google Analytics: Introduction and Significance Google Analytics Interface and Setup Understanding Goals and Conversions. Monitoring Traffic Behavior and preparing Reports Social Media Marketing: Introduction and Significance Facebook Marketing, Types of Various Ad Formats

Unit: 5	Setting up Facebook Advertising Account, Understanding Facebook Audience and its Types Designing Facebook Advertising Campaigns. Working with Facebook Pixel, Twitter Marketing: Basics Designing, Twitter Advertising Campaigns. Introduction to LinkedIn Marketing Developing digital marketing strategy in Integration form
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns by Ian Dodson, Wiley; 1st edition (2016)
2	Digital Marketing For Dummies by Ryan Deiss and Russ Henneberry, For Dummies.
Reference Books:	
1	Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation by Damian Ryan, Kogan Page Publisher
2	Digital Marketing by Seema Gupta, McGraw Hill Education

Course Code	Course Title	Lecture			Semester:
MMCA317PET	Internet of Things (IoT)	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Hardware, Networking, Security, Artificial Intelligence

Course Objectives:

1. To understand the concept of IoT.
2. To learn the IoT Market perspective.
3. To demonstrate the use of various IOT devices.
4. To apply IoT Architecture in different applications.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Explain and demonstrate various components of Internet of Things (IoT)	PO_1
CO_2	Investigate and propose various requirements of IoT for real world applications;	PO_2, PO_4
CO_3	Describe and evaluate different applications of the IoT.	PO_3, PO_5, PO_9
CO_4	Analyze the role and importance of IoT in the modern world;	PO_2, PO_6

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2		2		1								
CO_3			2		2				2			
CO_4		2				1						

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to IoT, IOT Architecture, Sensing, Actuation, Basics of Networking, Basics of Networking Communication Protocols.
Unit: 2	Communication Protocols, Sensor Networks, Machine-to-Machine Communications and Introduction to SDN, SDN for IoT.
Unit: 3	Interoperability in IoT, Introduction to Arduino Programming, IoT development tools/platforms, Integration of Sensors and Actuators with Arduino, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.
Unit: 4	IOT based Cloud Computing, Sensor-Cloud, Fog Computing, Smart Cities and Smart Homes, Data Handling and Analytics.
Unit: 5	IOT Based Connected Vehicles, Smart Grid, And Industrial IoT. Applications of IOT, Case Study: Agriculture, Healthcare, Activity Monitoring, Implementation of IoT concepts.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press).
2	The Internet of Things: Enabling Technologies, Platforms, and Use Cases, by Pethuru Raj and Anupama C. Raman (CRC Press).

Reference Books:	
1	Buyya, R., & Dastjerdi, A. V. (Eds.). (2016). Internet of Things: Principles and paradigms. Elsevier.
2	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting everything", 1st Edition, Apress Publications, 2013.

Course Code	Course Title	Lecture			Semester: III
MMCA318PET	Compiler Design	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Operating System

Course Objectives:

1. To understand the various phases in the design of a compiler.
2. To demonstrate the design of top-down and bottom-up parsers.
3. To analyze syntax directed translation schemes.
4. To develop algorithms to generate code for a target machine.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concept of Designing, developing, and implementing a compiler for any language.	**PO1, PO2**
CO_2	Demonstrate LL and LR parsers.	**PO3**
CO_3	Design algorithms to perform code optimization in order to improve the performance of a program in terms of space and time complexity.	**PO3, PO4**
CO_4	Develop and analyze algorithms to generate machine code	**PO3, PO4, PO5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2	1								
CO_4			2	1	1							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction to compilers:** Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering –Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA.
Unit: 2	**Syntax Analysis: Role** of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar –Top-Down Parsing – General Strategies Recursive Descent Parser Predictive Parser-LL (1) Parser-Shift Reduce Parser-LR Parser-LR (0) Item Construction of SLR Parsing Table -Introduction to LALR Parser – Error Handling and Recovery in Syntax Analyzer
Unit: 3	**Intermediate Code Generation:** Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.
Unit: 4	**Run-Time Environment and Code Generation:** Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management – Issues in Code Generation – Design of a simple Code Generator.
Unit: 5	**Code Optimization: Principal** Sources of Optimization – Peep-hole optimization – DAG- Optimization of Basic BlocksGlobal Data Flow Analysis – Efficient Data Flow Algorithm.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:	
1	Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson.
2	Compiler Construction-Principles and Practice, Kenneth C Louden, Cengage Learning.
Reference Books:	
1	Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
2	The Theory and Practice of Compiler writing, J. P. Tremblay and P. G. Sorenson, TMH

Course Code	Course Title	Lecture			Semester: III
MMCA319PET	Pattern Recognition	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Mathematics and Machine Learning

Course Objectives:

1. To understand the basic concept of pattern recognition.
2. To equip with mathematical and statistical techniques used in pattern recognition.
3. To acquire the technique to develop machine learning algorithms for real world problems.
4. To apply pattern recognition techniques in practical problems.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms and applications of PR system.	**PO_1**
CO_2	Demonstrate the basic methods of feature extraction, feature evaluation, analyze and relate research in the pattern recognition area.	**PO_2, PO_4**
CO_3	Apply both supervised and unsupervised classification methods to develop PR system in real-world data.	**PO_3, PO_5, PO_9**
CO_4	Develop pattern recognition techniques to real-world problems such as object detection and recognition and to implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.	**PO_3, PO_4, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2											
CO_2		2		1								
CO_3			2		2				1			
CO_4			2	1	2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Pattern Recognition. Tree Classifiers Getting our feet wet with real classifiers-Decision Trees: CART, C4.5, ID3 Random Forests-Bayesian Decision Theory Grounding our inquiry- Linear Discriminants Discriminative Classifiers.
Unit: 2	The Decision Boundary, Separability, Perceptron, Support Vector Machines, Parametric Techniques Generative Methods grounded in Bayesian Decision Theory.
Unit: 3	Maximum Likelihood Estimation- Bayesian Parameter Estimation. Non-Parametric Techniques- Kernel Density Estimators.
Unit: 4	Nearest Neighbour Methods - Unsupervised Methods Exploring the Data for Latent Structure - Component Analysis and Dimension Reduction.
Unit: 5	The Curse of Dimensionality, Principal Component Analysis, Fisher Linear Discriminant, Locally Linear Embedding, Clustering, K-Means. Expectation Maximization, Mean Shift, Classifier Ensembles, Bagging, Boosting / AdaBoost.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Duda, Hart and Stork, Pattern Classification, Second Edition, Wiley, 2001.
2	Pattern Recognition principles: Julus T. Tou and Rafel C. Gonzalez, Addision –Wesley
Reference Books:	
1	S. Theodoridis, K. Koutroumbas, Pattern Recognition, Academic Press, 1999
2	Pattern recognition and machine learning, Christopher M. Bishop, Springer 2006

Course Code	Course Title	Lecture			Semester: III
MMCA321PET	Web Technology	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): No Prerequisite

Course Objectives:

1. To understand about client-server communication and protocols used during communication.
2. To design interactive web pages using Scripting languages.
3. To learn server-side programming using servlets and JSP.
4. To apply web services and utilize them in web applications.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Design a basic website using HTML and Cascading Style Sheets.	PO_1, PO_2
CO_2	Develop dynamic web pages using java script.	PO_2
CO_3	Construct server-side web pages with JSP.	PO_3, PO_9
CO_4	Build real applications with Servlet & Database.	PO_3, PO_4, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2						1			
CO_4			2	1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Web Essentials**: Clients, Servers, and Communication. The Internet-Basic Internet Protocols –The World Wide Web-HTTP request message-response message-Web Clients Web Servers. **Markup Languages**: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-HTML 5.0., Creating HTML documents, Case studies.
Unit: 2	**Cascading Style Sheets:** CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML- Types of Style Sheet-Selectors-Text Properties-Background Properties-Border Properties. **Client-Side Programming:** The JavaScript Language-History and Versions Introduction JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers.
Unit: 3	**Host Objects**: Browsers and the DOM-Introduction to the Document Object Model DOM History and Levels-Intrinsic Event Handling-Modifying Element Style-The Document Tree-DOM Event Handling- Accommodating Noncompliant Browsers Properties of window. **Server-Side Programming**: Java Servlets- Architecture -Overview-A Servlet-Generating Dynamic Content-Life Cycle- Parameter Data-Sessions-Cookies-URL Rewriting-Other Capabilities-Data Storage Servlets and Concurrency-Databases and Java Servlets.
Unit: 4	**Separating Programming and Presentation**: JSP Technology Introduction-JSP and Servlets-running JSP Applications Basic JSP-JavaBeans Classes and JSP-Tag Libraries and Files-Support for the Model-View-Controller Paradigm-

	Databases and JSP. **Representing Web Data**: XML-Documents and Vocabularies-Versions and Declaration-Namespaces- DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers.
Unit: 5	**AJAX** (Asynchronous Java And XML): Ajax Client Server Architecture-XML Http Request Object-Call Back Methods. **Web Services:** JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client-Describing Web Services: WSDL- Representing Data Types: XML Schema-Communicating Object Data: SOAP Related Technologies-Software Installation-Storing Java Objects as Files.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", PearsonEducation, 2006.
2	Ari Lerner, “ng-Books the Complete Books on AngularJS”, Fullstack.io, 2013.
Reference Books:	
1	Robert W. Sebesta, “Programming with World Wide Web”, Addison Wesley, 7th edition, 2013
2	Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", ThirdEdition, Pearson Education, 2006.

Course Code	Course Title	Lecture			Semester: III
MTCS322PCT	Artificial Neural Network	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Artificial Intelligence

Course Objectives:

1. To understand the role of neural networks in engineering.
2. To acquire the knowledge of artificial intelligence, and cognitive modeling.
3. To implement the concept of types of neural networks.
4. To analyze of computation and dynamical systems using neural networks.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Identify the neural network algorithms.	**PO_1, PO_2**
CO_2	Apply a variety of neural network algorithm on the available data set.	**PO_3, PO_5**
CO_3	Implement the neural network algorithms and solve real-world problems.	**PO_3, PO_5**
CO_4	Perform evaluation of neural network algorithms.	**PO_4, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2		1							
CO_3			2		2							
CO_4				2					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	General characteristics of the human brain, Introduction to Biological Neural Networks, Nerve structure and synapse, Basic concepts of Neural Networks, Characteristics of Neural Networks, Terminologies, Applications of the artificial neural networks.
Unit: 2	Structure of a neural net (topology), Directed graphs, Models of Neuron, Neural Network Architectures, Artificial Neuron, Activation functions, Threshold function, Piecewise linear function, Sigmoidal function, Supervised learning, Unsupervised learning, Re-enforcement Learning.
Unit: 3	Knowledge Representation, Artificial Intelligence, learning rules, Error correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, single layer perceptron, Multilayer perceptron, Back propagation, Recurrent networks, Network pruning.
Unit: 4	Adaptive networks, Supervised Learning Neural Networks, Decision-based neural networks, Hierarchical neural networks, Probabilistic neural network, Radial basis function networks, Comparision of RBF Networks and multilayer perceptron.
Unit: 5	Classification of linearly separable patterns, Boltzmann machine, Sigmoid Belief Networks, Helmholtz machine, Support vector machines, Self-organization maps, Genetic Algorithms, Optimization, Prediction Systems, speech and decision-making.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	S. Haykin, "Neural Networks a comprehensive Foundation" second edition, Prentice-Hall India.
2	Laurene Fausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Prentice Hall, 1993
Reference Books:	
1	Jacek M. Zurada, Introduction to artificial neural systems, Jaico Publ. House, 1994.
2	Anderson, —An introduction to Artificial Neural Networks‖, Prentice Hall.

Course Code	Course Title	Lecture			Semester: III
MMCA323PET	Semantic Web	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Artificial Intelligence

Course Objectives:

1. To learn about the Semantic Web Vision.
2. To understand about XML, RDF, RDFS, OWL.
3. To create and querying the ontology.
4. To form ontology reasoning and migrate from document to Data Web.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the concepts of structure of the semantic web technology, semantics of knowledge and resource, ontology.	PO_1, PO_2
CO_2	Describe logic semantics and inference with OWL.	PO_2
CO_3	Use ontology engineering approaches in semantic applications	PO_3, PO_9
CO_4	Analyze Web graph processing for various applications such as search engine, community detection	PO_2, PO_3

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2						1			
CO_4		2	2									

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Foundation of Semantic Web Technologies: Introduction, Current web vs Semantic Web, Semantic Web Technologies, A layered approach Descriptive Logic, Introduction, Definition of the basic formalism, Reasoning algorithms, Language extensions
Unit: 2	Structured Web Documents in XML: Introduction, XML Structuring, Namespaces, Addressing and querying XML document Processing
Unit: 3	Describing Web Resources: RDF, Introduction RDF: Basic Ideas, RDF: XML-Based Syntax, RDF serialization, RDF Schema: Basic Ideas, RDF Schema: The Language, RDF and RDF Schema in RDF Schema
Unit: 4	Web Ontology Language: OWL Introduction, OWL and RDF/RDFS, Three Sublanguages of OWL, Description of the OWL Language, Layering of OWL, Examples of OWL
Unit: 5	SPARQL, SPARQL simple Graph Patterns, Complex Graph Patterns, Group Patterns, Queries with Data Values, Filters OWL Formal Semantics

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	John Davies, Rudi Studer, and Paul Warren John, "Semantic Web Technologies: Trends and Research in Ontology-based Systems", Wiley and Son's, 2006.
2	John Davies, Dieter Fensel and Frank Van Harmelen, "Towards the Semantic Web: Ontology- Driven

	Knowledge Management", John Wiley and Sons, 2003.
Reference Books:	
1	Foundation of Semantic Web Technologies, Pascal Hitzler, Markus and Sebastian
2	Michael C. Daconta, Leo J. Obrst, and Kevin T. Smith, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Fourth Edition, Wiley Publishing, 2003.

Course Code	Course Title	Lecture			Semester:
MMCA324PET	PHP Programming	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Computer Programming and Database

Course Objectives:

1. To introduce the necessary knowledge to design and develop dynamic, database-driven web applications using PHP.
2. To understand basics of web programming, POST and GET in form submission.
3. To illustrate how server-side programming works on the web.
4. To analyze how to Read, write cookies and develop PHP application with MySQL Database.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand principle of Web page design and about types of websites	**PO_1, PO_2**
CO_2	Explain and recognize the basic concept of HTML, CSS, JavaScript and their application in web designing.	**PO_2, PO_3**
CO_3	Implement the dynamic web pages with validation using JS object by applying different handling mechanism.	**PO_3, PO_5, PO_9**
CO_4	Develop a simple web application using server-side PHP programming and Database Connectivity using My SQL.	**PO_3, PO_5, PO_9**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2									
CO_3			2		2				1			
CO_4			2		2				1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	HTML: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms. Style sheets: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties. Introduction to JavaScript: Client-side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes.
Unit: 2	Introduction to PHP, Language Features, PHP Basics, PHP's Supported Data Types, Identifiers, Variables, Constants, Expressions, String Interpolation, Control Structures, Arrays, Strings and Regular Expressions, Working with the File and Operating System.
Unit: 3	Handling Html Form With PHP: Capturing Form Data, Dealing with Multi-value filed, and Generating File uploaded form, Redirecting a form after submission. Function: What is a function, Define a function, Call by value and Call by reference, Recursive function.
Unit: 4	PHP state management: Using query string (URL rewriting), Using Hidden field, Using cookies, Using session. PHP string matching with regular expression: What is regular expression, Pattern matching in PHP, Replacing text, Splitting a string with a Regular Expression. PHP OOPs concepts, Abstract class, Inheritance, Constructor.

Unit: 5	MySQL:- PHP and MySQL : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP Myadmin and database bugs.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Beginning PHP and MySQL,W. Jason Gilmore, Apress, 2010, Fourth Edition.
2	Head First PHP & MySQL, Lynn Beighley & Michael Morrison, First Edition, O'Reilly.
Reference Books:	
1	Developing Web Applications in PHP and AJAX, Harwani, McGraw Hill
2	PHP6 and MySQL, Steve Suehring, Tim Converse and Joyce Park, Wiley India 2010, Second Edition

Course Code	Course Title	Lecture			Semester: III
MTCS325PCT	Soft Computing	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Algorithms and Programming

Course Objectives:

1. To introduce and use the idea of fuzzy logic and use of heuristics based on human experience
2. To familiarize the Neuro-Fuzzy modeling using classification and clustering techniques.
3. To learn the concepts of genetic algorithm and its applications.
4. To acquire the knowledge of rough sets.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Identify and describe soft computing techniques and their roles in building intelligent machines.	**PO_1, PO_2**
CO_2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.	**PO_2, PO_3, PO_5**
CO_3	Analyze genetic algorithms to combinatorial optimization problems.	**PO_2, PO_3**
CO_4	Evaluate and compare solutions by various soft computing approaches for a given problem.	**PO_2, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2	2		2							
CO_3		2	2									
CO_4		2		2								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to soft computing and neural networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning fundamentals.
Unit: 2	Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques of Fuzzy logic. controller design, applications of Fuzzy logic.
Unit: 3	Genetic Algorithms: Concepts of Genetics and Evolution and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection and Mutation.
Unit: 4	Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real-life problems.
Unit: 5	Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2	George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
Reference Books:	
1	Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2	Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd Edition.

Course Code	Course Title	Lecture			Semester: III
MTCS326PCT	Deep Learning	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Statistics, Data Science and Machine Learning

Course Objectives:

1. To introduce major deep learning algorithms.
2. To demonstrate the applications to solve real world problems.
3. To apply the advanced deep learning approaches.
4. To acquire the knowledge about the importance of deep learning in real life.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.	**PO_1, PO_2**
CO_2	Demonstrate deep learning algorithms and solve real-world problems.	**PO_2, PO_4**
CO_3	Develop the concept and evolution of deep learning.	**PO_3, PO_5, PO_7**
CO_4	Evaluate the deep learning analyzing algorithms.	**PO_2, PO_4**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2		2		1					
CO_4		2		1								

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs
Unit: 2	Sigmoid Neurons, Gradient Descent, Feed-forward Neural Networks, Representation Power of Feed-forward Neural Networks, Feed-forward Neural Networks, Back-propagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis, Principal Component Analysis and its interpretations, Singular Value Decomposition
Unit: 3	Auto-encoders and relation to PCA, Regularization in auto-encoders, De-noising auto-encoders, Sparse auto-encoders, Contractive auto-encoders, Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layer-wise Pre-training, Better activation functions, better weight initialization methods, Batch Normalization
Unit: 4	Learning Vectorial Representations of Words, Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO.

Unit: 5	Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks, Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated, BPTTGated Recurrent Units (GRUs), Long Short-Term Memory (LSTM) Cells, Solving the vanidhing gradient problem with LSTMs.
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
Reference Books:	
1	Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
2	Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

Course Code	Course Title	Lecture			Semester: III
MMCA327PET	Web Mining	L	T	P	
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Discrete Mathematics and Statistics

Course Objectives:

1. To understand about web mining and understand the need for web mining.
2. To learn differentiate between Web mining and data mining.
3. To apply the different Methods and application areas for web mining.
4. To analyze Web Mining strategies and algorithms in their workplace or research career.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Understand the need for web mining and Data Mining.	PO_1, PO_2
CO_2	Conduct business intelligence from online resources.	PO_3
CO_3	Apply Web Mining strategies and algorithms in their workplace or research career.	PO_3, PO_5
CO_4	Create the search engines index and rank web documents.	PO_3, PO_4, PO_9

PO_1- Engineering Knowledge, PO_2- Problem analysis, PO_3- Design/development of solutions, PO_4- Conduct investigations of complex problems, PO_5- Modern tool usage, PO_6- The engineer and society, PO_7- Environment and sustainability, PO_8- Ethics, PO_9- Individual or team work, PO_{10}- Communication, PO_{11}- Project management and finance, PO_{12}- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2			2									
CO_3			2		2							
CO_4			2	1					1			

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	Introduction to Web Data Mining and Data Mining Foundations, Introduction – World Wide Web (WWW), A Brief History of the Web and the Internet, Web Data Mining-Data Mining, Web Mining. Data Mining Foundations – Association Rules and Sequential Patterns – Basic Concepts of Association Rules, Apriori Algorithm- Frequent Itemset Generation, Association Rule Generation, Data Formats for Association Rule Mining, Mining with multiple minimum supports – Extended Model, Mining Algorithm, Rule Generation, Mining Class Association Rules, Basic Concepts of Sequential Patterns, Mining Sequential Patterns on GSP,
Unit: 2	Supervised and Unsupervised Learning Supervised Learning – Basic Concepts, Decision Tree Induction – Learning Algorithm, Impurity Function, Handling of Continuous Attributes, Classifier Evaluation, Rule Induction – Sequential Covering, Rule Learning, Classification Based on Associations, Naïve Bayesian Classification, Naïve Bayesian Text Classification – Probabilistic Framework, Naïve Bayesian Model. Unsupervised Learning – Basic Concepts, K-means Clustering – K-means Algorithm, Representation of Clusters, Hierarchical Clustering, Strength and Weakness.
Unit: 3	Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval Methods – Boolean Model, Vector Space Model and Statistical Language Model, Relevance Feedback, Evaluation Measures, Text and Web Page Preprocessing – Stopword Removal, Stemming, Web Page Preprocessing, Duplicate Detection, Inverted Index and Its Compression –

	Inverted Index, Search using Inverted Index, Index Construction, Index Compression, Latent Semantic Indexing – Singular Value Decomposition, Query
Unit: 4	Link Analysis and Web Crawling: Link Analysis – Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank Algorithm, HITS Algorithm, Community Discovery-Problem Definition, Bipartite Core Communities, Maximum Flow Communities, Email Communities. Web Crawling – A Basic Crawler Algorithm- Breadth First Crawlers, Preferential Crawlers, Implementation Issues – Fetching, Parsing, Stopword Removal, Link Extraction, Spider Traps, Page Repository, Universal Crawlers, Focused Crawlers,
Unit: 5	Opinion Mining and Web Usage Mining Opinion Mining – Sentiment Classification – Classification based on Sentiment Phrases, Classification Using Text Classification Methods, Feature based Opinion Mining and Summarization – Problem Definition, Object feature extraction, Feature Extraction from Pros and Cons of Format1, Feature Extraction from Reviews of Format 2 and 3, Comparative Sentence and Relation Mining, Web Usage Mining – Data Collection and Preprocessing- Sources and Types of Data, Key Elements of Web usage Data Preprocessing, Data Modeling for Web Usage Mining, Discovery
Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.	
Text Books:	
1	Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications)
2	Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti
Reference Books:	
1	Data Mining: Concepts and Techniques, Second Edition Jiawei Han, Micheline Kamber (Elsevier Publications)
2	Web Mining: Applications and Techniques by Anthony Scime

Course Code	Course Title	Lecture			Semester:
MMCA328PET	Natural Language Processing	L	T	P	III
Version: 1.2	**Date of Approval:** 16th BoS 17-11-2022	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Prerequisite(s): Mathematics

Course Objectives:

1. To understand the basic Concepts of Natural Language Processing.
2. To demonstrate the problems using NLP Techniques.
3. To apply of basic programming tools for NLP.
4. To analyze the statistical approach in machine Translation.

Course Outcomes (CO):

COs No.	Statement	Mapped Program Outcomes (POs)
CO_1	Explain the approaches to syntax and semantics in NLP.	**PO_1, PO_2**
CO_2	Analyze the approaches of generation, dialogue and summarization within NLP.	**PO_2**
CO_3	Illustrate the methods for statistical approaches to machine translation.	**PO_3**
CO_4	Apply Machine learning techniques and models for Machine Translation.	**PO_3, PO_5**

PO_1- Engineering Knowledge, **PO_2**- Problem analysis, **PO_3**- Design/development of solutions, **PO_4**- Conduct investigations of complex problems, **PO_5**- Modern tool usage, **PO_6**- The engineer and society, **PO_7**- Environment and sustainability, **PO_8**- Ethics, **PO_9**- Individual or team work, **PO_{10}**- Communication, **PO_{11}**- Project management and finance, **PO_{12}**- Life-long Learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_{10}	PO_{11}	PO_{12}
CO_1	2	2										
CO_2		2										
CO_3			2									
CO_4			2		2							

1 – Reasonable; 2 – Significant; 3 – Strong

Detailed Contents:

Unit: 1	**Introduction:** Introduction to the Morphology, Syntax, Semantics by linking the "linguistics view" (computational linguistics) with the "artificial intelligence view" (natural language processing).
Unit: 2	**Morphology:** Analysis and generation of language on word level: e.g., problems with compounding and idiomatic phrases, homophonous strings as well as loan words and their processing using e.g., finite state automata as well as semantic networks. Ambiguities in words like "pen" and "pipe", but will also discuss some complex strings.
Unit: 3	**Syntax Analysis:** Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues.
Unit: 4	**Semantic Analysis**: Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus. Representing Linguistically Relevant Concepts – Syntax Driven Semantic Analysis - Semantic Attachments –Syntax Driven Analyzer. Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval
Unit: 5	**Applications of NLP**: Machine Translation, Grammar Checkers Dictation, Automatic Document Generation, NL Interfaces.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:	
1	Daniel Jurafsky, James H. Martin "Speech and Language Processing" Second Edition, Prentice Hall, 2008.
2	Tanvier Siddiqui: Natural Language Processing and Information Retrieval, U.S. Tiwary
Reference Books:	
1	Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999