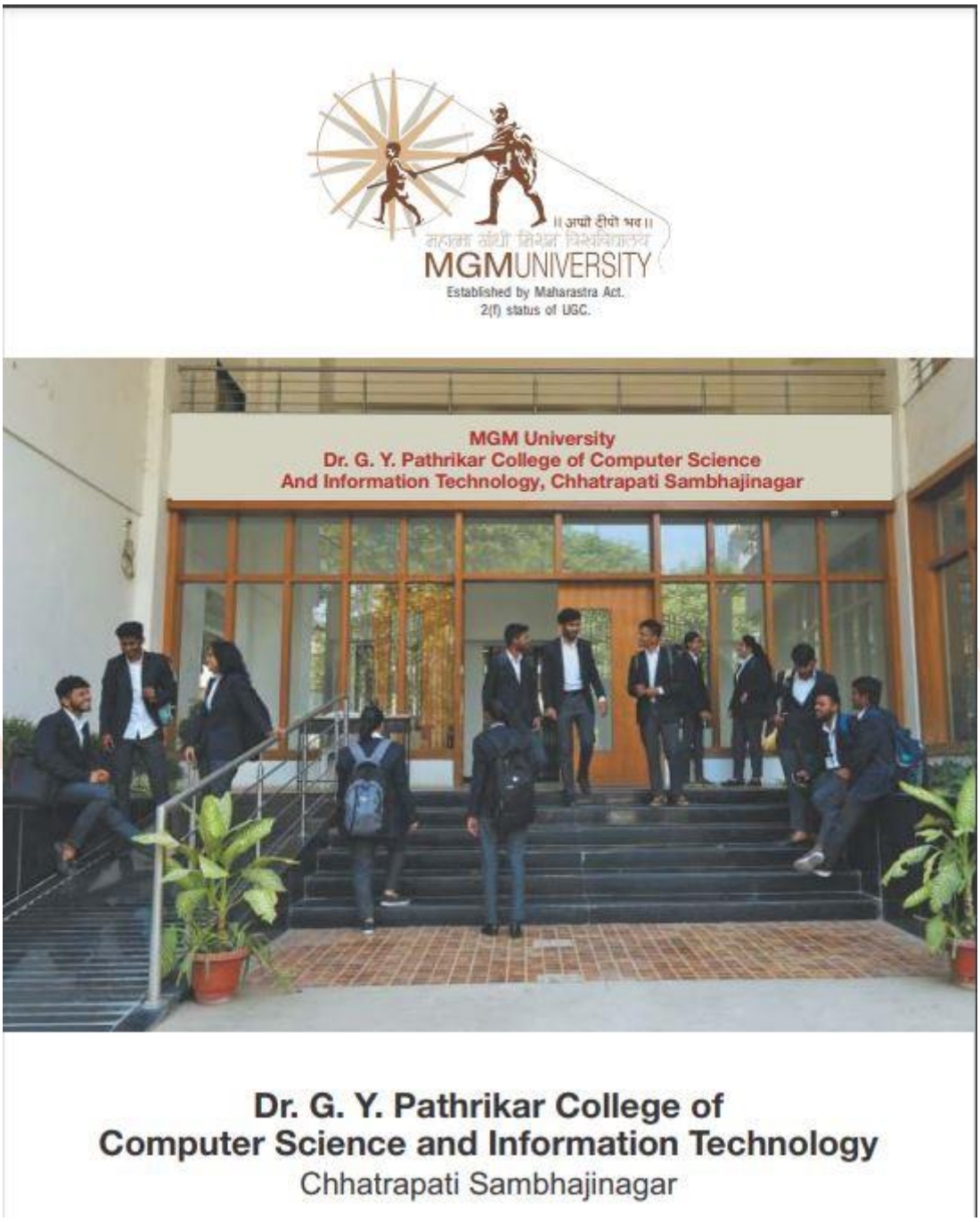

Integrated M.Sc. Data Science

First , Second & Third Year (Syllabus)

W.E.F. ACADEMIC YEAR: 2023-24

MGM University

Vision

- To ensure sustainable human development which encourages self-reliant and self-content society.
- To promote activities related to community services, social welfare and also Indian heritage and culture.
- To inculcate the culture of non-violence and truthfulness through vipassanna meditation and Gandhian Philosophy.
- To develop the culture of simple living and high thinking

Mission

- To impart state of art education and technical expertise to students and give necessary training to teachers to create self-reliant society for future.
- To encourage students to participate in Indian and International activities in sports, literature, etc. so that future generation becomes base for free and liberal society
- To educate students in areas like Management, Finance, Human relations to inculcate philosophy of simple living and high thinking value of simple economic society.
- To inculcate culture of non-violence and truthfulness through Vipassana.
- To sustain activities of Indian culture (viz. classical dance, music and fine arts) through establishing institutes like Mahagami, Naturopathy, etc.

विद्यापीठगीत

अत्तदिपभवभवप्रदिपभव,

स्वरूपरूपभवहो

ज्ञानसब्बविज्ञानसब्बभव ,

सब्बदिपभवहो

अत्ताहिअत्तनोनाथो ,

अत्ताहिअत्तनोगति

अत्तमार्गपरअप्रमादसेहैतुझेचलना

सब्बकाकल्याणहो ,

वोकार्यकुशलकरना

सब्बकाउत्तममंगल , पथप्रदर्शकहो

अत्तदिपभवभवप्रदिपभव ,

स्वरूपरूपभवहो

ज्ञानसब्बविज्ञानसब्बभव ,

सब्बदिपभवहो

बुद्धमंशरनंगच्छामि :

धम्मंशरनंगच्छामि :

संघंशरनंगच्छामि :

Dr. G. Y. Pathrikar College of Computer Science & Information Technology

MGM college of Computer Science and Information Technology was established in 2001 offering undergraduate and postgraduate degree program in Computer Science and Information Technology. College was renamed as Dr.G.Y.Pathrikar College of Computer Science and Information Technology in 2003 in memory of great educationalist, one of the founder member and Ex-Secretary MGM, Dr.G.Y.Pathrikar Sir.

It is first self-financed ISO certified institution offering program dedicated to Computer science and Information technology in Maharashtra and has achieved status of 2f/12b. Ours was the only and first college to be re-accredited as A+ grade with NAAC in the year 2017. Experienced and qualified faculty with Ph.D is strength of our college. Starting with 77 student's College has crossed total students strength of 10,000 passing out. Student are doing well in various MNCs like Infosys, Tech-Mahindra, Wipro, Capgemini, Cognizant etc. Many have their own Startups. Some of the students have completed their Masters and Ph.D. program from foreign countries like US, UK, Australia. Now we are constituent college of MGM University, Chhatrapati Sambhajinagar.

Vision

To be an academic institution in dynamic equilibrium in social, ecological and economical environment striving continuously for excellence in total quality education, research and technological service to the nation.

Mission

- To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, and economical issues.
- To upgrade our students in all respect with the help of latest infrastructure in the area of Computer Science and Information Technology in order to build the National Capabilities.
- To understand the culture of Non-violance, truth, peace through Gandhian Philosophy.

Programs offered at Dr. G. Y. Pathrikar College of Computer Science & Information Technology

Undergraduate Programmes	Postgraduate Programmes	PhD Programmes
B.Sc. (Computer Science) Honours / Honours with Research	M.Sc(Computer Science)	Ph.D. in Computer Science and Information Technology
B.Sc(Information Technology) Honours/ Honours with Research	M.Sc(Information Technology)	
BCA(Science) Honours / Honours with Research	M.Sc(Data Science)	
B.Sc(Animation) Honours / Honours with Research	M.Sc(Animation)	
Integrated M.Sc. Data Science		
BCA(Digital Marketing) Honours		
B.Sc(Robotics) Honours		

Name of Program – Integrated M.Sc. Data Science

Duration – Five Years

Eligibility -

- He / She Must have passed the Higher Secondary (Multipurpose) Examination conducted by H.S.C. Board Government of Maharashtra with Science / Technical Subjects or an Examination of any statutory University and Board recognized as equivalent thereto.

OR

- Candidates having offered prescribed vocational courses, (MCVC) with Computer Techniques / Information Technology / Electronics.

OR

- Three Years Course in Diploma Engineering conducted by the Board of Technical Education, Maharashtra State. He / She must have passed at qualifying examination.

Name of Faculty: Basic and Applied Science
Name of the College/Institute/Department/School: Dr. G. Y. Pathrikar College of Computer Science and Information Technology
Name of the Programme: Integrated M.Sc. Data Science
Programme Type (UG/PG): PG
Duration: Five Years

List of Options to select from Bucket of Courses provided in various categories:

Major	
Data Science	
Core Major	**Core Elective**

Minor options for basic and applied science Faculty	**GYP**	**IBT**	**UDBAS**
	Cyber Security	Food Technology and Processing	Chemistry
	Robotics	Microbiology	Geo-Informatics
	Data Analytics	Biotechnology	Mathematics
	Block-Chain Technologies	Bioinformatics	Statistics
		Food Nutrition and Dietetics	Material Science

Minor options from Other Faculty	**Faculty of Engineering and Technology**	**Faculty of Social Sciences & Humanities**	**Faculty of Design**	**Faculty of Management and Commerce**	**Interdisciplinary Faculty**	**Performing Arts**
	Data Science	Filmmaking	Product Design	Financial Management	Cosmetic Technology	Theatre Arts
	IoT	Photography	Interior Design	E-Commerce	Education	Dance
	Geo-informatics and Applications	Mass Communication and Journalism	Contemporary Arts	International Business Management	Yog Sciences	Music
	EV Technology	Psychology	Visual Communication	Hospitality Mgmt	Physical Education	Folk Art
	Drone Technology	Economics	Fashion Technology	Travel and Tourism	Home Science	
	Robotics Technology	English		Art of Leadership		
	Chemical Technology	Social Work		Art of Business		
	AI&ML					
	Universal Human Values					
	Energy management					

Name of Faculty: Basic and Applied Science

Name of the College/Institute/Department/School: Dr. G. Y. Pathrikar College of Computer Science and Information Technology

Name of the Programme: Integrated M.Sc. Data Science

Programme Type (UG/PG): PG

Duration: Five Years

First Year- Semester I												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	MDI41MML101	Foundation of Data Science	Lecture	2	2		30	20	50		8	20
MM	MDI41MML102	Principles of Programming Languages	Lecture	2	2		30	20	50		8	20
MM	MDI41MMP101	Practical based on Foundation of Data Science	Practical	1		2	30	20	50		8	20
MM	MDI41MMP102	Practical based on Principles of Programming Languages	Practical	1		2	30	20	50		8	20
MIN	MDI41IKT101	Indian Psychology and yoga	Lecture	2	2	-	30	20	50		8	20
AEC		Basket of AEC From University	Lecture	2	2	-	30	20	50		8	20
OE		Basket of OE From University	Lecture	2	2	-	30	20	50		8	20
OE		Basket of OE From University	Lecture	2	2	-	30	20	50		8	20
VSC	MDI41VSP101	Office Automation	Practical	2		4	30	20	50		8	20
SEC	MDI41SEL101	Mathematical Foundation	Lecture	2	2	-	30	20	50		8	20
VEC		Basket of VEC From University	Lecture	2	2	-	30	20	50		8	20
CC		Basket of CC From University	Practical	2	-	4	50	-	50	20	-	20
Total				**22**	**18**	**12**	**380**	**220**	**600**			

First Year- Semester II												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	MDI41MML103	Design and Analysis of Algorithms	Lecture	2	2		30	20	50		8	20
MM	MDI41MML104	Computer Architecture	Lecture	2	2		30	20	50		8	20
MM	MDI41MMP103	Practical based on Design and Analysis of Algorithms	Practical	1		2	30	20	50		8	20
MM	MDI41MMP104	Practical based on Computer Architecture	Practical	1		2	30	20	50		8	20
MIN		Basket of MIN From University	Lecture	2	2	-	30	20	50		8	20
AEC		Basket of AEC From University	Lecture	2	2	-	30	20	50		8	20
OE		Basket of OE From University	Lecture	2	2	-	30	20	50		8	20
OE		Basket of OE From University	Lecture	2	2	-	30	20	50		8	20
VSC	MDI41VSP102	Programming for Data Science	Practical	2		4	30	20	50		8	20
SEC	MDI41SEL102	Statistical Methods	Lecture	2	2	-	30	20	50		8	20
VEC		Basket of VEC From University	Lecture	2	2	-	30	20	50		8	20
CC		Basket of CC From University	Practical	2	-	4	50	-	50	20	-	20
Total				**22**	**18**	**12**	**380**	**220**	**600**			

Note:

Nature of Course :L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Second Year- Semester III												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	MDI41MML201	Data Communication Network	Lecture	2	2		30	20	50		8	20
MM	MDI41MML202	Database Management System	Lecture	2	2		30	20	50		8	20
MM	MDI41MML203	Regression Analysis	Lecture	2	2		30	20	50		8	20
MM	MDI41MMP201	Practical Based on Data Communication Network	Practical	1		2	30	20	50		8	20
MM	MDI41MMP202	Practical Based on Database Management System	Practical	1	-	2	30	20	50		8	20
OE		Basket of OE From University	Lecture	2	2	-	30	20	50		8	20
MIN		Basket of MIN From University	Lecture	3	3	-	60	40	100		16	40
MIN		Basket of MIN From University	Practical	1	-	2	30	20	50		8	20
AEC		Basket of AEC From University	Lecture	2	2		30	20	50		8	20
VSC	MDI41VSP201	Python Programming	Practical	2	-	4	30	20	50		8	20
FP	MDI41FPJ201	Field Project Based on Data Collection	Project	2	-	4	50	-	50	20	-	20
CC		Basket of CC From University	Practical	2	-	4	50	-	50	20	-	20
Total				**22**	**13**	**18**	**430**	**220**	**650**			

Second Year- Semester IV

Course Category	Course Code	Course Title	Nature of Course	No. of Credits	Teaching (Contact hrs/ week)		Evaluation Scheme (Marks)			Minimum Passing (Marks)		
					L	P	Internal	External	Total	Internal	External	Total
MM	MDI41MML204	Introduction NOSQL Databases	Lecture	2	2		30	20	50		8	20
MM	MDI41MML205	Google Analytics	Lecture	2	2		30	20	50		8	20
MM	MDI41MML206	Optimization Techniques	Lecture	2	2	-	30	20	50		8	20
MM	MDI41MMP203	Practical Based on Introduction NOSQL Databases	Practical	1		2	30	20	50		8	20
MM	MDI41MMP204	Practical Based on Google Analytics	Practical	1	-	2	30	20	50		8	20
OE		Basket of OE From University	Lecture	2	2	-	30	20	50		8	20
MIN		Basket of MIN From University	Lecture	3	3	-	60	40	100		16	40
MIN		Basket of MIN From University	Practical	1	-	2	30	20	50		8	20
AEC		Basket of AEC From University	Lecture	2	2	-	30	20	50		8	20
SEC	MDI41SEP201	R Programming	Practical	2	-	4	30	20	50		8	20
CEP	MDI41CEP201	Community Engagement Program (from University)	Practical	2	-	4	50	-	50	20	-	20
CC		Basket of CC From University	Practical	2	-	4	50	-	50	20	-	20
Total				**22**	**13**	**18**	**430**	**220**	**650**			

Third Year- Semester V

Course Category	Course Code	Course Title	Nature of Course	No. of Credits	Teaching (Contact hrs/ week)		Evaluation Scheme (Marks)			Minimum Passing (Marks)		
					L	P	Internal	External	Total	Internal	External	Total
MM	MDI41MML301	Machine Learning	Lecture	2	2		30	20	50		8	20
MM	MDI41MML302	Data Mining	Lecture	2	2		30	20	50		8	20
MM	MDI41MML303	Artificial Intelligence	Lecture	2	2		30	20	50		8	20
MM	MDI41MMP301	Practical Based on Machine Learning	Practical	1		2	30	20	50		8	20
MM	MDI41MMP302	Practical Based on Data Mining	Practical	1	-	2	30	20	50		8	20
Core elective	MDI41MEL301	Sentiment Analysis	Lecture	3	3	-	60	40	100		16	40
	MDI41MEL302	Social Media Mining										
Core elective	MDI41MEP301	Practical Based on Sentiment Analysis	Practical	1	-	2	30	20	50		8	20
	MDI41MEP302	Practical Based on Social Media Mining										
MIN		Basket of MIN From University	Lecture	3	3	-	60	40	100		16	40
MIN		Basket of MIN From University	Practical	1		2	30	20	50		8	20
VSC	MDI41VSP301	User Interface and User Experience Design	Practical	2	-	4	30	20	50		8	20
FP	MDI41FPJ301	Field Project	Project	2	-	4	50	-	50	20	-	20
Total				20	12	16	410	240	650			

Third Year- Semester VI												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	MDI41MML304	Cloud Computing	Lecture	2	2		30	20	50		8	20
MM	MDI41MML305	Business Intelligence	Lecture	2	2		30	20	50		8	20
MM	MDI41MML306	Cyber Security	Lecture	2	2		30	20	50		8	20
MM	MDI41MMP303	Practical Based on Cloud Computing	Practical	1		2	30	20	50		8	20
MM	MDI41MMP304	Practical Based on Business Intelligence	Practical	1		2	30	20	50		8	20
Core elective	MDI41MEL303	Big Data	Lecture	3	3	-	60	40	100		16	40
	MDI41MEL304	Data Visualization										
Core elective	MDI41MEP303	Practical Based on Big Data	Practical	1	-	2	30	20	50		8	20
	MDI41MEP304	Practical Based on Data Visualization										
MI		Basket of MIN From University	Lecture	3	3	-	60	40	100		16	40
MI		Basket of MIN From University	Practical	1		2	30	20	50		8	20
OJT	MDI41JTP301	On Job Training	OJT	4	-	8	30	20	50		8	20
Total				20	12	16	360	240	600			

Fourth Year (Semester VII)												
Course Code	**Course Title**	**Type**	**Teaching Scheme**			**Evaluation Scheme**			**Minimum Passing**			**Credits**
			L	**T**	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**	
MDI41MML401	Neural Networks	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML402	Data Analytics	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML403	Compiler Design	Major	3	-	-	60	40	100	-	16	40	3
MDI41MEL401	Software Project Management	Elective	3	-	-	60	40	100	-	16	40	3
MDI41MEL402	Internet of things											
MDI41RML401	Research Methodology	Compulsory	4	-	-	60	40	100	-	16	40	4
MDI41MMP401	Practical Based on Neural Networks	Major	-	-	2	30	20	50	-	08	20	1
MDI41MMP402	Practical Based on Data Analytics	Major	-	-	2	30	20	50	-	08	20	1
MDI41MMP403	Practical Based on Compiler Design	Major	-	-	2	30	20	50	-	08	20	1
MDI41MEP401	Practical Based Software Project Management	Elective	-	-	2	30	20	50	-	08	20	1
MDI41MEP402	Practical based on Internet of things											
	Total		**16**		**08**	**420**	**280**	**700**				**20**

Fourth Year (Semester VIII)												
Course Code	**Course Title**	**Type**	**Teaching Scheme**			**Evaluation Scheme**		**Total**	**Minimum Passing**		**Total**	**Credits**
			L	**T**	**P**	**Internal**	**External**		**Internal**	**External**		
MDI41MML404	Cloud Services	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML405	Natural Language Processing	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML406	Time Series Analysis	Major	3	-	-	60	40	100	--	16	40	3
MDI41MEL403	High Performance Computing	Elective	3	-	-	60	40	100	--	16	40	3
MDI41MEL404	Quantum Computing											
MDI41MMP404	Practical Based on Cloud Services	Major	-	-	2	30	20	50	--	08	40	1
MDI41MMP405	Practical Based on Natural Language Processing	Major	-	-	2	30	20	50	--	08	20	1
MDI41MMP406	Practical Based on Time Series Analysis	Major	-	-	2	30	20	50	--	08	20	1
MDI41MEP403	Practical Based on High Performance Computing	Elective	-	-	2	30	20	50	--	08	20	1
MDI41MEP404	Practical based on Quantum Computing											
MDI41JTP401	On Job Training	OJT			8	60	40	100	--	16	40	4
	Total		**12**		**16**	**420**	**280**	**700**				**20**

Fifth Year (Semester IX)												
Course Code	**Course Title**	**Type**	**Teaching Scheme**			**Evaluation Scheme**		**Total**	**Minimum Passing**		**Total**	**Credits**
			L	**T**	**P**	**Internal**	**External**		**Internal**	**External**		
MDI41MML501	Development Operations	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML502	Recommendation System	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML503	Deep Learning	Major	3			60	40	100	--	16	40	3
MDI41MEL501	Remote Sensing	Elective	3	-	-	60	40	100	--	16	40	3
MDI41MEL502	Generative AI											
MDI41MMP501	Practical Based on Development Operations	Major	-	-	2	30	20	50	--	08	20	1
MDI41MMP502	Practical Based on Recommendation System	Major	--		2	30	20	50	--	08	20	1
MDI41MMP503	Practical Based on Deep Learning	Major	--		2	30	20	50	--	08	20	1
MDI41MEP501	Practical Based on Remote Sensing	Elective	--		2	30	20	50	--	08	20	1
MDI41MEP502	Practical based on Generative AI											
MDI41RPJ501	Research Project	Project	--		8	60	40	100	--	16	40	4
		Total	**12**		**16**	**420**	**280**	**700**				**20**

Fifth Year (Semester - X)												
Course Code	**Course Title**	**Type**	**Teaching Scheme**			**Evaluation Scheme**		**Total**	**Minimum Passing**		**Total**	**Credits**
			L	**T**	**P**	**Internal**	**External**		**Internal**	**External**		
MDI41MML504	Data Centre Technologies	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML505	Fuzzy Logic	Major	3	-	-	60	40	100	--	16	40	3
MDI41MML506	Geographic Information System	Major	2			30	20	50	--	08	20	2
MDI41MEL503	Human Computer Interaction	Elective	3	-	-	60	40	100	--	16	40	3
MDI41MEL504	Explainable AI											
MDI41MMP504	Practical Based on Data Centre Technologies	Major	-	-	2	30	20	50	--	08	20	1
MDI41MMP505	Practical Based on Fuzzy Logic	Major			2	30	20	50	--	08	20	1
MDI41MEP503	Practical Based on Human Computer Interaction	Elective			2	30	20	50	--	08	20	1
MDI41MEP504	Practical based on Explainable AI											
MDI41RPJ502	Research Project	Dissertation	--		8	120	80	200	--	32	80	6
		Total	**12**		**16**	**420**	**280**	**700**				**20**

Semester: FIRST

Syllabus
Semester-I

Course Code: MDI41MML101 **Course Name:** Foundation of Data Science **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2, P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basics of mathematics and working of Computer System
Course Objectives:
1. To identify the Data Sources and its Processing Life Cycle
2. To impart basic introduction to of data science
Course Outcomes: At the end of the course, the students will be able to -
CO1: To understand the foundational skills in data Science
CO2: Methodology applications and theory in data science
CO3: Data science foundations including preparing and working with data abstracting and modeling.
CO4: Focusing on mathematical, statistical and computation methods in Data Science

Contents –

Unit	Content	Teaching hours
1	**Introduction to Data Science Concepts:** Basics of Data, Data Types, Data Sources, Data Science Life Cycle, Data Collection, Data Preprocessing: Data cleaning, Data reduction, Data transformation, Data discretization. Visualization and Graphing: Visualizing Categorical Distributions, Visualizing Numerical Distributions, Overlaid Graphs, plots, and summary statistics of exploratory data analysis, Randomness, Probability, Introduction to Statistics, Sampling, Sample Means and Sample Sizes.	10
2	**Descriptive Statistics:** Central tendency, Dispersion, variance, covariance, kurtosis, five point summary, Distributions, Bayes Theorem, Error Probabilities, Permutation Testing.	10
3	**Statistical Inference**: Hypothesis Testing, Assessing Models, Decisions and Uncertainty, Comparing Samples, A/B Testing, P-Values. **Prediction Foundations:** Estimation, Prediction, Confidence Intervals, Inference for Regression, Classification, Graphical Models, Updating Predictions.	10

Text Books:
1. Adi Adhikari and John DeNero ,Computational and Inferential Thinking: The Foundations of Data Science
2. Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl Jr.,Data Mining for Business Analytics: Concepts, Techniques and Applications in R,Wiley India, 2018.
Reference Books:
1. Rachel Schutt & Cathy O'Neil Doing Data Science, O' Reilly, First Edition, 2013
2. B. Ram Computer Fundamental, BPB Publication.

Syllabus
Semester-I

Course Code: MDI41MML102 **Course Name:** Principles of Programming Languages **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2, P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Logical Thinking and Problem-Solving Skills
Course Objectives:
To introduce the foundations of computing, programming and problem- solving using computer Programming and its principles.
Course Outcomes: At the end of the course, the students will be able to -
CO1: The course aims to provide exposure to problem-solving and principles through programming.
CO2: It aims to train the student to the basic concepts of the C programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.
CO3: Write the C code for a given algorithm.
CO4: Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Contents –

Unit	Content	Teaching hours
1	**Introduction to C Programming**: Principles of Programming languages, Importance of C, History of C, Basic structure of C program Constants, Variables, Keywords & Data Types: C Character set, C tokens, Constants, Keywords, Identifiers, Data types, C variable declaration, Assigning values to variables, Compilation and execution, Receiving input from user	10
2	**Decision Making with Operators & Expressions:** Types of operators: Arithmetic, Relational, logical, Unary operators: Increment & decrement, Assignment and Conditional operator, I/O functions, escape sequence characters, Decision making with if, if…else, nested if…else, else if ladder, switch statement. Loop Control Instruction: While loop, for loop, do…while loop, jumps in loops.	10
3	**Arrays:** Introduction to array, types of arrays, Declaration and initialization of arrays, character arrays. Functions: Need for user defined function, Definition of function, passing values between functions, Return values and their types, Function Call, nesting of functions, Recursion.	10

Text Books:
1. Y.P. Kanetkar Let us C, BPB publication
Reference Books:
1. E. Balaburuswamy Programming in C, Tata Macgraw Hill
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-I

Course Code: MDI41MMP101 **Course Name:** Practical based on Foundation of Data Science **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basics of mathematics and working of Computer System
Course Objectives:
1. To impart basic introduction to of data science
2. To identify the Data Sources and its Processing Life Cycle
Course Outcomes: At the end of the course, the students will be able to -
CO1: To understand the foundational skills in data Science
CO2: Methodology applications and theory in data science
CO3: Data science foundations including preparing and working with data abstracting and modelling.
CO4: Focusing on mathematical, statistical and computation methods in Data Science

Contents –

Sr no.	Description of Practical	Practical Hours
1	Creating data in Excel using various data formats	1
2	Reading Data in to Excel using various formats	1
3	Data Pre-processing using Excel	1
4	Basic Spreadsheet Operations	1
5	Basic Spreadsheet functions	1
6	Advanced Spreadsheet functions to organize data	1
7	Data filtering capabilities of Excel	1
8	Construction of Visualizing Numerical Distributions using Excel	1
9	Understanding and constructing advanced graphing and Charting	1
10	Statistical operations using Excel	1

Text Books:
1. Adi Adhikari and John DeNero , Computational and Inferential Thinking: The Foundations of Data Science
2. Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl Jr.,Data Mining for Business Analytics: Concepts, Techniques and Applications in R, Wiley India, 2018.
Reference Books:
1. Rachel Schutt & Cathy O'Neil Doing Data Science, O' Reilly, First Edition, 2013
2. B. Ram Computer Fundamental, BPB Publication

Syllabus
Semester-I

Course Code: MDI41MMP102 **Course Name:** Practical based on Principles of Programming Languages **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Basics of mathematics and working of a computer system.
Course Objectives:
To introduce the foundations of computing, programming and problem- solving using computer programming and its principles**.**
Course Outcomes: At the end of the course, the students will be able to -
CO1: The course aims to provide exposure to problem-solving and principles through programming.
CO2: It aims to train the student to the basic concepts of the C programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.
CO3: Write the C code for a given algorithm.
CO4: Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Contents –

Sr.no.	Description of Practical	Practical Hours
1	Write a Program to convert temperature from degree Centigrade to Fahrenheit	1
2	Write a Program to find whether given number is Even or Odd	1
3	Write a Program to find greatest of Three numbers	1
4	Write a Program to using switch statement to display Monday to Sunday	1
5	Write a Program to display first Ten Natural Numbers and their sum	1
6	Write a Program to find Multiplication of Two Matrices	1
7	Write a Program to find the maximum number in Array using pointer.	1
8	Write a Program to reverse a number using pointer.	1
9	Write a Program to solve Quadratic Equation using functions	1
10	Write a Program to find factorial of a number using Recursion	1

Text Books:
1. Y.P. Kanetkar Let us C, BPB publication
Reference Books:
1. E. Balaburuswamy Programming in C, Tata Macgraw Hill

Syllabus
Semester-I

Course Code: MDI41VSP101 **Course Name:** Office Automation **Course Category:** Vocational Skill Course
Credits:2 **Teaching Scheme:** L-0, P-4 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Introduction to Computer System
Course Objectives:
To understand and learn Office automation tools
Course Outcomes: At the end of the course, the students will be able to -
CO1: The course aims to provide exposure to work with Text Processing techniques
CO2: The course aims to provide exposure to work with PowerPoint Presentation Techniques
CO3: The course aims to provide exposure to work with Data accessing techniques
CO4: The course aims to provide exposure to work with Excel Data Handling Techniques

Contents –

Sr no.	Description of Practical	Practical hours
1	Generate equations, sample calculations, and basic diagrams in Microsoft Word	1
2	Perform calculations in Microsoft Excel using both manually inputting formulas and built-in functions	1
3	Create Graph and Tables and Integrate both graphs and tables created in Microsoft Excel into a report file in Microsoft Word.	1
4	To create a Power Point presentation including Audio, Video and animation effect using PowerPoint.	1
5	To create any document Using Word Processing Tool and different styles.	1
6	To create any document Using Presentation Tool	1
7	To Create a graph of any numeric data in Microsoft office and give appropriate Label.	1
8	To draw any digital electronic circuit diagram using Microsoft word	1
9	Introduction to MS Access	1
10	Create & edit Database & tables in Access	1

Text Books:
1. Bittu Kumar · 2017,Mastering MS Office ISBN 9789350578780,V&S Publishers
Reference Books:
1. Dr. S.S. Srivastava MS-Office
Online Resources: 1.NPTEL / SWAYAM lectures. https://www.rgycsm.org/uploads/books/MICROSOFT-OFFICE-BOOK.pdf

Syllabus
Semester-I

Course Code: MDI41SEL101 **Course Name:** Mathematical Foundation **Course Category:** Skill Enhancement course
Credits:2 **Teaching Scheme:**L-2, P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basics of Mathematical Concepts
Course Objectives:
Towards the end of the course, we will also cover a subset of topics from graph theory. Part of the course is also devoted to understanding what goes into mathematics.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Principles and processes of Set Theory
CO2: Operations of Set Theory
CO3: Provides students with essential mathematical skills
CO4: Learn Graph, Tree, Relations and functions

Contents –

Unit	Content	Teaching hours
1	**Set Theory and Operations:** Types of Set: Finite, Infinite, Singleton, Empty, Subset, Proper Subset, Universal Set, Power Set, Venn Diagram, Operations on Set: Union of Sets, Intersection of Sets, Complement of Set, Cartesian Product, Difference and Symmetric Difference of Set, Principal of Inclusion and Exclusion. Introduction to Matrices: Types of Matrices, Matrix, Operations, Adjoint and Inverse of a Matrix, Rank of a Matrix and Special Matrices.	10
2	**Graph Theory and Tree:** Introduction to Graph, Application of Graph, Finite and Infinite Graph, Incidence and Degree, Null Graph, Isolated and Pendent Vertex, Isomorphism, Subgraph, Walks, Path and Circuit, Union and Intersection Operation. Graph, Planner Graph, Trees, Pendant Vertices on Tree, Binary Tree, Spanning Tree.	10
3	**Relation and Function:** Relations: Properties of Binary Relations, Relation Matrix and Digraph, Operations on Relations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering Relations. Functions: Objective Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions, Lattice and its Properties.	10

Text Books:

1. Narsingh Deo Graph Theory with Applications To Engineering And Computer Science, Prentice – Hall
2. J. L. Mott, A.Kandel, T.P. Baker,Discrete Mathematics for Computer Scientists and Mathematicians,Prentice Hall of India,2nd Edition

Reference Books:

1. BernandKolman, Robert C. Busby, Sharon Cutler Ross, Discrete Mathematical Structures,PHI

Semester: SECOND

Syllabus
Semester-II

Course Code: MDI41MML103 **Course Name:** Design and Analysis of Algorithms **Course Category:** Major Mandatory
Credits:2 **Teaching Scheme:** L-2, P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basic understanding of Data and its applications
Course Objectives:
Student get familiar with basic concepts about stacks, queues, lists, trees and graphs Student can implement practically searching and sorting techniques.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Student can analyze algorithms and the correctness of algorithm, can summarize searching and sorting techniques and describe stack, queue and linked list operation with knowledge of tree and graphs concepts
CO2: Students demonstrate an ability to apply knowledge of computing and mathematics appropriate to the discipline including computer science theory.
CO3: Students get competent in applying design and development principles in the development of software systems of varying complexity
CO4: Students will implement various sorting, searching, and hashing algorithms. Students will build a substantial, complex data structure

Contents –

Unit	Content	Teaching hours
1	**Introduction to Algorithms:** Introduction to Algorithm, Analysis of algorithm, Designing of algorithm, the Correctness of Algorithms and the Complexity of Algorithms	10
2	**Linear Data Structure:** Stack, Queue, Array, Linked list, Priority Queue, Deque, Doubly linked list, circular linked list Searching and sorting Techniques.	10
3	**Non Linear Data Structure:** Graphs: Introduction to Graph Theory, Graph isomorphism, Graph data structures: Adjacency lists, Adjacency matrices Elementary graph Algorithms: BFS, DFS, Topological sort, strongly connected components. Trees: Introduction to Trees, Tree Operations, Tree traversals (preorder, inorder and postorder), Binary trees.	10

Text Books:
1. Seymour Lipschutz, Data Structures, Tata McGraw Hill Publication.
2. Thomas H. Cormen, Charles E. Leiserson, Ronaild L. Rivest, Clifford Stein Introduction to Algorithm,PHI Publication
Reference Books:
1. Jean Paul Tremblay and Pal G. Soresion, An Introduction to Data Structure And application, McGraw Hill Publication
2. Tannenbaum,Data Structure,PHI Publication

Syllabus
Semester-II

Course Code: MDI41MML104 **Course Name:** Computer Architecture **Course Category:**Major Mandatory
Credits:2 **Teaching Scheme:** L-2, P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basic Knowledge of Digital Electronics and Computer System architecture
Course Objectives:
Basic introduction of computer system architecture, the structure of computer, working of Gates and its functionality.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Student understands of the basic structure and operation of a digital computer.
CO2: To learn the architecture and assembly language Programming of microprocessor.
CO3: Learn Arithmetic Circuits Structures
CO4: To study the different Processors.

Contents –

Unit	Content	Teaching hours
1	**Computer Arithmetic:** Number System: Decimal System Binary Number System, Hexadecimal Number System. Octal Number System, Number Conversion: Decimal to Other, Binary to Other, Octal to Other, Hexadecimal to Other, BCD Numbers, ASCII Code, Computer Arithmetic: Addition, Subtraction. Logic Gates & Boolean Algebra Positive & Negative Logic, Truth Table, Logic Gates: AND, OR, NOT, NAND, NOR and Exclusive- Universal Gates. Postulates & Theorems of Boolean Algebra (Idempotent, Complementation, Commutative, Associative, Distributive, De-Morgan's Theorem)	10
2	**Arithmetic Circuits:** Combinational Circuits, Implementing Combinational logic. Arithmetic Circuits: Half-Adder, Full-Adder, Half-Sub tractor, Full-Sub tractor. Fundamentals of Microprocessors:Comparisonof8-bit, 16-bitand32-bitmicroprocessor.8086 Pin Configuration 8086InternalArchitectures Execution Unit & Bus Interface Flag Registers, Introduction to Addressing Modes.	10
3	**8086 Interrupt and Interrupt Applications:** Interrupts of 8086 Hardware Interrupts, Software Interrupts, Latest Trends in Microprocessor: RISC and CISC Architectures, Design: Multicore Processor and Multicore Processing, Multicore Technology and Intel, Dual Core and Core Duo Processors Corei3,i5, Mobile Processors.	10

Text Books:
1. Anil K. Maini, Digital Electronics: Principles, Devices and Applications, Wiley Publication
2. Lyla B Das Microprocessors & Multi core systems,Pearson Publication
Reference Books: 1.Douglas V Hall, Microprocessor and Interfacing, Tata McGraw Hill
2. M. Morris Mano,Microprocessor and Interfacing

Syllabus
Semester-II

Course Code: MDI41MMP103 **Course Name:** Practical based on Design and Analysis of Algorithms **Course Category:** Major Mandatory
Credits:1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Basic understanding of Data and its applications.
Course Objectives:
Student get familiar with basic concepts about stacks, queues, lists, trees and graphs Student can implement practically searching and sorting techniques.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Student can analyze algorithms and the correctness of algorithm, can summarize searching and sorting techniques and describe stack, queue and linked list operation with knowledge of tree and graphs concepts.
CO2: Students demonstrate an ability to apply knowledge of computing and mathematics appropriate to the discipline including computer science theory.
CO3: Students get competent in applying design and development principles in the development of software systems of varying complexity
CO4: Students will implement various sorting, searching, and hashing algorithms. Students will build a substantial, complex data structure

Contents –

Sr.no.	Description of Practical	Practical hours
1	Write and execute programs for insertion and deletion of n item from the Queues	1
2	Implement a program to display a Linked List.	1
3	Implement a program for Circular Doubly Linked List	1
4	Write and execute a program for binary search algorithm	1
5	Write and execute BFS and DFS Traversing	1
6	Write and execute Tree traversals	1
7	Write and execute a program for Bubble sort Algorithm	1
8	Write and execute programs for traversing of n item from the linked list	1
9	Write and execute a program for implementation of insertion sort	1
10	Write and execute a program for demonstration of merge sort	1

Text Books:
1. Seymour Lipschutz, Data Structures, Tata McGraw Hill Publication.
2. Thomas H. Cormen, Charles E. Leiserson, Ronaild L. Rivest, Clifford Stein Introduction to Algorithm, PHI Publication
Reference Books:
1. Jean Paul Tremblay and Pal G. Soresion, An Introduction to Data Structure And application, McGraw Hill Publication
2. Tannenbaum,Data Structure,PHI Publication

Syllabus
Semester-II

Course Code: MDI41MMP104 **Course Name:** Practical based on Computer Architecture **Course Category:** Major Mandatory
Credits:1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basic Knowledge of Digital Electronics and Computer System architecture
Course Objectives:
Basic introduction of computer system architecture, the structure of computer, working of Gates and its functionality.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Student understands of the basic structure and operation of a computer.
CO2: Student learns about the architecture and assembly language Programming of microprocessor.
CO3: Student learns about the Arithmetic Circuits Structures
CO4: Student learns about different Processors.

Contents –

Sr.no.	Description of Practical	Practical Hours
1	To Perform Number systems Conversations	1
2	To Perform Binary Arithmetic operations	1
3	To Verify the truth table of Basic Logic Gates	1
4	To Verify the truth table of Universal Logic Gates	1
5	To Verify the truth table of Special Purpose Logic Gates	1
6	State and Prove Demorgan's Theorem	1
7	To Study and Verify Combinational Logic Circuits (Half adder)	1
8	To Study and Verify Combinational Logic Circuits (Full adder)	1
9	To Study General Purpose Registers of 8086 Microprocessor	1
10	To Study Special Purpose Registers of 8086 Microprocessor	1

Text Books:
1. Anil K. Maini, Digital Electronics: Principles, Devices and Applications, Wiley Publication
Lyla B Das Microprocessors & Multi core systems, Pearson Publication
Reference Books:
1. Douglas V Hall, Microprocessor and Interfacing, Tata McGraw Hill
2. M. Morris Mano,Microprocessor and Interfacing

Syllabus
Semester-II

Course Code: MDI41VSP102 **Course Name:** Programming for Data Science **Course Category:** Vocational skill course
Credits:2 **Teaching Scheme:** L-0, P-4 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Understanding of C Programming.
Course Objectives:
To develop an in-depth understanding of functional, logic, and object-oriented programming paradigms, implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing, and Implement several programs in languages other than the one emphasized in the core curriculum C++.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Student understands of the basic of Object-Oriented Programming
CO2: To learn the Object and Classes declaration
CO3: Learn C++ Programming tool
CO4: To study Object Oriented Concepts and write the code in C++

Contents –

Sr.no.	Description of Practical	Practical Hours
1	Write a C++ program to find the sum of individual digits of a positive integer	1
2	Write a C++ program to generate the first n terms of the sequence	1
3	Write a C++ program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.	1
4	Write a C++ program to sort a list of numbers in ascending order.	1
5	Write a program Illustrating Class Declarations, Definition, and Accessing Class Members	1
6	Program to illustrate default constructor, parameterized constructor and copy constructors	1
7	Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.	1
8	Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.	1
9	Write a Program to Generate Fibonacci Series use Constructor to Initialize the Data Members.	1
10	Write a Program to Generate Fibonacci Series use Constructor to Initialize the Data Members.	1

Text Books:
1. E Balagurusamy Object-Oriented Programming with C++ | 8th Edition
Reference Books:
1. Yashavant P. Kanetkar Object Oriented Programming with C++.
Online Resources: 1. NPTEL / SWAYAM lectures. https://www.w3schools.com/cpp/cpp_oop.asp

Syllabus
Semester-II

Course Code: MDI41SEL102 **Course Name:** Statistical Methods **Course Category:** Skill Enhancement Course
Credits:2 **Teaching Scheme:** L-2, P-0 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Basic Knowledge of Mathematical Foundation
Course Objectives:
The emphasis of course is on descriptive statistics. It gives an idea about the various statistical methods, measures of central tendency, measure of dispersion and correlation. Statistics is matter of science and logic. It mainly indulges on mathematics and logic.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand the elementary statistical methods.
CO2: Apply the measures of central tendency, measure of dispersion and co-relation to solve our day-today life problem.
CO3: Analyze the data to represent it graphically or tabulate and interpret it to generate information.
CO4: Compare data to tabulate statistical information given in descriptive form.

Contents –

Unit	Content	Teaching hours
1	**Statistical Methods:** Definition, scope and importance of Statistics, concepts of statistical population and sample. Data & Types of data: Primary and Secondary data, qualitative & quantitative data, Numerical (discrete, continuous), Categorical and Ordinal. Cross-section, time series, failure, industrial, directional data. Attributes, variables, Processing of Data: Completeness, Consistency, Accuracy and Editing. Accuracy of Measurement. Classification, Tabulation and Graphical. Representation: Preparation of Tables, Presentation of Data: Variable, Random Variable, Frequency, And Frequency Distribution. Diagrammatic representation of Measures of Skewness and Kurtosis: Data: Line and Bar Diagram, Histogram, Component Bar diagram, Pie Chart, Line Graph, Frequency polygon and Ogive.	10
2	**Measures of Central Tendency:** Characteristics of Good measure of Central Tendency. Concept of central tendency- for Group and Ungroup data. Mean: Arithmetic mean (A.M.): simple and weighted Merits and demerits. Geometric mean (G.M.): computation for G M, Merits demerits and applications of G.M. Harmonic Mean (H.M.): computation for frequency, non-frequency data, merits and demerits of H.M., Median: Definition, Median for grouped and nongrouped data, Properties and Merits & demerits, Mode: Definition, Mode for grouped & Non-grouped data, Graphical Method for finding mode, Merits and demerits.	10
3	**Measures of Dispersions:** Purposes of Measure of Dispersion, Properties of Good measures of Dispersion. Range, Quartile Deviation & Mean Deviation: Variance: Standard Deviation: Coefficient of Variation: Bivariate data: Definition,	10

	scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression.	

Text Books:
1. B.L. Agarwal, Basic Statistics,New Age International (P) Limited.
2. S. C. Gupta & V. K. Kapoor Fundamental of Mathematical Statistics,Sultan Chand & Sons
Reference Books:
1. S. C. Gupta Fundamental of Statistics
2. Kapoor J. , N &Saxena S. C. Mathematical Statistics

Semester: THIRD

Syllabus
Semester-III

Course Code: MDI41MML201 **Course Name:** Data Communication Network **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2 P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basic Knowledge of computer, operating System.
Course Objectives:
Understanding of the fundamental concepts of computer networking.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand Data Communication Basics and their topology
CO2: Understand Data Transmission Media
CO3: Understand Network Hardware Component and OSI Reference Model:
CO4: Understand the Data Networking Protocols

Contents –

Unit	Content	Teaching hours
1	**Introduction to Computer Networks:** Computer network, Characteristic & advantages of networking, types of network, LAN, MAN, WAN,Network topology: Bus, star, ring, tree, mesh & hybrid topology. Advantages, disadvantages of each.Transmission media & Network Topologies: Guided & Unguided media, Twisted pair, coaxial cable, Fiber optics, Radio. VHF and microwaves, Satellite link.	6
2	**Introduction to Network Hardware Components:** Network Connectivity Devices, Repeater, Hub, Bridges, Switch, Routers. OSI Reference Model: The OSI reference Model, The Physical Layer, The Data Link Layer, The Network Layer, The Transport Layer, The Session Layer, Presentation Layer, Application Layer.	8
3	**TCP/IP Reference Model:** Comparison of the OSI and TCP/IP Reference Model, Critique of the OSI Model and Protocol, A Critique of the TCP/IP Reference Model, VPN. **Network Protocols**: Data link protocols, Ethernet and token rings, X.25.	8
4	**Transport protocols:** Transport services, protocol mechanism. **Network Services:** TCP /IP protocol, architecture, operations and applications, Internet and e-mail protocols: SMTP, SLIP, POP, PPP, FTP, and HTTP.	8

Text Books:
1. Computer Networks Tanenbaum A. PHI 4th Edition Publisher: Prentice Hall Pub Date: March 17, 2003 ISBN: 0-13-066102-3
2. Data Communications and Networking Fourauzan B. Tata McGraw Hill Publications 3rd edition
Reference Books:
1. An Engineering Approach to Computer Networking Keshav S. Pearson Education
2. High Performance TCP/IP: Networking Concepts, Issues, and Solutions, Mahbub Hassan and Raj Jain IST Edition,2009

Syllabus
Semester-III

Course Code: MDI41MML202 **Course Name:** Database Management System **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2 P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Understanding of computer software, basic computer concepts such as memory, database, data structures and algorithms.
Course Objectives:
Understand the concept of database & its component and Create & Implement the data Model in Computer.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Recognize and understand the basic concepts of database, knowledge, classifications of Architecture of database, database users, define advantages of database.
CO2: Describe the components of database system, define transaction, data modeling
CO3: Draw E-R diagram, schema diagram, classify attributes, entity, entity set, relationship
CO4: Implement DDL, DML DCL Commands, set operations

Contents –

Unit	Content	Teaching hours
1	**Introduction to Basic Concepts of DBMS:** Database System Application, Purpose of Database System, Database Architecture: 3-Level architecture, Database Users & Administrators Responsibilities, Functional Components of Database system: Storage & Query Processor, Transaction Management	6
2	**Data Modeling & Design:** Type of Data Model: Relation Data Model , E-R Data Model ,Object Based Data Model, Semi-Structured Data Model, Hierarchical & Network Data Model, E-R Data Model: Entity, Entity set, Entity types, Attributes, Types of Attributes, E-R diagram, Mapping Cardinalities, Data Association, Constraints : Integrity constraints I & II.	8
3	**Database Design**: Overview of Design Process, Designing Phase, Normalization (1NF, 2NF, 3 NF). **Relational Data Model**: Basic Structure, Database Schema, Integrity Rules, E.F. Codds Rules, Relational Algebra: Union, Intersection, Difference, Cartesian Product, Selection, Projection, Join: Natural & Outer Join, Division.	8
4	**Introduction to SQL & Pl/SQL**: Introduction to SQL, Types of SQL: DDL, DML, DCL, Features of Pl/SQL, Advantageous & Disadvantageous, Basic Syntax, Cursor, Triggers & Stored Procedure	8

Text Books:
1. Database System concepts Korth, Siberschatz Fifth Edition
2. An Introduction to Database System B. Desai
Reference Books:
1.SQL Primer: An Accelerated Introduction to SQL Basics Rahul Batra Apress

Syllabus
Semester-III

Course Code: MDI41MML203 **Course Name:** Regression Analysis **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2, P-0 **Evaluation Scheme:**CA-30,ESE-20
Pre-requisites: Basics of Statistics.
Course Objectives:
To predict the value of a dependent variable based on an independent variable.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Use correlation analysis to describe the relationship between two interval-level variables
CO2: Perform and interpret dummy variable regression
CO3: Analyze interaction relationships using multiple regression
CO4: Solve two-way ANOVA

Contents –

Unit	Content	Teaching hours
1	**Simple Linear Regression:** Linear Regression Model, Least square estimation of the parameters, Hypothesis Testing on the slope and intercept, Interval estimation in Simple linear Regression, Prediction of New Observations and Coefficient of Determination.	6
2	**Multiple Linear Regression:** Multiple Linear Regression Models, Estimation of the Model Parameters, Hypothesis testing in Multiple Linear Regression, Confidence Interval on the Regression and Prediction of New observations.	8
3	**Introduction to analysis of variance-** One way and two-way ANOVA – Analysis of variance in Regression: Response surface designs – Introduction to response surface methodology.	8
4	**Method of steepest accent**: Introduction, Analysis of second order response surface, experimental design for fitting response surfaces.	8

Text Books:
1. Introduction to Linear Regression Analysis Douglas C. Montgomery and Elizabeth A.Peck and G.Geoffrey Vining John Wiley& Sons 3rd Edition
2. Regression Analysis: A Practical Introduction, Jeremy Arkes, Taylor & Francis, 2023
Reference Books:
1. Probability and Statistics for engineers Ravichandran, J.Wiley
2. Handbook of Regression Analysis, Samprit Chatterjee, Jeffrey S. Simonoff, John Wiley & Sons, 2012

Syllabus
Semester-III

Course Code: MDI41MMP201 **Course Name:** Practical Based on Data Communication Network **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0,P-2 **Evaluation Scheme**:CA-30,ESE-20
Pre-requisites: Basic Knowledge of computer Network, operating System, Internet etc.
Course Objectives:
Understanding of the fundamental concepts of computer networking.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand Data Communication Basics and their topology
CO2: Understand Data Transmission Media
CO3: Understand Network Hardware Component and OSI Reference Model:
CO4: Understand the Data Networking Protocols

Content -

Sr.no.	Description of Practical	Practical Hours
1	Configure Peer-to-Peer Network at least three Host	2
2	Create desired standard network cable including Cross cable and test it by using cable tester	2
3	Connect computer using given topology with wired media.	2
4	Connect Computers Using Wireless Media	2
5	Create a Network Using Bluetooth	2
6	Share a Printer and Folder in Network	2
7	Install Operating System Windows Server 2008	2
8	Configure File Server	2
9	Configure client to file server and use file services	2
10	Configure static and dynamic IP addresses	2
11	Project	10

Reference Books :

1. Computer Networks Tanenbaum A. PHI 4th Edition
2. Data Communications and Networking Fourauzan B. TataMcGrawHillPublications 3rd edition
3. An Engineering Approach to Computer Networking Keshav S. Pearson Education
4. High Performance TCP/IP: Networking Concepts, Issues, and Solutions, Mahbub Hassan and Raj Jain IST Edition,2009

Syllabus
Semester-III

Course Code: MDI41MMP202 **Course Name:** Practical Based on Database Management System **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0,P-2 **Evaluation Scheme:**CA-30,ESE-20
Pre-requisites: Understanding of computer software, basic computer concepts such as memory, database, data structures and algorithms.
Course Objectives:
Understand the concept of database & its component and Create & Implement the data Model in Computer.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Recognize and understand the basic concepts of database, knowledge, classifications of Architecture of database, database users, define advantages of database.
CO2: Describe the components of database system, define transaction, data modeling
CO3: Draw E-R diagram, schema diagram, classify attributes, entity, entity set, relationship
CO4: Implement DDL, DML DCL Commands, set operations

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Installation and Configuration MySQL	2
2	Design Database Student Registration using queries creation Data insertion, update/modification/Delete and retrieval through MySQL	2
3	Create student Registration database and apply integrity constraints (Domain, Key constraints (Primary/Foreign keys), not null, unique, default, Check)	2
4	Create Student Registration database execute View	2
5	Design Student Mark sheet database using Avg, Count, Min, Max, Sum	2
6	Prepare Dataset and execute Join operator (Natural join, Outer join (left, right and full)	2
7	Design Student Registration Database and apply Data Control Language (DCL) Grant, Revoke queries	2
8	Design Bank Database and apply Transaction Control Language Commit and Rollback	2
9	Design Bank Database and apply Transaction Control Language Save point and Set Transaction	2
10	Design Employee Registration and Data Query Language	2
11	Project	10

Reference Books:
1. Database System concepts Korth, Siberschatz Fifth
2. An Introduction to Database SystemB.Desai
3. SQL Primer: An Accelerated Introduction to SQL Basics Rahul Batra Apress

Syllabus
Semester-III

Course Code:MDI41VSP201 **Course Name:** Python Programming **Course Category:** Vocational skill course
Credits: 2 **Teaching Scheme:**L-0,P-4 **Evaluation Scheme:** CA-30,ESE-20
Pre-requisites: Programming Concepts
Course Objectives:
Describe the core syntax and semantics of Python programming language
Course Outcomes: At the end of the course, the students will be able to -
CO1: To learn basics of Python
CO2: Develop console application
CO3: To Learn Python Data Types
CO4: To illustrate the process of structuring the data using lists, dictionaries, tuples and sets.

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Installing Python and Shell or Notebook, Launching the IPython Shell, Launching the Jupyter Notebook	4
2	Passing Values to and from the Shell, Shell-Related Magic Command, Errors and Debugging, Controlling Exceptions	4
3	Aggregations: Min, Max, and Everything in Between, Summing the Values in an Array, Minimum and Maximum, Example: What Is the Average Height of US Presidents?	4
4	Sorting Arrays, Fast Sorting in NumPy: np.sort and np.argsort, Partial Sorts: Partitioning, Example: k-Nearest Neighbors	4
5	Data Indexing and Selection, Data Selection in Series, Data Selection in DataFrame, Operating on Data in Pandas, Ufuncs: Index Preservation, UFuncs: Index Alignment	4
6	Handling Missing Data, Trade-Offs in Missing Data Conventions, Missing Data in Pandas, Operating on Null Values	4
7	Vectorized String Operations, Introducing Pandas String Operations, Tables of Pandas String Methods, Example: Recipe Database	4
8	General Matplotlib Tips, Importing matplotlib, Setting Styles, show() or No show()? How to Display Your Plots, Saving Figures to File	4
9	Text and Annotation, Example: Effect of Holidays on US Births, Transforms and Text Position, Arrows and Annotation, Customizing Ticks, Major and Minor Ticks, Hiding Ticks or Labels, Reducing or Increasing the Number of Ticks	4
10	Three-Dimensional Plotting in Matplotlib, Three-Dimensional Points and Lines, Three-Dimensional Contour Plots	4
11	Project	20

Reference Books:

1. Introduction to Python Programming Gowrishankar S, Veena A,CRC Press/Taylor 1st Edition
2. Core Python Programming Chun, J Wesley Pearson 2nd Edition
3. Learning Python Lutz, Mark O Rielly 4th Edition
4. Head First Python Barry, Paul O Rielly 2nd Edition

Semester: FOURTH

Syllabus
Semester-IV

Course Code: MDI41MML204 **Course Name:** Introduction NOSQL Databases **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:**L-2, P-0 **Evaluation Scheme**:CA-30,ESE-20
Pre-requisites: Students should knows Data Types
Course Objectives:
NoSQL databases are designed for a number of data access patterns that include low-latency applications.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Demonstrate the RDBMS
CO2: Demonstrate competency in designing NoSQL database management systems
CO3: Demonstrate competency in describing how NoSQL databases differ from relational databases from a theoretical perspective.
CO4: Demonstrate competency in selecting a particular NoSQL database for specific use case

Contents –

Unit	Content	Teaching hours
1	**Introduction:** Relational Database Design,Early Database Management Systems,Flat File Data Management Systems,Hierarchical Data Model Systems,Network Data Management Systems,The Relational Database Revolution,Relational Database Management Systems, Limitations of Relational Databases.	6
2	**NoSQL:** Motivations for Not Just/No SQL (NoSQL) Databases,Scalability, Cost Flexibility, Availability,Case Study. **Varietyof NoSQL Databases:**Data Management with Distributed Databases,Consistency of Database Transactions,ACID: Atomicity, Consistency, Isolation, and Durability.	8
3	**BASE:** Basically Available, Soft State, Eventually Consistent,Four Types of NoSQL Databases,Document Databases,Differences Between Document and Relational Databases,Column Family Databases,Graph Databases,Differences Between Graph and Relational Databases.	8
4	**Key-Value Databases**:Introduction to Key-Value Databases,From Arrays to Key-Value Databases,Essential Features of Key-Value Databases,Keys: More Than Meaningless Identifiers,Values: Storing Just About Any Data You Want,Values Do Not Require Strong Typing, Limitations on Searching for Values.	8

Text Books:
1. NoSQL for Mere Mortals By Dan Sullivan ISBN-13:978-0-13-402321-2.
2. Hernandez, Michael J. Data Design for Mere Mortals: A Hands-On Guide to Relational Database Design. Reading, MA: Addison-Wesley, 2007.
Reference Books:
1. Codd, E. F. A Relational Model of Data for Large Shared Data Banks communications of the ACM
2. Viescas, John L., and Michael J. Hernandez. SQL Queries for Mere Mortals.

Syllabus
Semester-IV

Course Code: MDI41MML205	**Course Name:** Google Analytics	
Course Category: Major Mandatory		
Credits: 2	**Teaching Scheme:**L-2,P-0	**Evaluation Scheme:**CA-30,ESE-20
Pre-requisites: Student knows about Foundation terms of Data Science		
Course Objectives:		
Students should know about configuration of Google Analytics and generate different reports available in Google Analytics to support improvement decisions.		
Course Outcomes: At the end of the course, the students will be able to -		
CO1: Determine basic navigation of Google Analytics Interface.		
CO2: Identify the benefits of a customer-centric approach to website design and optimization		
CO3: How to navigate the Google Analytics interface and reports, and set up dashboards and shortcuts		
CO4: Determine site content in GA, filtering data techniques		

Contents –

Unit	Content	Teaching hours
1	**Introducing Web Analytics:** Defining Web Analytics, Quantitative and Qualitative Data, The Continuous Improvement Process, Measuring Outcomes, What Google Analytics Contributes, How Google Analytics Fits in the Analytics Ecosystem. Creating an Implementation Plan: Gather Business Requirements, Analyze and Document Website Architecture.	6
2	**Create an Account and Configure Your Profile:** Configure the Tracking Code and Tag Pages, Tag Marketing Campaigns, Create Additional User Accounts and Configure Reporting Features, Perform Optional Configuration Steps. **How Google Analytics Works:** Data Collection and Processing, Reports, About the Tracking Code, The Mobile Tracking Code, App Tracking, The (Very) Old Tracking Code: urchin.js, Understanding Page views. Tracking Visitor Clicks, Outbound Links, and Non-HTML	8
3	**Files:** About the Tracking Cookies, Designing Blogs for Google Analytics. Google Analytics Accounts and Profiles: Google Analytics Accounts, Creating a Google Analytics Account, Creating Additional Profiles, Access Levels, All About Profiles, Basic Profile Settings, Profile Name, Website URL, Time Zone, Default Page, Exclude URL Query Parameters, E-Commerce Settings, Tracking On-Site Search, Applying Cost Data.	8
4	**Filters:** Filter Fields, Filter Patterns, Filter Type, Include/Exclude Filters, Search and Replace Filters, Lowercase/Uppercase Filters, Advanced Profile Filters, Predefined Filters. Tracking Conversions with Goals and Funnels: Goals, Time on Site, Pages per Visit, URL Destinations, Additional Goal Settings, Tracking Defined Processes with Funnels.	8

Text Books: 1.Google Analytics Justin Cutroni O'Reilly
2. Introduction to Google Analytics: A Guide for Absolute Beginners Todd Kelsey APress
Reference Books:
1. Google Analytics Jerri L. Ledford, Joe Teixeira, and Mary E. Tyler Google Analytics

Syllabus
Semester-IV

Course Code: MDI41MML206 **Course name:** Optimization Techniques **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2, P-0 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Basics of mathematical and statistics.
Course Objectives:
Inculcate modeling skills necessary to describe and formulate optimization problems in Data Science.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Learn Liner Programming.
CO2: Understand solve the Transpiration Problem.
CO3: Solve the Assignment problem.
CO4: To know the Project Management.

Contents –

Unit	Content	Teaching hours
1	**Linear Programming:** Introduction to linear programming model, general structure of LPP , advantages of LPP, limitations of LPP, general mathematical model of LPP, guidelines on linear programming model formulation ,examples based on LPP model formulation, extreme point solution method ,examples based on maximization and minimization cases, examples based on mixed constraints, unbounded and infeasible solution examples, introduction of slack ,surplus and artificial variables , Simplex method algorithm maximization ,minimization case	6
2	**Transportation Problem**: Introduction, mathematical model of transportation Problem, methods of finding Initial basic feasible solution (IBFS): north west corner method (NWCM), least cost method (LCM), Vogel's approximation method (VAM).	8
3	**Conceptual problems:** Method of finding optimized solution: MODI method, examples based of unbalanced supply and demand, maximization case. Assignment problem: Introduction, mathematical model of assignment problem, solution methods of assignment problem: Hungarian method, conceptual problems, unbalanced assignment problem.	8
4	**Project Management:** PERT and CPM: Introduction , basic difference between PERT and CPM, significance of using PERT and CPM, rules for AOA and AON network, errors and dummies in network, conceptual problems. Critical path analysis (CPM) forward pass method (for earliest event time) ,backward pass method (for latest allowable event time).	8

Text Books:
1. Operations research by JK Sharma
2. S.S. Rao, Engineering optimization: Theory and Practice, New age international, 3rd edition, 2013.
Reference Books:
1. J. S. Arora, Introduction to Optimum Design, Academic press, 4th Edition, 2017.
2. K. Deb., Optimization for Engineering Design: Algorithms and Examples, PHI, 2nd Edition, 2012.

Syllabus
Semester-IV

Course Code: MDI41MMP203 **Course Name:** Practical Based on Introduction NOSQL Databases **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Students knows Data Types
Course Objectives:
Understand NoSQL databases with data access pattern including low-latency applications.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Demonstrate the RDBMS.
CO2: Demonstrate competency in designing NoSQL database management systems.
CO3: Demonstrate competency in describing how NoSQL databases differ from relational databases from a theoretical perspective.
CO4: Demonstrate competency in selecting a particular NoSQL database for specific use case

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Installing and configuring NOSQL	2
2	Creating Railway Reservation database	2
3	Apply CRUD Operations on Student Registration database using Create, Read	2
4	Apply CRUD Operations on Student Registration database using Update And Delete	2
5	Design Key-value Payroll System databases and execute task	2
6	Design Document- Payroll System databases and execute task	2
7	Design Graph- Payroll System databases and execute task	2
8	Design Student Admission databases for ACID: Atomicity and Consistency Property	2
9	Design Student Admission databases and apply ACID: Isolation Property	2
10	Design Student Admission databases apply ACID: Durability Property	2
11	Project	10

Reference Book

1. NoSQL for Mere Mortals By Dan Sullivan ISBN-13:978-0-13-402321-2
2. Hernandez, Michael J. Data Design for Mere Mortals: A Hands-On Guide to Relational Database Design. Reading, MA: Addison-Wesley, 2007
3. Codd, E. F. A Relational Model of Data for Large Shared Data Banks. Communications of the ACM 13, no. 6 (June 1970).
4. Viescas, John L., and Michael J. Hernandez. SQL Queries for Mere Mortals. Reading, MA: Addison-Wesley, 2007.

Syllabus
Semester-IV

Course Code: MDI41MMP204 **Course Name:** Practical Based on Google Analytics **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Basics of Data Science
Course Objectives: Students should know about configuration of Google Analytics and generate different reports available in Google Analytics to support improvement decisions.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Determine basic navigation of Google Analytics Interface.
CO2: Identify the benefits of a customer-centric approach to website design and optimization
CO3: How to navigate the Google Analytics interface and reports, and set up dashboards and shortcuts.
CO4: Determine site content in GA, filtering data techniques

Contents –

Sr.no.	Description of Practical	Practical Hours
1	Create Google Analytics Account	2
2	Configure Google Analytics Account	2
3	Design Web Blog using Free host Server	2
4	Create Google Analytics Tracking Code and insert in Web Blog	2
5	Creating an Implementation Plan of Business case i.e. Web blog	2
6	Configure Google Analytics Accounts and Profiles	2
7	Create Administrator and User Profiles	2
8	Create Filters in Google Analytics	2
9	Create Tracking Conversions with Goals	2
10	Create Tracking Conversions with Funnels	2
11	Project	10

Reference Book:
1. Google Analytics Justin Cutroni O'Reilly
2. Introduction to Google Analytics: A Guide for Absolute Beginners Todd Kelsey APress
3. Google Analytics Jerri L. Ledford, Joe Teixeira, and Mary E. Tyler

Syllabus
Semester-IV

Course code: MDI41SEP201 **Course Name:** R Programming **Course Category:** SEC-Skill Enhancement course
Credits: 2 **Teaching Scheme:** L-0, P-4 **Evaluation Scheme:** CA-30,ESE-20
Pre-requisites: Programming Concepts.
Course Objectives:
Understand and learn the lifecycle and phases of data science and work comfortably with data science projects
Course Outcomes: At the end of the course, the students will be able to -
CO1: Develop fundamental knowledge of concepts underlying data science
CO2: Develop practical data analysis skills, which can be applied to practical problems
CO3: Explain how math and information sciences can contribute to building better algorithms and software
CO4: Develop applied experience with data science software, programming, applications and processes

Contents –

Sr.no.	Description of Practical	Practical Hours
1	Install and configure R, R Studio and R Packages	4
2	**Basic Arithmetic Operations:** Perform arithmetic operations such as addition, subtraction, multiplication, and division on numeric values. Variables and Data Types: Declare variables of different data types (numeric, character, logical) and perform operations on them.	4
3	**Importing Data**: Use read.csv() to import a CSV file into R and examine its structure. **Data Exploration:** Explore the imported dataset by checking its dimensions, column names, and summary statistics using functions like dim(), names(), and summary().	4
4	**Indexing and Subsetting:** Subset the dataset to select specific rows and columns using indexing techniques. Basic Data Manipulation: Use functions from the dplyr package (e.g., select(), filter(), mutate()) to manipulate and transform the dataset.	4
5	**Creating Basic Plots:** Use ggplot2 to create a scatter plot of two variables from the dataset. **Customizing Plots:** Customize the scatter plot by adding titles, axis labels, changing colors, and adjusting point shapes.	4
6	**Histogram Creation:** Create a histogram of a numerical variable from the dataset using ggplot2. Adding Statistical Summary to Plots: Overlay the scatter plot with a line representing a regression line or mean value.	4
7	**Exporting Plots:** Export the created plot to a file (e.g., PNG or PDF) using the appropriate functions. Descriptive Statistics: Calculate descriptive statistics (mean, median, standard deviation) for a numerical variable in the dataset.	4
8	**Creating Vectors:** Create a numeric vector containing numbers from 1 to 10. **Vector Operations:** Perform arithmetic operations (addition, subtraction, multiplication, division) on two numeric vectors of equal length. **Vector Indexing:** Access and print the third element of a given character vector.	4

	Vector Concatenation: Combine two numeric vectors of different lengths using the c() function. Vector Length: Determine the length of a given logical vector.	
9	**Vector Subsetting:** Create a new vector containing only the even numbers from a given numeric vector. Vector Recycling: Perform an arithmetic operation between a scalar and a numeric vector of shorter length, observing recycling behavior. **Logical Operations on Vectors:** Create a logical vector by comparing each element of a numeric vector to a threshold value. Vector Naming: Assign names to elements of a given numeric vector and access an element using its name. Vector Replication: Replicate each element of a given numeric vector three times.	4
10	**Vector Sorting:** Sort a numeric vector in ascending order and print the result. Vector Element Replacement: Replace the second element of a given character vector with a new value. **Vector Comparison:** Compare two numeric vectors element-wise and return a logical vector indicating where they are equal. **Vector Filtering:** Filter a given numeric vector to include only values greater than a specified threshold. Vector Sum: Calculate the sum of all elements in a numeric vector.	4
11	Mini Project	20

Reference Book:

1. Introduction to Data Science Jeffrey S.Saltz,Jeffrey M.Stanton Ebook SAGE Publications.
2. The Art Of R Programming by Norman Matloff Publisher: William Pollock ISBN-10: 1-59327-384-3.

Semester: FIFTH

Syllabus
Semester-V

Course Code: MDI41MML301 **Course Name:** Machine Learning **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2 P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basic knowledge about Data Mining and data warehousing
Course Objectives:
To introduce students to the basic concepts and techniques of Machine Learning. To become familiar with regression methods, classification methods, clustering methods
Course Outcomes: At the end of the course, the students will be able to -
CO1: To become familiar with Dimensionality reduction Techniques.
CO2: Identify machine learning techniques suitable for a given problem.
CO3: At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.
CO4: Understand the Data Clustering.

Contents –

Unit	Content	Teaching hours
1	**Introduction to Machine Learning**- Introduction to Analytics and Machine Learning, What is Machine Learning, Types of Machine Learning, Applications of Machine Learning, Issues in Machine Learning, Why Machine Learning?, Framework for Developing Machine Learning Models, State-of-the-Art Languages / Tools In Machine Learning. **Descriptive Analytics**- Working with Data Frames in Python, Handling Missing Values, Exploration of Data using Visualization: Drawing Plots, Bar Chart, Histogram, Distribution or Density Plot, Box Plot, Comparing Distributions, Scatter Plot, Pair Plot, Correlation and Heatmap.	6
2	**Linear Regression**- Simple Linear Regression, Steps in Building a Regression Model, Building Simple Linear Regression Model, Model Diagnostics, Multiple Linear Regression.	8
3	**Classification**- Classification Overview, Binary Logistic Regression, Credit Classification, Gain Chart and Lift Chart, Classification Tree (Decision Tree Learning) **Clustering**- Overview, Clustering Working, K-Means Clustering, Creating Product Segments Using Clustering, Hierarchical Clustering.	8
4	**Advances in Machine Learning**- Gradient Descent Algorithm, Scikit-Learn Library for Machine Learning, K-Nearest Neighbors (KNN) Algorithm, Random Forest.	8

Text Books:

1. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley
2. Machine Learning, Author: Saikat Dutt, S. Chandramouli, Amit K.Das, Pearson Pub.

Reference Books:

1.Machine Learning with Python, By Abhishek Vijayvargia, BPB Publications
2.Machine Learning, By Mitchell Tom, McGraw Hill Pub.

Syllabus
Semester-V

Course Code: MDI41MML302 **Course Name:** Data Mining **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2 P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: students should know the basic concepts of data Structure and analysis.
Course Objectives:
Students will be able to actively manage and participate in data mining projects. To develop research interest towards advances in data mining. Students will be able to understand the visualization techniques
Course Outcomes: At the end of the course, the students will be able to -
CO1: Identify appropriate data mining algorithms to solve real world problems.
CO2: Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
CO3: Describe complex data types with respect to spatial and Data Visualization.
CO4: Benefit the user experiences towards research and innovation. Integration in Data Mining area.

Contents –

Unit	Content	Teaching hours
1	**Introduction to Data Mining:** Need of Data Mine, Commercial Viewpoint, Scientific Viewpoint Motivation, Definitions, Origins of Data Mining, Data Mining Tasks, Classification, Clustering, Association Rule Discovery, Sequential Pattern Discovery, Regression, Challenges of Data Mining, Data Mining Data: Data, Attribute Values, Measurement of Length, Types and Properties of Attributes, Discrete and Continuous Attributes, Types of data sets, Data Quality, Data Preprocessing, Aggregation, Sampling, Dimensionality Reduction, Feature subset selection, Feature creation, Discretization and Binarization, Attribute Transformation, Density.	6
2	**Data Mining:** Exploring Data, Data Exploration Techniques, Summary Statistics, Frequency and Mode, Percentiles, Measures of Location: Mean and Median, Measures of Spread: Range and Variance, **Data Exploration:** Visualization, Representation, Arrangement, Selection, Visualization Techniques: Histograms, Box Plots, Scatter Plots, Contour Plots, Matrix Plots, Parallel Coordinates, Other Visualization Techniques, OLAP : OLAP Operations	8
3	**Data Mining Classification:** Basic Concepts, Decision Trees, and Model Evaluation: Classification: Definition, Classification Techniques, Tree Induction, Measures of Node Impurity, Practical Issues of Classification, ROC curve, Confidence Interval for Accuracy, Comparing Performance of Two Models, Comparing Performance of Two Algorithms.	8
4	**Alternative Classification Techniques:** Alternative Techniques: Rule-Based Classifier, Rule Ordering Schemes, Building Classification Rules, Instance-Based Classifiers, Nearest Neighbor	8

Text Books:
1. Tan, Steinbach, Kumar, Introduction to Data Mining.
Reference Books:
1. Jiawei Han, Micheline Kamber Data Mining: Concepts and Techniques Morgan Kaufmann Publishers
2. Classifiers, Bayes Classifier, Naive Bayes Classifier, Artificial Neural Networks (ANN), Support Vector Machines.

Syllabus
Semester-V

Course Code: MDI41MML303	**Course Name:** Artificial Intelligence	
Course Category: Major Mandatory		
Credits: 2	**Teaching Scheme:** L-2, P-0	**Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Basic knowledge of Data Mining and Analytics Skills.		
Course Objectives:		
Understand basic principles, techniques, and applications of Artificial Intelligence and Problem solving, inference, perception, knowledge representation, and learning.		
Course Outcomes: At the end of the course, the students will be able to -		
CO1: Understanding of the history of artificial intelligence (AI) and its foundations.		
CO2: Apply basic principles of AI in solutions that require problem solving, inference.		
CO3: Perception, knowledge representation, and learning.		
CO4: Demonstrate awareness and a fundamental understanding of various applications of AI.		

Contents –

Unit	Content	Teaching hours
1	**Introduction: -**Introduction to Artificial Intelligence, Historical Background, what is Intelligence, Depth First Search (DFS), Breadth First Search (BFS), Comparison of Depth First Search and Breadth First Search, Quality of Solution	6
2	**Heuristic Search: -** Heuristic Functions, Best First Search, Hill Climbing, Local Maxima, Solution Space Search, Variable Neighbourhood Decent, Beam Search, Tabu Search, Peak to Peak Method.	8
3	**Randomized Search and Emergent Systems: -**Iterated Hill Climbing, Simulated Annealing, Genetic Algorithm, The Travelling Salesman Problem, Neural Network, Emergent System, Ant Colony Optimization	8
4	**Finding Optimal Paths: -**Brute Force, Branch and Bound, Refinement Search, Dijkstra's Algorithm, Algorithm of A*, Admissibility of A*, Recursive Best First Search (RBFS), Pruning the CLOSED List, Pruning the OPEN List, Divide and Conquer Beam Stack Search	8

Text Books:

1. A First Course in Artificial Intelligence Deepak Khemani McGraw-Hill Education.
2. Artificial Intelligence A Modern Approach by stuart Russell, peter Norvig, third edition.

Reference Books:

1. Artificial Intelligence Elaine Rich Tata McGraw-Hill Education.
2. Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter NorvigPublisher: Pearson **ISBN**-13: 978-0134610993

Syllabus
Semester-V

Course Code: MDI41MMP301 **Course Name:** Practical Based on Machine Learning **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme**:CA-30, ESE-20
Pre-requisites: Basic knowledge about Data Mining and data warehousing.
Course Objectives:
To introduce students to the basic concepts and techniques of Machine Learning. To become familiar with regression methods, classification methods, clustering methods.
Course Outcomes: At the end of the course, the students will be able to -
CO1: To become familiar with Dimensionality reduction Techniques.
CO2: Identify machine learning techniques suitable for a given problem.
CO3: At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.
CO4: Understand the Data Clustering.

Contents:

Sr.no.	Description of Practical	Practical Hours
1	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	2
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	2
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2
4	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	2
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test datasets	2
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	2
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	2
8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results	2

	of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	2
10	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and drawgraphs.	2
11	Project	10

Text Book:
1. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley.
2. Machine Learning, Author: Saikat Dutt, S. Chandramouli, Amit K.Das, Pearson Pub.
Reference Books:
1. Machine Learning with Python, By Abhishek Vijayvargia, BPB Publications
2. Machine Learning, By Mitchell Tom, McGraw Hill Pub.

Syllabus
Semester-V

Course Code: MDI41MMP302 **Course Name:** Practical Based on Data Mining **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme**:CA-30, ESE-20
Pre-requisites: Basics concepts of Data Structure and their Operations
Course Objectives:
Students will be able to actively manage and participate in data mining projects. To develop research interest towards advances in data mining. Students will be able to understand the visualization techniques
Course Outcomes: At the end of the course, the students will be able to -
CO1: Identify appropriate data mining algorithms to solve real world problems.
CO2: Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
CO3: Describe complex data types with respect to spatial and Data Visualization.
CO4: Benefit the user experiences towards research and innovation. Integration in Data Mining area.

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Demonstration of preprocessing on dataset student.arff	2
2	Demonstration of preprocessing on dataset labor.arff	2
3	Demonstration of Association rule process on dataset contactlenses.arff using apriori algorithm	2
4	Demonstration of Association rule process on dataset test.arff using apriori algorithm	2
5	Demonstration of classification rule process on dataset using Nearest neighbor algorithm	2
6	Demonstration of classification rule process on dataset using K-NN algorithm	2
7	Demonstration of classification rule process on dataset using Decision tree algorithm	2
8	Demonstration of classification rule process on dataset using Regression algorithm	2
9	Apply Visualization techniques for Various Dataset	2
10	Apply Visualization techniques for Various Dataset	2
11	Project	10

Reference Books:
1. Tan, Steinbach, Kumar. Introduction to Data Mining.
2. Jiawei Han, Micheline Kamber Data Mining: Concepts and Techniques Morgan Kaufmann Publishers

Syllabus
Semester-V

Course Code: MDI41MEL301	**Course Name:** Sentiment Analysis
Course Category: Major Mandatory Elective	
Credits: 3 **Teaching Scheme:** L-3, P-0	**Evaluation Scheme:**CA-60,ESE-40
Pre-requisites: Basics of Analytics Techniques	
Course Objectives: This course is an introduction to Sentiment Analysis, with topics covered including relevant aspects of machine learning and Natural Language Processing.	
Course Outcomes: At the end of the course, the students will be able to -	
CO1: Understand the Data Analysis concepts	
CO2: Establish an understanding of concepts and theories of Sentiment Analysis.	
CO3: Understanding the types of Sentiment Analysis.	
CO4: Understanding Sentiment Analysis how to implement Opinion Analysis .	
CO5: Mapping Implicit aspects .	

Contents –

Unit	Content	Teaching hours
1	**Sentiment Analysis:** A Fascinating Problem, Sentiment Analysis Applications, Sentiment Analysis Research, Different Levels of Analysis, Sentiment Lexicon and Its Issues, Natural Language Processing Issues, Opinion Spam Detection, The Problem of Sentiment Analysis, Problem Definitions, Opinion Definition	9
2	**Sentiment Analysis Tasks**: Opinion Summarization, Different Types of Opinions, Regular and Comparative Opinions Explicit and Implicit Opinions, Subjectivity and Emotion. Document Sentiment Classification: Sentiment Classification Using Supervised Learning, Sentiment Classification Using Unsupervised Learning, Sentiment Rating Prediction.	9
3	**Cross-Domain Sentiment Classification:** Cross-Language Sentiment Classification, Sentence Subjectivity and Sentiment Classification, Sentiment Analysis and Opinion Mining, Subjectivity Classification, Sentence Sentiment Classification, Dealing with Conditional Sentences. Dealing with Sarcastic Sentences Cross-language Subjectivity and Sentiment Classification Using Discourse Information for Sentiment Classification.	9
4	**Aspect-based Sentiment Analysis:** Aspect Sentiment Classification, Basic Rules of Opinions and Compositional Semantics, Aspect Extraction, Finding Frequent Nouns and Noun Phrases, Using Opinion and Target Relations, Using Supervised Learning, Using Topic Models	9
5	**Mapping Implicit Aspects:** Identifying Resource Usage Aspect, Simultaneous Opinion Lexicon Expansion and Aspect, Extraction, Grouping Aspects into Categories, Entity, Opinion Holder and Time Extraction, Coreference Resolution and Word Sense Disambiguation	9

Text Books:

1. Bing Liu Sentiment Analysis and Opinion Mining Morgan & Claypool Publishers, May 2012.

Reference Books:

1. Bo Pang and Lillian Lee Opinion mining and sentiment analysis

Syllabus
Semester-V

Course Code: MDI41MEL302 **Course Name:** Social Media Mining **Course Category:** Major Mandatory Elective
Credits: 3 **Teaching Scheme:**L-3, P-0 **Evaluation Scheme:**CA-60,ESE-40
Pre-requisites: Basic knowledge of Data Analytics
Course Objectives:
Understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics.
Course Outcomes: At the end of the course, the students will be able to -
CO1: To know the Users on Social Media.
CO2: Understand the Social Media Networks.
CO3: Social Media Configurations.
CO4: Design Content on Social Media.
CO5: Apply Social media tools on Processing Large Datasets.

Contents –

Unit	Content	Teaching hours
1	**Users: The Who of Social Media:-**Measuring Variations in User Behavior in Wikipedia, The Diversity of User Activities, The Long Tail in Human Activities, Long Tails Everywhere: The 80/20 Rule (p/q Rule), Online Behavior on Twitter, Retrieving Tweets for Users, Logarithmic Binning, and User Activities on Twitter.	9
2	**Networks: The How of Social Media:-**Introduction, Types and Properties of Social Networks, When Users Create the Connections: Explicit Networks, Directed Versus Undirected Graphs, Node and Edge Properties, Weighted Graphs, Creating Graphs from Activities: Implicit Networks, Visualizing Networks, Degrees: The Winner Takes All, Counting the Number of Connections, The Long Tail in User Connections, Beyond the Idealized Network Model, Capturing Correlations: Triangles, Clustering, and Assortativity.	9
3	**Temporal Processes:**The When of Social Media:-Traditional Models, Inter-Event Times, Comparing to a Memoryless Process, Autocorrelations, Deviations from Memorylessness, Periodicities in Time in User Activities, Bursty Activities of Individuals, Correlations and Bursts, Forecasting Metrics in Time, Finding Trends.	9
4	**Content: The What of Social Media:-**Defining Content: Focus on Text and Unstructured Data, The Basics of Natural Language Processing, The Basic Statistics of Term Occurrences in Text, Using Content Features to Identify Topics, The Popularity of Topics, How Diverse Are Individual Users' Interests, Extracting Low-Dimensional Information from High-Dimensional Text, Topic Modeling	9
5	**Processing Large Datasets:-**MapReduce: Structuring Parallel and Sequential Operations, Counting Words, Multi-Stage MapReduce Flows, Merging Data Streams, Joining Against Small Datasets, Patterns in MapReduce Programming, Incremental MapReduce Jobs, Temporal MapReduce Jobs, Challenges with Processing Long-Tailed Social Media Data. Executing on a Hadoop Cluster (Amazon EC2)	9

Text Books:
1. Social Media Data Mining and Analytics by Gabor Szabo,Gungor Polatkan Oscar Boykin,Antonios Chalkiopoulos Published byJohn Wiley & Sons, IncISBN: 978-1-118-82485-6.
2. Social media analytics by Matthews's ganis, avinash kohirkar.
Reference Books:
1.Social Media Analytics By Matthew Ganis Avinash Kohirkar IBM Press Pearson plc ISBN-13: 978-0-13-389256-7

Syllabus
Semester-V

Course Code: MDI41MEP301 **Course Name:** Practical Based on Sentiment Analysis **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L-0, P-2 **Evaluation Scheme:**CA-30, ESE-20
Pre-requisites: Basics of Data Analysis
Course Objectives:
This course is an introduction to Sentiment Analysis, with topics covered including relevant aspects of machine learning and Natural Language Processing.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand the Data Analysis process
CO2: Establish an understanding of concepts and theories of Sentiment Analysis.
CO3: Understanding the types of Sentiment Analysis
CO4: Understanding Sentiment Analysis how to implement Opinion Analysis
CO5: Implement Aspect based sentiment analysis

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Installation of R Programing and Configuration	2
2	Installation of R Studio and configuration	2
3	Loading Sentiment Analysis Packages	2
4	Social media monitoring.	2
5	Customer support ticket analysis	2
6	Brand monitoring and reputation management.	2
7	Amazon Product analysis	2
8	Amazon Product Reviews	2
9	Analyze IMDb Reviews	2
10	Twitter Sentiment Analysis	2
11	Project	10

Text Books:
1. Bing Liu Sentiment Analysis and Opinion Mining Morgan &Claypool Publishers, May 2012.
Reference Books:
1. Bo Pang and Lillian Lee Opinion mining and sentiment analysis.

Syllabus
Semester-V

Course Code: MDI41MEP302 **Course Name:** Practical Based on Social Media Mining **Course Category:** Major Mandatory Elective
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme:**CA-30,ESE-20
Pre-requisites: Basic knowledge of Data Analytics
Course Objectives:
Understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics.
Course Outcomes: At the end of the course, the students will be able to -
CO1: To know the Users on social media
CO2: Understand the Social Media Networks
CO3: Social Media Configurations
CO4: Content on social media
CO5: Apply Social media tools on Processing Large Datasets

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Data Collection and API Access Set up API access (e.g., Twitter API) for social media data. Retrieve tweets or posts related to a specific hashtag or topic.	2
2	Data Cleaning and Preprocessing Clean and preprocess the collected social media data. Handle missing values, remove duplicates, and format text data.	2
3	Sentiment Analysis Perform sentiment analysis on social media text. Classify tweets or posts as positive, negative, or neutral.	2
4	Trend Analysis Identify trending topics or hashtags. Analyze the frequency and changes in usage over time.	2
5	Network Analysis Build a network graph based on social media connections (e.g., retweets, mentions). Analyze network properties and identify influential users.	2
6	Hashtag Analysis Analyze the usage and popularity of specific hashtags. Visualize the relationships between hashtags.	2
7	User Engagement Metrics Calculate engagement metrics (likes, shares, comments) for social media posts. Identify highly engaging content.	2
8	Geographic Analysis Extract location information from social media data. Visualize the geographic distribution of posts.	2
9	Social Media Analytics Dashboard Create a simple dashboard using tools like Tableau or Power BI. Display key metrics and visualizations for social media data.	2
10	Predictive Analytics Build a predictive model to forecast social media engagement.	2

	Use historical data to predict future trends.	
11	Project	10

Reference Book:
1. Social Media Data Miningand Analytics by Gabor Szabo, Gungor PolatkanOscar Boykin,Antonios Chalkiopoulos Published byJohn Wiley & Sons, IncISBN: 978-1-118-82485-6
2. Social Media Analytics By Matthew Ganis Avinash Kohirkar IBM Press Pearson plc ISBN-13: 978-0-13-389256-7

Syllabus
Semester-V

Course code: MDI41VSP301 **Course name:** User Interface and User Experience Design **Course category:** Vocational Skill Course
Credits: 2 **Teaching Scheme:** L-0 P-2 **Evaluation Scheme:** CA-30 ESE-20
Pre-requisites: Basic Knowledge of Graphic Design.
Course Objectives:
Create Empathy map, User Persona and journey map for user research design user friendly simple, functional website And Mobile Apps.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Create empathy map for understanding user requirements
CO2: Design user persona and journey map for product information.
CO3: Draw information architecture and wireframe for organizing and presenting information.
CO4: Design mobile app screen.

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Write five features of any mobile app.	2
2	Design Empathy map for Coffee shop app.	2
3	Write User Persona for Designing E-Commerce Website.	2
4	Write Journey Map for Traveling app.	2
5	Create research document using card sorting method.	2
6	Create research document using interview, survey method.	2
7	Create wireframe structure for Music app.	2
8	Create Information Architecture for E-Commerce Website.	2
9	Draw flow diagram for any mobile app.	2
10	Draw sitemap for Educational website.	2
11	Design Landing Page design for website.	2
12	Design Responsive layout for an social media app.	2
13	Design mobile app screens for educational website.	2
14	Design animated screens for app journey information.	2

15	Design animated slideshow for app features.	2
16	Create a reusable icon grid.	2
17	Create a responsive card with auto layout and constraints.	2
18	Design an onboarding flow with advanced prototyping.	2
19	Create a prototype with custom animations with micro interaction.	2
20	Design text animation for app feature.	2
21	Project.	20

Text Book:

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler, Second Edition New Riders publication.
2. The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Wilbert O. Galitz, third edition WILEY publication.
3. Design Thinking for Dummies by Christian Muller-Roterberg , Wiley publication.

Reference Books:

1. The UX Design Field Book, Doug Collins, 2022.
2. UI/UX Design Basics and Fundamentals, John RICHARDS, Independently Published, 2018

Semester: SIXTH

Syllabus
Semester-VI

Course Code: MDI41MML304 **Course Name:** Cloud Computing **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:** L-2 P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basic Knowledge of networking & Operating system
Course Objectives:
Understanding basics of cloud computing and Key concepts of Cloud Analytics and different cloud computing services.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand Cloud Computing Basics.
CO2: Understand the use of Cloud Computing in Data Analytics.
CO3: Learn the Concept of Cloud Infrastructure.
CO4: Understand Business imperative of Cloud Computing.

Contents –

Unit	Content	Teaching hours
1	**Introduction to Cloud computing:**-Evolution of computing paradigms, Concept of cloud, Introduction to virtualization and virtual machine, Virtualization in fabric/cluster/grid context, Virtual network, Information model & data model for virtual machine, Service Oriented Architecture, On Demand Computing, Web services: SOAP versus REST.	6
2	**Cloud Computing Technologies:-** Introduction to Cloud Computing, Cloud Architecture and Cloud Storage, Characteristics of cloud computing, Components and Organizational scenarios of clouds, Administering and Monitoring cloud services, Benefits and Limitations of cloud computing, Deploy application over cloud: Cloud computing technology, Accessing the cloud, Cloud Applications, Migrating to the Cloud, Software Licenses, Cloud Cost Model, Service Levels for Cloud Applications.	8
3	**Web Services and Platforms:-** Service Models, Software-as-a-Service, Platform-as-a-Service, Infrastructure -as-a-Service, Process-as-a-Service, Application-as-a-Service, Storage-as-a-Service, Information-as-a-Service, Integration-as-a-Service, Security-as-a-Service, Management/Governance-as-a-Service, Testing-as-a-Service, Comparison among IAAS, PAAS, SAAS Cloud computing platforms	8
4	**Cloud Disaster Management:-** Cloud Disaster Management, Disaster Recovery, Disaster Recovery Planning, Benefits of a cloud Disaster Recovery service, Disaster Recovery as a Cloud Service, Cloud data Centers, Comparing approaches	8

Text Books:
1. Cloud Computing Dr.Pandey U.S. & Dr. Chaudhary KavitaS. Chand Publishing.
2. Cloud Computing Miller Pearson Education India.
Reference Books:
1. Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud Mark Wilkins-First Edition.
2. ”Handbook of cloud computing” by Borko Furht, Armando Escalante published by springer(2010)

Syllabus
Semester-VI

Course Code:MDI41MML305 **Course Name:** Business Intelligence **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:**L-2 P-0 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Introduction to Analytics techniques.
Course Objectives:
This course provides an introduction to the concepts of business intelligence (BI) as components and functionality of information systems.
Course Outcomes: At the end of the course, the students will be able to -
CO1: To learn organization's business operations through the use of relevant data.
CO2: It explores how business problems can be solved effectively by using operational data to create data warehouses
CO3: Applying data mining tools and analytics to gain new insights into organizational operations.
CO4: Understand decision support systems and knowledge management systems

Contents –

Unit	Content	Teaching hours
1	**Business intelligence:** Effective and timely decisions, Data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence Decision support systems: Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system.	6
2	**Mathematical models for decision making:** Structure of mathematical models, Development of a model, Classes of models Data mining: Definition of data mining, Representation of input data , Data mining process, Analysis methodologies Data preparation: Data validation, Data transformation, Data reduction.	8
3	**Classification:** Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression, Neural networks, Support vector machines Clustering: Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models.	8
4	**Business intelligence applications:** Marketing models: Relational marketing, Sales force management, Logistic and production models: Supply chain optimization, Optimization models for logistics planning, Revenue management systems. Data envelopment analysis: Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices.	8

Text Books:
1. Carlo Vercellis Business Intelligence: Data Mining and Optimization for Decision Making Wiley 2009
Reference Books:
1. Efraim Turban, Ramesh Sharda, Dursun Delen Decision support and Business Intelligence Systems Pearson

Syllabus
Semester-VI

Course Code: MDI41MML306 **Course Name:** Cyber Security **Course Category:** Major Mandatory
Credits: 2 **Teaching Scheme:**L-2, P-0 **Evaluation Scheme:**CA-30,ESE-20
Pre-requisites: Basic Computer Skills and Data Communication Networking.
Course Objectives:
Understand principles of web security and Cyber Security techniques, Guidelines, configurations, and use of secure web based applications.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Analyze and evaluate the cyber security types and their needs of an organization
CO2: Determine and use of Cyber Security Techniques
CO3: Understand the Guidelines and configurations of Cyber Security.
CO4: Apply the Security measures using Internet based application

Contents –

Unit	Content	Teaching hours
1	**Introduction to Internet:** History of Internet, Internet Addresses, Domain Name System, Internet Infrastructure, World Wide Web. **Introduction To Cyber Crime:** Classification of Cyber Crimes, Reasons for Commission of Cyber Crimes, Malware And Its Type, Kinds Of Cyber Crime.	6
2	**Cyber Security Techniques:** Authentication, Encryption, Digital Signatures, Antivirus, Firewall, And Steganography, Investigating Cyber Crimes: Introduction, To Cyber Forensic, Computer Forensics, Why Should We Report Cyber Crime, Cyber Security Attacks, Introduction, Cyber Crime Incidents, Cyber Security Initiatives In India, Introduction, And Counter Cyber Security Initiatives In India.	8
3	**Guidelines of Cyber Security:** Guidelines For Secure Password, Two Step Verification And Using Free Antivirus, Generating Secure Password, Using Password Manager, Enabling Two-Step Verification, Securing Computer Using Free Antivirus. **Configuration:** Configuring Firewall On Mac Computer, Working With Windows Firewall In Windows, Choosing Best Browser To Suit Your Requirements, Guidelines For Safe Internet Browsing, Safe Browsing, Tips For Buying Online, Clearing Cache For Browsers.	8
4	**Wireless Security:** Wireless Security, What is Wireless LAN, Major Issues With WLAN, Email And Social Media Security, Safe Browsing Guidelines For Social Networking Sites, Email Security Tips, Smartphone Security, Smartphone Security Guidelines.	8

Text Books:
1. Introduction to Cyber Security by Dr. Jeetendra PandeISBN: 978-93-84813-96-3Published By: Uttarakhand Open University
Reference Books:
1. Cyber SecurityEssentials Edited byJames Graham, Richard Howard,Ryan Olson CRC Publication ISBN-13: 978-1-4398-5126-5 (Ebook-PDF).
2. Everyday Cybersecurity by Christopher K. CoxeBook ISBN-13: 978-1-7330186-1-6.

Syllabus
Semester-VI

Course Code:MDI41MMP303 **Course Name:** Practical Based on Cloud Computing **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**:CA-30,ESE-20
Pre-requisites: Basic Knowledge of networking & Operating system.
Course Objectives:
Understanding basics of cloud computing and Key concepts of Cloud Analytics and different cloud computing services.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand Cloud Computing Basics.
CO2: Understand the use of Cloud Computing in Data Analytics.
CO3: Learn the Concept of Cloud Infrastructure.
CO4: Understand Business imperative of Cloud Computing.
CO5: Learn Cloud computing Security Components.

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Install Virtual box/VMware Workstation with different flavors of Linux or windows Operating System.	2
2	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.	2
3	Install Google App Engine. Create hello world app and other simple web applications using python/java..	2
4	Use Google App Engine launcher to launch the web applications.	2
5	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.	2
6	Find a procedure to transfer the Text files from one virtual machine to another virtual machine..	2
7	Find a procedure to transfer the Image files from one virtual machine to another virtual machine.	2
8	Find a procedure to transfer the Video files from one virtual machine to another virtual machine.	2
9	Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)	2
10	Install Hadoop single node cluster and run simple applications like wordcount.	2
11	Project.	10

Reference Books :

1. Cloud Computing Dr.Pandey U.S. & Dr. Chaudhary Kavita S. Chand Publishing.
2. Cloud Computing Miller Pearson Education India.
3. Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud Mark Wilkins-First Edition.

Syllabus
Semester-VI

Course Code:MDI41MMP304 **Course Name:** Practical Based on Business Intelligence **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**:CA-30,ESE-20
Pre-requisites: Basics of Data Analytics.
Course Objectives:
This course provides an introduction to the concepts of business intelligence (BI) as components and functionality of information systems.
Course Outcomes: At the end of the course, the students will be able to -
CO1: To learn organization's business operations through the use of relevant data.
CO2: It explores how business problems can be solved effectively by using operational data to create data warehouses
CO3: Applying data mining tools and analytics to gain new insights into organizational operations.
CO4: Understand decision support systems and knowledge management systems

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Import the legacy data from different sources such as (Excel , SqlServer, Oracle etc.) and load in the target system. (You can download sample database such as Adventureworks, Northwind, foodmart etc.)	2
2	Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver.	2
3	Create the Data staging area for the selected database.	2
4	Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model.	2
5	Create the ETL map and setup the schedule for execution.	2
6	Execute the MDX queries to extract the data from the datawarehouse.	2
7	Import the datawarehouse data in Microsoft Excel and create the Pivot table and Pivot Chart.	2
8	Import the cube in Microsoft Excel and create the Pivot table and Pivot Chart to perform data analysis	2
9	Apply the what – if Analysis for data visualization. Design and generate necessary reports based on the data warehouse data.	2
10	Perform the data classification using classification algorithm.	2
11	Project	10

Text Books:
1. Carlo Vercellis Business Intelligence: Data Mining and Optimization for Decision Making Wiley
Reference Books:
1. Efraim Turban, Ramesh Sharda, Dursun Delen Decision support and Business Intelligence Systems Pearson

Syllabus
Semester-VI

Course Code: MDI41MEL303 **Course Name:** Big Data **Course Category:** Major Mandatory Elective
Credits: 3 **Teaching Scheme:**L-3, P-0 **Evaluation Scheme:**CA-60,ESE-40
Pre-requisites: Basic knowledge of Data science concepts and applications.
Course Objectives:
Understand the Big data platform and its use cases.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Identify Big Data and its Business Implications.
CO2: List the components of Hadoop and Hadoop Eco-System
CO3: Access and Process Data on Distributed File System
CO4: Solve ordinary differential equations analytically and numerically and apply these methods to solve engineering problems.
CO5: Manage Job Execution in Hadoop Environment

Contents –

Unit	Content	Teaching hours
1	**Introduction to Big Data**-Data, Data Storage and Analysis, Comparison with Other Systems, RDBMS, Grid Computing, Volunteer Computing, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem	9
2	**MapReduce**-A Weather Dataset, Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Map and Reduce, Java MapReduce Scaling Out, Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming, Ruby, Python, Hadoop Pipes, Compiling and Running	9
3	**The Hadoop Distributed Filesystem:-** The Design of HDFS,HDFS Concepts, Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, Failover and fencing, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems, Interfaces, HTTP, FUSE, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, FSDataInputStream, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow, Coherency Model, Parallel Copying with distcp, Keeping an HDFS Cluster Balanced.	9
4	**Hadoop I/O:-** Data Integrity, Compression, Serialization, Writable Classes, Serialization Frameworks, File-Based Data Structures, MapFile	9
5	**Developing a MapReduce Application:-** The Configuration API, Configuring the Development Environment, Writing a Unit Test, Writing a Unit Test, Testing the Driver, Running on a Cluster, Running on a Cluster, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Remote Debugging, Tuning a Job, Profiling Tasks, MapReduce Workflows	9

Text Books:

1. Hadoop: The Definitive Guide Tom WhiteO'reily Media, Third Edit on, 2012.
2. Big Data AnalyticsSeema Acharya, Subhasini Chellappan, Wiley 2015.

Reference Books:

1. "Big Data and Business Analytics" Jay Liebowitz Auerbach Publications, CRC press (2013). 2. "Big data principles and paradigms",edited by rajkumar buyya,Rodrigo N. calheiros, Amir Vahid Dastjerdi in 2016.

Syllabus
Semester-VI

Course Code: MDI41MEL304 **Course Name:** Data Visualization
Course Category: Major Mandatory Elective
Credits: 3 **Teaching Scheme:**L-3, P-0 **Evaluation Scheme:**CA-60,ESE-40
Pre-requisites: Foundation of Data and their application areas.
Course Objectives:
Understand the fundamental design techniques and different types of data visualization.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Basics concepts of data visualization
CO2: Understand appropriate Processing Development Environment for given data
CO3: Select Understand the time series data visualization
CO4: Design Data Connections and Correlations
CO5: Apply Data visualizations Scatterplot Maps

Contents –

Unit	Content	Teaching hours
1	**Introduction to Data Visualization:** The Seven Stages of Visualizing Data, Data Display Requires Planning, Data Collection, About Data, Data Never Stays the Same, What Is the Question, A Combination of Many Disciplines, Process, Question Framing process: Acquire, Parse, Filter, Mine, Represent, Refine, Interact, Iteration and Combination, Principles, Unique Requirements.	9
2	**Processing Development Environment**: Sketching with Processing, Exporting and Distributing Data Work, Loading and Displaying Data, Functions, Libraries Add New Features, Sketching and Scripting, Build a Cathedral.Mapping: Drawing a Map, Explanation of the Processing Code, Locations on a Map, Data on a Map, Two-Sided Data Ranges, Information with a Mouse Rollover, Updating Values over Time, Smooth Interpolation of Values over Time, Using Your Own Data, Taking Data from the User	9
3	**Time Series:** Acquire and Parse, Cleaning the Table, A Simple Plot, Labeling the Current Data Set, Drawing Axis Labels, Year Labels, Labeling Volume on the Vertical Axis, Bringing It All Together and Titling Both Axes, Choosing a Proper Representation, Using Rollovers to Highlight Points, Ways to Connect Points, Showing Data As an Area, Further Refinements and Erasing Elements, Discrete Values with a Bar Chart, Text Labels As Tabbed Panes, Adding the Necessary Variables, Drawing Tabs Instead of a Single Title, Handling Mouse Input, Better Tab Images, Interpolation Between Data Sets, End of the Series,	9
4	**Connections and Correlations:** Changing Data Sources, Problem Statement, Preprocessing, Retrieving Win/Loss Data, Unpacking the Win/Loss files, Retrieving Team Logos, Retrieving Salary Data, Using the Preprocessed Data, Finishing the Setup, Displaying the Results, Highlighting the Lines, A Better Typeface for Numeric Data, Typography, Sophisticated Sorting, Moving to Multiple Days, Drawing the Dates, Switching Between Dates, Checking Our Progress, Deployment Considerations	9
5	**Scatterplot Maps:** Preprocessing, Data from the U.S., Dealing with the Zip Code Database File, Building the Preprocessor, Loading the Data, Drawing a Scatterplot of Zip Codes, Highlighting Points While Typing, Show the Currently Selected Point, Progressively Dimming and Brightening Points, Zooming In, Changing How Points Are Drawn When Zooming, Deployment Issues	9

Text Books:
1. Visualizing Data by Ben Fry First Edition O'Reilly Media, Inc. ISBN-10: 0-596-51455-7.
Reference Books:
1. Data Visualization: Exploring and Explaining with Data with MindTap, by Jeffrey D. Camm/James J Cochran/Michael J. Fry/Jeffrey W. Ohlmann (Author) 1st Edition ISBN- 9355733976.
2. Data Visualization: Storytelling Using Data by Sharada Sringeswara; Purvi Tiwari; U. Dinesh Kumar ISBN-9354643132.

Syllabus
Semester-VI

Course Code:MDI41MEP303 **Course Name:** Practical Based on Big Data **Course Category:** Major Mandatory Elective
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme:**CA-30,ESE-20
Pre-requisites: Data science concepts and applications.
Course Objectives:
Understand the Big Data Platform and its Use cases.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Identify Big Data and its Business Implications.
CO2: List the components of Hadoop and Hadoop Eco-System
CO3: Access and Process Data on Distributed File System
CO4: Manage Job Execution in Hadoop Environment
CO5: Developing MapReduce Application

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Install and Configure Apache Hadoop.	2
2	Write Script for MapReduce program to calculate the frequency of a given word in a given file.	2
3	Write Script for MapReduce program to find the maximum temperature in each year.	2
4	Write Script for MapReduce program to find the grades of student's.	2
5	Write Script for MapReduce program to implement Matrix Multiplication.	2
6	Write Script for MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.	2
7	Write Script for MapReduce to analyze weather data set and print whether the day is shinny or cool day.	2
8	Write Script for MapReduce program to find the number of products sold in each country by considering sales data containing fields like.	2
9	Tranction _Date Prod uct Pri ce Payment _Type Na me Ci ty St ate Cou ntry Account_ Created Last_L ogin Latit ude Longi tude.	2
10	Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data.	2
11	Project	10

Text Books:
1. Hadoop: The Definitive Guide Tom WhiteO'reily Media, Third Edit on, 2012.
2. Big Data Analytics Seema Acharya, Subhasini Chellappan,Wiley 2015.
Reference Books:
1. "Big Data and Business Analytics" Jay LiebowitzAuerbach Publications, CRC press (2013).

Syllabus
Semester-VI

Course Code:MDI41MEP304 **Course Name:** Practical Based on Data Visualization **Course Category:** Major Mandatory Elective
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme:**CA-30,ESE-20
Pre-requisites: Foundation of Data and their application areas.
Course Objectives:
Understand the fundamental design techniques and different types of data visualization.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Basics concepts of data visualization.
CO2: Understand appropriate Processing Development Environment for given data.
CO3: Select Understand the time series data visualization.
CO4: Design Data Connections and Correlations.
CO5: Apply Data visualizations Scatterplot Maps.

Contents -

Sr.no.	Description of Practical	Practical Hours
1	Write a code for compare values to find the minimum and maximum Mining using data mining approach.	2
2	Write a code for Basic visual representation of zip code data, Using color to refine the representation.	2
3	Write a code for Sketching with Processing and Exporting and Distribution of data and visualize it.	2
4	Write a code for Loading and Displaying Data and Libraries also Add New Features for effective data visualization.	2
5	Write a code for Sketching and Scripting and Process data and Draw a Map.	2
6	Write a code for representation of Locations on a Map and Data on a Map with Two-Sided Data Ranges and Mouse Rolloverwith Updating Values over Time.	2
7	Create and Cleaning the TableA Simple Plot	2
8	Write a code for Labeling the Current Data SetDrawing Axis and select a Proper Representation labels for data visualization.	2
9	Write a code for Retrieving and Unpacking Win/Loss Data, Retrieving Team Logos using Web scraping and visualize the output.	2
10	Write a code for Loading the Data from the U.S. Census Bureau and Drawing a Scatterplot of Zip Codes.	2
11	Project	10

Text Books:

1. Visualizing Data by Ben Fry First Edition O'Reilly Media, Inc. ISBN-10: 0-596-51455-7.

Reference Books:

1.Data Visualization: Exploring and Explaining with Data with MindTap, by Jeffrey D. Camm/James J Cochran/Michael J. Fry/Jeffrey W. Ohlmann (Author) 1st Edition ISBN- 9355733976

2.Data Visualization: Storytelling Using Data by Sharada Sringeswara; Purvi Tiwari; U. Dinesh Kumar ISBN-9354643132.

Semester: Seven

Syllabus
Semester-VII

Course Code: MDI41MML401 **Course Name:** Neural Networks Course Category: Major Mandatory
Credits: 3 Teaching Scheme:L-3 P-0 Evaluation Scheme: CA-60, ESE-40
Pre-requisites: Basic knowledge of Mathematics, Understanding of Probability and Statistics, Fundamentals of Programming, Basic concepts of Data Structures and Algorithms.
Course Objectives: To introduce fundamental concepts of neural networks and learning paradigms To understand different neural network architectures and training algorithms To apply neural networks for real-world data science problems To develop analytical and implementation skills in neural computing.
Course Outcomes: At the end of the course, the students will be able to –
CO1: Explain the fundamental concepts of artificial neural networks.
CO2: Distinguish between different neural network architectures and learning paradigms.
CO3: Design and develop single-layer and multi-layer neural network models for data science problems.
CO4: Apply appropriate learning algorithms and evaluate neural network performance using suitable metrics.
CO5: Analyze and apply neural network techniques to solve real-world classification and prediction problems.

Course Contents –

Unit	Content	Teaching hours
1	**Introduction to Neural Networks:** Biological neurons and brain-inspired computing, Structure and functioning of biological neuron, Artificial neuron model, Components of artificial neuron, Types of neural networks, Feedforward and feedback networks, Activation functions: step, sigmoid, tanh, ReLU, Learning paradigms: supervised, unsupervised, reinforcement, Historical development of neural networks, Applications of neural networks	9
2	**Single Layer Neural Networks** Perceptron model, Mathematical formulation of perceptron, Perceptron learning algorithm, Convergence of perceptron algorithm, Adaline model, Madaline model, Delta learning rule, Linear separability, Limitations of single-layer networks, Applications of single-layer neural networks	9
3	**Multilayer Neural Networks** Multilayer perceptron (MLP) architecture, Forward propagation, Backpropagation algorithm, Gradient descent learning, Error surfaces, Convergence issues, Overfitting and underfitting, Regularization techniques, Performance evaluation metrics.	9

4	**Advanced Neural Network Models** Radial Basis Function (RBF) networks, Structure and training of RBF networks, Self-Organizing Maps (SOM), Competitive learning, Hopfield networks, Energy function, Boltzmann machines, Stochastic learning, Recurrent Neural Networks (RNN), Feedback connections	9
5	**Deep Learning and Applications** Introduction to deep learning, Deep neural network architectures, Convolutional Neural Networks (CNN), Convolution and pooling operations, Long Short-Term Memory (LSTM) networks, Gated mechanisms, Autoencoders, Dimensionality reduction, Applications in data science.	9

Text Books: Simon Haykin, Neural Networks and Learning Machines, Pearson B. Yegnanarayana, Artificial Neural Networks, PHI
Reference Books: 1. Marting T. Hagan et al., Neural Network Design, 2nd edition. 2. Ian Goodfellow et al., Deep Learning, MIT Press 3. S. Rajasekaran, G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-VII

Course Code: MDI41MML402 **Course Name:** Data Analytics **Course Category:** Major Mandatory
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40
Pre-requisites: Students must have to basic knowledge about programming and data understanding
Course Objectives: To equip students with the technical skills required to collect, clean, analyze, and visualize data using the Python ecosystem for evidence-based decision-making.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand and explain the comprehensive data analysis process, distinguishing between quantitative and qualitative data
CO2: Apply Python syntax and the NumPy library to perform high-performance numerical computations
CO3: Utilize Pandas data structures to ingest, organize, and manage data from diverse sources such as CSVs, Excel files, JSON
CO4: Analyze and Transform raw datasets by applying advanced techniques
CO5: Create professional-grade visualizations using Matplotlib and Seaborn to interpret data trends and present findings visually

Course Contents –

Unit	Content	Teaching hours
1	**Introduction to Data Analysis:** Data Analysis, Knowledge Domains of the Data Analyst, Computer Science, Mathematics and statistics, Machine Learning and Artificial Intelligence, Professional fields of Application, Understanding the Nature of the Data, The Data Analysis Process, Quantitative and Qualitative Data Analysis, Open Data, Python and Data Analysis	9
2	**Introduction to the Python:** Python the Programming Language, The Interpreter and the execution phases of the code, Installing Python, Python Distributions, Ipython, PyPI the Python Package Index, SciPy, NumPy, Pandas, Matplotlib, **NumPy Library:** NumPy Installation, ndarray, Basic Operations, Indexing, Slicing and Iterating, Conditions and Boolean Arrays, Shape Manipulations, Array Manipulations, General Concepts, Structured Arrays, Reading and Writing Array Data on Files	9
3	**The Pandas Library**: Installations of Pandas, Introduction to Pandas Data Structure, Operations between Data Structures, Function application and Mapping, Sorting and Ranking, Correlation and Covariance, Hierarchical Indexing and leveling **Pandas:** Reading and Writing Data, I/O API Tools, CSV and textual Files, Reading Data in CSV or text files, Reading and writing HTML Files, Reading Data from XML, Reading and writing data on Microsoft excel	9

	files , JSON Data Interacting with Databases, Reading and writing data with NoSQL Databases: MangoDB.	
4	**Pandas in Depth: Data Manipulation:** Data Preparation, Concatenating, Data Transformation, Discretization and Binning, Permutation, String Manipulations, Data Aggregation, Group Iteration, Advanced Data Aggregation	9
5	**Data Visualization with matplotlib and seaborn:** The matplotlib Library, The matplolt Architecture, pyplot, Data Visualization with Jupyter Notebook, Using kwargs, Adding Elements to the chart, Handling Data Values, Chart typology: Line Charts, Bar Charts, Pie Charts, Advanced Charts, The mplot3d Toolkit, Multipanel Plots, The Seaborn	9

Text Books: Python Data Analytics by Fabio Nelli ISBN 9798868800993 Third Edition
Reference Books: Data Analytics by Anil Maheshwari ISBN-9352604180 2nd Edition
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-VII

Course Code: MDI41MML403 **Course Name:** Compiler Design **Course Category:** Major Mandatory
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40
Pre-requisites: Basic knowledge of programming concepts, data structures, automata theory fundamentals, and formal languages is required to understand this course.
Course Objectives: The objective of this course is to introduce students to the fundamental concepts and phases of compiler design, enabling them to understand how high-level programs are translated into machine-level code, with emphasis on lexical analysis, syntax analysis, semantic analysis, intermediate code generation, basic optimization techniques, and code generation, thereby providing a strong foundation for understanding language processing systems.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand the basic concepts, structure, and phases involved in compiler design and language processing systems.
CO2: Apply lexical analysis techniques to identify tokens using regular expressions and finite automata.
CO3: Analyze programming language syntax using context-free grammars and basic parsing techniques.
CO4: Explain semantic analysis concepts, symbol table management, and intermediate code generation methods.
CO5: Describe basic code generation, optimization concepts, and runtime environment of a compiler.

Course Contents –

Unit	Content	Teaching hours
1	**Introduction to Compiler Design:** Introduction to Programming Languages, Need for Compilers, Compiler vs Interpreter, Language Processing System, Structure of a Compiler, Phases of a Compiler (Overview), Errors in Compilation, Overview of Compiler Tools, Simple Compilation Process Example	9
2	**Lexical Analysis:** Role of Lexical Analyzer, Tokens, Lexemes, and Patterns, Regular Expressions, Finite Automata (Basic Concepts), Conversion of RE to FA (Overview), Design of Lexical Analyzer, Input Buffering, Lexical Errors, Lexical Analyzer Generator (Introduction to LEX)	9
3	**Syntax Analysis:** Role of Syntax Analyzer, Context-Free Grammars, Derivation and Parse Trees, Ambiguity in Grammar, Top-Down Parsing (Overview), Recursive Descent Parsing, Predictive Parsing (LL(1) Basics), Bottom-Up Parsing (Introduction), Syntax Error Handling	9
4	**Semantic Analysis & Intermediate Code**: Introduction to Semantic Analysis, Syntax-Directed Translation (Basics), Symbol Tables, Data Types and Type Checking, Type Conversion, Introduction to	9

	Intermediate Code, Three-Address Code, Simple Code Generation Examples, Semantic Error Handling	
5	**Code Generation & Optimization Basics:** Introduction to Code Generation, Target Machine Overview, Basic Code Generation Techniques, Introduction to Optimization, Types of Code Optimization, Basic Block Concept, Simple Optimization Techniques, Runtime Environment (Basics), Overview of Compiler Construction	9

Text Books: Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques, and Tools (2nd Edition), Pearson Education
Reference Books: Kenneth C. Louden, Compiler Construction– Principles and Practice, 1st edition, PWS Publishing.
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-VII

Course Code: MDI41MEL401 **Course Name:** Software Project Management **Course Category:** Major Elective
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40
Pre-requisites: Basic knowledge of programming concepts, fundamentals of databases and computer systems.
Course Objectives: This course aims to provide a comprehensive understanding of software project management principles and practices, enabling students to plan, estimate, evaluate, schedule, monitor, and control software projects effectively, helping students develop the managerial and decision-making skills required for successful execution of software projects.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand the fundamentals of software project management, software project characteristics, and requirement specification techniques.
CO2: Apply stepwise project planning methods, select suitable software process models, and choose appropriate technologies and tools for software development.
CO3: Analyze and estimate software project effort, cost, and schedule using techniques such as Function Point Analysis and the COCOMO model.
CO4: Perform project evaluation, activity planning, scheduling, and risk management using tools like cost–benefit analysis, critical path method, and PERT.
CO5: Implement effective resource allocation, project monitoring, and control strategies to track progress, manage costs, and ensure successful project completion.

Course Contents –

Unit	Content	Teaching hours
1	**Introduction to Software Project Management:** Software project versus other types of project, Problems, Requirement specifications. Introduction to step wise project planning, Choosing technologies - technical plan contents list - choice of process models - structured methods - rapid application development -waterfall model - spiral model - software prototyping - ways of categorizing prototypes - tools - incremental delivery	9
2	**Project evaluation:** Introduction to Strategic assessment technical assessment - cost benefit analysis - cash flow forecasting cost benefit evaluation techniques - risk evaluation.	9
3	**Software Efforts estimation:** Introduction, where estimates done, problems with over and under estimates done, basics for software estimating, estimation techniques, function point analysis, COCOMO model.	9
4	**Activity Planning:** Objectives, project schedule, projects and activities, sequence and schedule, adding time dimension, identifying the critical path.	9

	Risk Management: Risk, category of risk, frame work for dealing with risk, risk identification, risk assessment, risk planning, risk management, PERT Technique.	
5	**Resource Allocation:** Nature of resources, identifying resource requirement, scheduling resources, counting the cost, scheduling sequence. **Project Monitoring and control:** Framework creation, data collection, visualizing progress, monitoring of cost and prioritizing.	9

Text Books: Software project management : Bob Hughes and Mike Cotterell - - Fourth edition McGraw Hill
Reference Books: Software Project Management : Walker Royce - - Addison Wesley
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-VII

Course Code: MDI41MEL402 **Course Name:** Internet of things **Course Category:** Major Elective
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40
Pre-requisites: Basics of Computer Networks, Fundamentals of Data Science, Basic understanding of Databases
Course Objectives: To understand the fundamentals and architecture of IoT systems To learn IoT sensing, communication, and middleware technologies To analyze and manage large-scale IoT data streams To apply data analytics and machine learning techniques on IoT data To design and implement IoT-based data-driven applications
Course Outcomes: At the end of the course, the students will be able to -
CO1: Explain IoT concepts, architectures, and enabling technologies
CO2: Design IoT systems using sensors, actuators, and communication protocols
CO3: Collect, store, and preprocess IoT data efficiently
CO4: Apply data analytics and machine learning techniques to IoT data
CO5: Develop real-time IoT applications using cloud and edge platforms & Address security, privacy, and ethical issues in IoT systems

Course Contents –

Unit	Content	Teaching hours
1	**Introduction to Internet of Things: Preliminaries, Motivation, and Related Work** *:* What is the Internet of Things , Wireless Ad-hoc and Sensor Networks: The Ancestors without IP, IoT-enabled Applications , Home and Building Automation, Smart Cities, Smart Grids *4,* Industrial IoT, Smart Farming. **Standards:** Physical/Link Layer *10*, IEEE 802.3 (Ethernet), IEEE 802.11, Network Layer, IPv6 and IPv4, Transport Layer, TCP and UDP, Application Layer , HTTP, AMQP, SIP, Designing the Architecture of an IP-based Internet of Things, Physical/Link Layer, IEEE 802.15.and ZigBee, Low-power Wi-Fi, Bluetooth and BLE, Powerline Communications, Network Layer, The 6LoWPAN Adaptation Layer, Transport Layer, Application Layer, CoAP, CoSIP Protocol Specification, The Industrial IoT.	9
2	**Sensors, Devices, and Interoperability:** Applications in the IoT, The Verticals: Cloud-based Solutions, REST Architectures: TheWeb of Things, The Web as a Platform, Resource-oriented Architectures, Representation of Resources, Resource Identifiers, Messaging Queues and Publish/Subscribe, Communications, Advantages & Disadvantages of the Pub/Sub Model. Session Initiation for the IoT, Motivations , Lightweight Sessions in the IoT, A Protocol for Constrained Session Initiation, Session Initiation, Session Tear-down, Session Modification, Performance Evaluation, Implementation, Experimental Results.	9

	Devices: CoRE Interfaces, Sensor, Parameter, Read-only Parameter, Actuator, Data Formats: Media Types for Sensor Markup Language, JSON Representations.	
3	**Discoverability:** Service and Resource Discovery, Local and Large-scale Service Discovery, URI Beacons and the Physical Web, Scalable and Self-configuring Architecture for Service, Discovery in the IoT, IoT Gateway, Proxy Functionality, Service and Resource Discovery, A P2P-based Large-scale Service Discovery Architecture, Distributed Location Service, Distributed Geographic Table, An Architecture for Large-scale Service Discovery based on Peer-to-peer Technologies, Zeroconf-based Local Service Discovery for Constrained Environments Architecture Service Discovery Protocol, Local Service Discovery, Large-scale Service Discovery, Lightweight Service Discovery in Low-power IoT Networks, Efficient Forwarding Protocol for Service Discovery, Multicast through Local Filtered Flooding, Efficient Multiple Unicast Forwarding.	9
4	**Security Issues in the IoT:** Security Mechanisms Overview, Traditional vs Lightweight security, Lightweight Cryptography, Symmetric-key LWC Algorithms, Public-key (Asymmetric) LWC Algorithms, Lightweight Cryptographic Hash Functions, Homomorphic Encryption Schemes, Key Agreement, Distribution, and Security, Bootstrapping, Key Agreement Protocols, Shared Group-key Distribution, Security Bootstrapping, Processing Data in the Encrypted Domain: Secure Data Aggregation, Authorization Mechanisms for Secure IoT Services, Privacy Issues in the IoT, The Role of Authorization, IoT-OAS: Delegation-based Authorization for the Internet of Things, Architecture, Granting Access Tokens, Authorizing Requests, SP-to-IoT-OAS Communication: Protocol Details, Configuration, IoT-OAS Application Scenarios, Network Broker Communication, Gateway-based Communication, End-to-End CoAP Communication, Hybrid Gateway-based Communication.	9
5	**The IoT in Practice:** Hardware for the IoT, Classes of Constrained Devices, Hardware Platforms, TelosB, Zolertia Z1, OpenMote, Arduino, Intel Galileo, Raspberry Pi, Software for the IoT, OpenWSN, TinyOS, FreeRTOS, TI-RTOS, RIOT, Contiki OS, Low-power Operation, Simulation, Programming Model, Vision and Architecture of a Testbed for theWeb of Things. An All-IP-based Infrastructure for Smart Objects, Enabling Interactions with Smart Objects through the IoT Hub, Integration Challenges, Testbed Access and Security, The Role of Authorization, Exploiting the Testbed:WoT Applications for Mobile and Wearable Devices, Open Challenges and Future Vision, Wearable Computing for the IoT: Interaction Patterns with Smart Objects in RESTful Environments, Shaping the Internet ofThings in a Mobile-Centric World, Interaction Patterns with Smart Objects throughWearable Devices, Smart Object Communication Principles, Interaction Patterns, Implementation in a Real-world IoT Testbed, Future Vision: towards the Tactile Internet, Effective Authorization for theWeb ofThings, Authorization Framework Architecture, System Operations, Implementation and Validation.	9

Text Books: Internet of Things Architecture, protocols and standards Simon Cirani, Gianluigi Ferrari, 1) Bahga, A., & Madisetti, V., Internet of Things: A Hands-On Approach, Universities Press 2) Buyya, R., & Dastjerdi, A., Internet of Things: Principles and Paradigms, Morgan Kaufmann
Reference Books: 1) Minerva, R., Biru, A., & Rotondi, D., Towards a Definition of the Internet of Things, IEEE 2) McEwen, A., & Cassimally, H., Designing the Internet of Things, Wiley
Online Resources: 1.NPTEL / SWAYAM lectures. 2. IEEE IoT Journal, 3. AWS, Azure, and Google IoT Documentation

Syllabus

Semester-VII

Course code: MDI41RML401 **Course Name:** Research Methodology **Course Category:** Research Methodology		
Credits: 4	**Teaching Scheme:** L-3 P-0	**Evaluation Scheme:** CA-60 ESE-40
Pre-requisites: Basic understanding of subject fundamentals, elementary statistics, and academic reading and writing skills.		
Course Objectives: To develop an understanding of research methodology principles and techniques applicable to problem identification, analysis		
Course Outcomes: At the end of the course, the students will be able to -		
CO1: To develops the ability to identify research problems and formulate objectives and hypotheses.		
CO2: To familiarizes students with research design, data collection, and analysis techniques relevant to robotics.		
CO3: To enhances skills in technical writing, documentation, and research ethics.		
CO4: Analyze and apply statistical techniques such as data processing, descriptive statistics, correlation, regression, and hypothesis testing to interpret and validate research data.		
CO5: Evaluate research findings and create a structured research report or mini proposal using appropriate referencing styles, ethical practices, and computer-based research tools.		

Contents -

Unit	Contents	Teaching Hours.
1	**Introduction to Research & Research Process:** Meaning of Research, objectives, motivation, and significance of research, Types of research (basic/applied, qualitative/quantitative, conceptual/empirical) Research methods vs. research methodology, Research Approaches, Significance of Research, Scientific method and research ethics, Steps in the research process, Criteria of Good Research, Problems Encountered by Researchers in India, Case Study	12
2	**Research Problem Formulation & Research Design:** Identification and definition of research problems in engineering/robotics (Meaning and sources of research problems, Criteria for selecting a research problem, Defining and formulating research problems), Review of literature and research gap identification, Formulation of objectives and hypotheses, Research design: exploratory, descriptive, experimental, Features of a good research design. Case Study	12
3	**Sampling Design & Data Collection Methods:** Sampling concepts, population, sample, sampling errors , Probability and non-probability sampling techniques (Sample size (basic concept)Types of sampling errors (Sampling error, Non-sampling error, Bias and sources of bias), Methods of data collection: observation, interview, questionnaire, experiments, Selection of appropriate sampling and data collection methods (Nature of research problem, Objectives of the study, Time, cost, and resource constraints, Accuracy and reliability requirements, Relevance to robotics and engineering research), Case Study	12
4	**Data Processing, Analysis & Hypothesis Testing:** Data processing (Editing, coding, classification, tabulation), Descriptive statistics) Measures of central tendency, Measures of dispersion, Correlation and regression, Hypothesis testing (Concepts and Procedure, parametric and non-parametric tests), Interpretation of Statistical results. Case Study	12

5	**Research Reporting:** Interpretation of research results, Research report writing (Structure of research report technical paper, and project report), Referencing styles and bibliography, Plagiarism and ethical issues in research, Role of computers in research (Data analysis tools, Documentation and presentation tools), Preparation of a mini research proposal / report, Case Study	12

Text Books :
Text Books :1.C.R. Kothari — Research Methodology: Methods & Techniques 2.Ranjit Kumar — Research Methodology: A Step-by-Step Guide for Beginners
Reference Books: 1.Garg, B.L., Karadia, R., Agarwal, R., & Agarwal, U.K. — An Introduction to Research Methodology 2.Paul D. Leedy& Jeanne Ellis Ormrod — Practical Research: Planning and Design
Online Resources: 1.Alison – Essentials of Research Methodology

Syllabus

Semester-VII

Course Code: MDI41MMP401 **Course Name:** Practical Based on Neural Networks **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**: CA-30, ESE-20
Pre-requisites: Knowledge of programming in Python, basic data handling and visualization
Course Objectives: • To understand neural network concepts through hands-on implementation. • To design and train neural network models using programming tools. • To analyze learning behavior and performance of neural networks. • To apply neural network models to real-world datasets.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Students will be able to implement neural network components and activation functions in software.
CO2: Students will be able to code and train single-layer neural networks for classification tasks.
CO3: Students will be able to apply and analyze regularization and model evaluation metrics.
CO4: Students will be able to implement advanced neural network models for clustering and sequence data.
CO5: Students will be able to select and justify neural network methods based on dataset and problem type.

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Implementation of an artificial neuron model and study of different activation functions.	2
2	Implementation of the Perceptron learning algorithm for binary classification.	2
3	Implementation of Adaline network using the delta learning rule.	2
4	Demonstration of linear separability and limitations of single-layer neural networks.	2
5	Implementation of Multilayer Perceptron (MLP) using backpropagation for classification.	2
6	Study of overfitting and underfitting in MLP using regularization techniques.	2
7	Implementation of Radial Basis Function (RBF) network for function approximation.	2
8	Implementation of Self-Organizing Map (SOM) for clustering and visualization.	2
9	Implementation of Recurrent Neural Network (RNN) for sequence prediction.	2

10	Implementation of deep learning models such as CNN or LSTM for real-world datasets.	2
11	**Mini Project (Neural Networks):** Design and implement a neural network model using an appropriate architecture (MLP/CNN/LSTM) to solve a real-world problem such as classification, prediction, or pattern recognition, analyze model performance using suitable metrics, and report the results.	10

Reference Book / Hand Books/ Lab Manual
1. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal
2. Deep Learning with Python by François Chollet — practical implementation using Keras/TensorFlow
3. Neural Networks for Pattern Recognition by Christopher M. Bishop

Syllabus

Semester-VII

Course Code: MDI41MMP402 **Course Name:** Practical Based on Data Analytics **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:** L- P-2 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Students must have to basic knowledge about programming and data understanding
Course Objectives: To equip students with the technical skills required to collect, clean, analyze, and visualize data using the Python ecosystem for evidence-based decision-making.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand and explain the comprehensive data analysis process, distinguishing between quantitative and qualitative data
CO2: Apply Python syntax and the NumPy library to perform high-performance numerical computations
CO3: Utilize Pandas data structures to ingest, organize, and manage data from diverse sources such as CSVs, Excel files, JSON
CO4: Analyze and Transform raw datasets by applying advanced techniques
CO5: Create professional-grade visualizations using Matplotlib and Seaborn to interpret data trends and present findings visually

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Create a list of student names and a list of their marks. Store them in a dictionary. Calculate the average marks using a simple loop.	2
2	Create a 1D array of numbers from 1 to 20. Reshape it into a 4x5 matrix (2D array) and print the shape and data type.	2
3	Create an array of 5 product prices and perform mathematical operations on entire datasets at once.	2
4	Create a Pandas DataFrame from a dictionary of 5 employees (ID, Name, Salary). Display the first 3 rows (head) and check column types (info).	2
5	Generate a dummy CSV file using Python, then read it back into a Pandas DataFrame.	2
6	Create a DataFrame with missing values (NaN). Fill numerical missing values with the Mean and categorical missing values with "Unknown".	2
7	Using the Employee DataFrame (from Practical 4), filter and display only those employees who earn more than 70,000.	2

8	Given a dataset of sales with "Region" (North, South), calculate the Total Sales per region.	2
9	Plot a Line Chart showing the temperature changes over a week. Add labels for "Days" and "Temperature".	2
10	Generate 100 random numbers using NumPy (representing ages of a population) and plot a Histogram using Seaborn to see the age distribution.	2
11	Project	10

Text Books: Python Data Analytics by Fabio Nelli ISBN 9798868800993 Third Edition
Reference Books: Data Analytics by Anil Maheshwari ISBN-9352604180 2nd Edition
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus

Semester-VII

Course Code: MDI41MMP403 **Course Name:** Practical Based on Compiler Design **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**:CA-30, ESE-20
Pre-requisites: Basic knowledge of programming concepts, data structures, automata theory fundamentals, and formal languages is required to understand this course.
Course Objectives: The objective of this course is to introduce students to the fundamental concepts and phases of compiler design, enabling them to understand how high-level programs are translated into machine-level code, with emphasis on lexical analysis, syntax analysis, semantic analysis, intermediate code generation, basic optimization techniques, and code generation, thereby providing a strong foundation for understanding language processing systems.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand the basic concepts, structure, and phases involved in compiler design and language processing systems.
CO2: Apply lexical analysis techniques to identify tokens using regular expressions and finite automata.
CO3: Analyze programming language syntax using context-free grammars and basic parsing techniques.
CO4: Explain semantic analysis concepts, symbol table management, and intermediate code generation methods.
CO5: Describe basic code generation, optimization concepts, and runtime environment of a compiler.

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Study the structure and phases of a compiler and prepare a report explaining the role of each phase with a simple example.	2
2	Demonstrate the language processing system (Preprocessor, Compiler, Assembler, Loader) using a simple program.	2
3	Write a program to identify tokens such as keywords, identifiers, operators, and literals from a given source program.	2
4	Design and implement a simple lexical analyzer for a given language using C or Python.	2
5	Construct a finite automaton for a given regular expression and simulate it.	2
6	Develop a lexical analyzer using **LEX** to recognize tokens.	2
7	Write context-free grammar (CFG) for arithmetic expressions and simple statements.	2

8	Implement a recursive descent parser for the given grammar.	2
9	Construct FIRST and FOLLOW sets and develop a predictive parsing table.	2
10	Implement a basic syntax analyzer using YACC for arithmetic expressions.	2
11	Project	10

Reference Book / Hand Books/ Lab Manual

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques, and Tools (2nd Edition), Pearson Education.(Popularly known as the "Dragon Book" – primary reference)
2. Kenneth C. Louden, Compiler Construction– Principles and Practice, 1st edition, PWS Publishing.

Syllabus

Semester-VII

Course Code: MDI41MEP401 **Course Name:** Practical Based Software Project Management **Course Category:** Major Elective
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**: CA-30, ESE-20
Pre-requisites: Basic knowledge of programming concepts, fundamentals of databases and computer systems.
Course Objectives: This course aims to provide a comprehensive understanding of software project management principles and practices, enabling students to plan, estimate, evaluate, schedule, monitor, and control software projects effectively, helping students develop the managerial and decision-making skills required for successful execution of software projects.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Understand the fundamentals of software project management, software project characteristics, and requirement specification techniques.
CO2: Apply stepwise project planning methods, select suitable software process models, and choose appropriate technologies and tools for software development.
CO3: Analyze and estimate software project effort, cost, and schedule using techniques such as Function Point Analysis and the COCOMO model.
CO4: Perform project evaluation, activity planning, scheduling, and risk management using tools like cost–benefit analysis, critical path method, and PERT.
CO5: Implement effective resource allocation, project monitoring, and control strategies to track progress, manage costs, and ensure successful project completion.

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Study the features of popular software project management tools	2
2	Identify a real-world software project and prepare a Software Requirement Specification (SRS) document including functional and non-functional requirements.	2
3	Prepare a stepwise project plan for the selected software project, defining project goals, deliverables, milestones, and constraints.	2
4	Analyze the project requirements and select a suitable software process model (Waterfall, Spiral, Incremental, RAD, or Prototyping) with proper justification.	2
5	Estimate the software size and development effort using Function Point Analysis based on the project requirements.	2
6	Estimate project effort, cost, and development time using the COCOMO model and compare the results with Function Point estimation.	2

7	Identify project activities, prepare a Work Breakdown Structure (WBS), and develop a project schedule using Gantt charts.	2
8	Construct CPM and PERT networks, calculate earliest and latest start times, identify the critical path, and analyze project duration.	2
9	Identify technical, managerial, and organizational risks for the project and prepare a risk assessment and mitigation plan.	2
10	Allocate human and technical resources, estimate project costs, track project progress using earned value analysis, and prepare a project monitoring report.	2
11	Mini Project	10

Reference Book / Hand Books/ Lab Manual

1. Software project management : Bob Hughes and Mike Cotterell - Fourth edition McGraw Hill
2. Software Project Management : Walker Royce - - Addison Wesley

Syllabus

Semester-VII

Course Code: MDI41MEP402 **Course Name:** Practical based on Internet of things **Course Category:** Major Elective
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**:CA-30, ESE-20
Pre-requisites: Basic Programming (Python) - Fundamentals of Networking - Basics of Data Science
Course Objectives: • To understand IoT architecture and data flow • To acquire real-time data from IoT devices • To apply data science techniques on IoT data • To build predictive and intelligent IoT applications
Course Outcomes: At the end of the course, the students will be able to -
CO1: Explain IoT concepts, architectures, and enabling technologies
CO2: Design IoT systems using sensors, actuators, and communication protocols
CO3: Collect, store, and preprocess IoT data efficiently
CO4: Apply data analytics and machine learning techniques to IoT data
CO5: Develop real-time IoT applications using cloud and edge platforms & Address security, privacy, and ethical issues in IoT systems

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Introduction to IoT Architecture & Data Flow: To understand IoT architecture and data flow from sensors to analytics layer.	2
2	Sensor Data Acquisition Using IoT Devices: To collect real-time data from IoT sensors.	2
3	IoT Data Transmission Using MQTT Protocol: To transmit sensor data using lightweight IoT protocols.	2
4	Cloud-Based IoT Data Storage: To store IoT data on cloud platforms.	2
5	IoT Data Preprocessing & Cleaning: To preprocess raw IoT data for analytics.	2
6	Exploratory Data Analysis (EDA) on IoT Data: To perform exploratory analysis on IoT datasets.	2
7	Time Series Analysis of IoT Sensor Data: To analyze time-dependent IoT data.	2
8	Predictive Analytics Using IoT Data: To build predictive models using IoT data.	2
9	Anomaly Detection in IoT Sensor Data:To detect anomalies in sensor data.	2
10	Real-Time IoT Data Visualization Dashboard: To design real-time dashboards for IoT data.	2
12	Mini Project – IoT + Data Science Use Case: To implement an end-to-end IoT Data Science solution.	10

	Suggested Use Cases: Smart Agriculture (Crop monitoring), Smart Health Monitoring, Smart Energy Management, Smart City Traffic Analysis	

Reference Book / Hand Books/ Lab Manual
1 Data Science Lab Manual with Python & R" Publisher: Pearson / Cengage
2. "IoT Projects with Arduino, Raspberry Pi, and ESP32" Author: Agus Kurniawan
3. "Hands-On Internet of Things" Author: Kamal Bharadwaj

Semester: Eight

Syllabus
Semester-VIII

Course Code: MDI41MML404 **Course Name:** Cloud Services **Course Category:** Major Mandatory	
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40	
Pre-requisites: Student should have basic knowledge of computer networks, Database systems, fundamental of Data Sciences.	
Course Objectives: Student will understand cloud computing concepts and service models.	
Course Outcomes: At the end of the course, the students will be able to - Manage cloud storage, security, and scalability.	
CO1: Explain cloud computing architecture and service models	
CO2: Use cloud services for large-scale data storage and processing	
CO3: Deploy data science pipelines on cloud platforms	
CO4: Implement scalable ML models using cloud tools	
CO5: Apply cloud security, cost optimization, and governance concepts	

Course Contents –

Unit	Content	Teaching hours
1	**Introduction to Cloud Computing:** Definition and Characteristics of Cloud Computing, The Motivations for Cloud, Flexible Computing The Power Wall and Multiple Cores and Multiple Machines. Clusters, Web-Sites and Load Balancing. Multi-Tenant Clouds , The Concept Of Elastic Computing , what are Virtualized Servers , Business Models For Cloud Providers, Intrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), A Special Case: Desktop as a Service(DaaS) The Economic Motivation for a Centralized Data Center. Cloud Deployment Models (Public, Private, Hybrid, Community), Benefits and Challenges of Cloud Computing, Application of Cloud Computing in Data Science.	9
2	**Cloud Architecture & Virtualization:** Cloud Architecture and Components, Virtualization Concepts (Hypervisors (Type-I & Type-II), Virtual Machines, Containers (Docker Overview), Resource Provisioning and Elasticity, Cloud Networking Basics, Load Balancing and Auto Scaling. Network Equipment And Multi-Port Server Interfaces, Smart Network Interfaces and Offload, Network Hierarchies, External Internet Connections, Storage In a Data Center, Unified Data Center Networks.	9
3	**Cloud Storage & Databases for Data Science:** Cloud Storage Types (Object Storage, Block Storage, File Storage), Distributed Storage Systems, Cloud Databases (Relational (RDS, Cloud SQL), NoSQL (DynamoDB, Bigtable, Cosmos DB), Data Lakes and Data Warehouses (Amazon S3 + Athena, Google BigQuery, Azure Data Lake), Data Ingestion and Management in Cloud.	9

	Virtual Machines, Introduction to Virtualization, Organization of VMSystems, Levels of Trust, Virtual I/O Devices, VM Migration, Running Virtual Machines In An Application.	
4	**Cloud Analytics & Machine Learning Services and Virtual Storage:** Virtual Storage Disks And Files interface Abstraction, Local And Remote Storage, Network Attached Storage (NAS) Technology, Storage Area Network (SAN)Technology, A Comparison Of NAS and SAN Technology. Big Data Processing on Cloud (Hadoop and Spark on Cloud, Managed Services (EMR, Dataproc, HDInsight), Cloud-based Data Analytics Tools, Machine Learning as a Service (MLaaS) (AWS SageMaker, Azure Machine, earning, Google Vertex AI), Model Training, Deployment, and Monitoring, Serverless Computing for Data Science (Lambda, Azure Functions).	9
5	**Cloud Security, Cost Management & Case Studies** Cloud Security Fundamentals (Identity and Access Management) Cloud-Specific Security Problems, , Security In A Traditional Infrastructure, The Zero Trust Security Model, Identity Management, Privileged Access Management (PAM), Protecting Remote Access, BackDoors, Side Channels, And Other Concerns, (IAM),Data Encryption (At Rest & In Transit), Compliance and Governance), Cost Management and Optimization, Fault Tolerance and Disaster Recovery, Ethical Issues and Data Privacy in Cloud, Case Studies (Cloud for Healthcare Analytics, Cloud in Finance & FinTech) Cloud for AI & IoT Applications	9

Text Books: 1. The cloud computing book , future of Computing explained : Douglus E. Corner , Cloud Computing: Principles and Paradigms, Rajkumar Buyya 2. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, Ricardo Puttini.
Reference Books: AWS Cloud Practitioner Documentation Microsoft Azure Data Science Documentation, Google Cloud Data Analytics & ML Resources
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus

Semester-VIII

Course Code: MDI41MML405 **Course Name:** Natural Language Processing **Course Category:** Major Mandatory
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40
Pre-requisites: Natural Language Processing (NLP) requires a solid foundation in data science fundamentals to understand how text is processed in computing platform.
Course Objectives: The fundamental concepts and evolution of Natural Language Processing, along with probabilistic and statistical approaches for modeling natural language. Explores language-specific challenges with special emphasis on Indian languages.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Explain the history, stages, approaches, and applications of NLP, including its relationship with Machine Learning and Artificial Intelligence.
CO2: Apply probabilistic models such as Noisy Channel Model and HMM for sequence labeling problems like Part of Speech (POS) tagging.
CO3: Analyze POS tagging challenges, accuracy measures, and morphological considerations with special emphasis on Indian languages
CO4: Evaluate Information Retrieval models, Latent Semantic Indexing (LSI), PCA, and SVD, and analyze how NLP enhances IR performance.
CO5: Design and compare Word Sense Disambiguation and Probabilistic Parsing algorithms, including supervised, unsupervised, and resource-constrained approaches.

Course Contents –

Unit	Content	Teaching hours
1	**Introduction:** Introduction to NLP, History of NLP, Application of NLP, Machine Learning and NLP, Stages of NLP,NLP Approaches, Sequence Labelling and Noisy Channel, Noisy Channel: Argmax Based Computation, Noisy Channel Application to NLP	9
2	Brief on Probabilistic Parsing & Start of Part of Speech Tagging, Part of Speech Tagging, Indian Language in Focus; Morphology Analysis, Indian Language Consideration; Accuracy Measure, Part of Speech Tagging; Fundamental Principle, Why Challenging; accuracy, Part of Speech Tagging; Accuracy Measurement; Word categories, Artificial intelligence and Probability, Hidden Markov Model (HMM)	9
3	HMM, Viterbi, Forward Backward Algorithm, HMM, Viterbi, Forward Backward Algorithm, HMM, Forward Backward Algorithms, Baum Welch Algorithm, HMM, Forward Backward Algorithms, Baum Welch Algorithm, Natural Language Processing and Informational Retrieval, IR Models: Boolean Vector, IR Models: NLP and IR Relationship.	9
4	NLP and IR: How NLP has used IR, Toward Latent Semantic, Least Square Method, Recap of PCA; Towards Latent Semantic Indexing(LSI), Principal Component Analysis, SVD, Towards Latent Semantic Indexing(LSI), Wordnet and Word Sense Disambiguation, Wordnet and Word Sense Disambiguation, Wordnet Metonymy and Word Sense Disambiguation, Word Sense Disambiguation, Word Sense Disambiguation.	9
5	Overlap Based Method, Supervised Method, Word Sense Disambiguation: Supervised and Unsupervised methods, Word Sense	9

	Disambiguation: Semi - Supervised and Unsupervised method resource - constrained WSD, Resource Constrained WSD, Parsing, Parsing, Parsing Algorithm, Parsing Ambiguous Sentences, Probabilistic Parsing, Probabilistic Parsing Algorithms	

Text Books: Natural language processing applications Daniel M Bikel and Imed Zitouni Pearson, 2013
Reference Books: Natural Language Processing with Python Steven Bird, Ewan Klein OReilly
Online Resources: 1.NPTEL / SWAYAM lectures. https://archive.nptel.ac.in/courses/106/101/106101007/

Syllabus
Semester-VIII

Course Code: MDI41MML406 **Course Name:** Time Series Analysis **Course Category:** Major Mandatory
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40
Pre-requisites: Knowledge of basic statistics, probability, linear algebra.
Course Objectives: • To introduce fundamental concepts and components of time series data • To understand classical and modern time series models • To analyze, model, and forecast time-dependent data • To apply time series techniques to real-world data science problems.
Course Outcomes: At the end of the course, the students will be able to –
CO1: Explain the characteristics and components of time series data.
CO2: Analyze time series using statistical and graphical techniques.
CO3: Build and evaluate classical time series models.
CO4: Apply advanced time series models for forecasting.
CO5: Use time series methods to solve real-world data science problems.

Course Contents –

Unit	Content	Teaching hours
1	**Introduction to Time Series (Foundations)** Definition of time series, Examples of time series, Objectives of time series analysis, Types of time series: univariate, multivariate, stationary, non-stationary, Components of time series: trend, seasonal, cyclical, irregular, Additive and multiplicative models, Time series visualization and exploratory analysis, Applications of time series	9
2	**Trend and Seasonal Modeling (Smoothing Techniques)** Estimation and elimination of trend, Estimation and elimination of seasonality, Estimation of trend in absence of seasonality, Estimation and elimination of both trend and seasonality, Smoothing methods: moving average, exponential smoothing, Residual analysis and testing for randomness.	9
3	**Stationary Time Series and ARIMA Models** Concept of stationarity, Testing for stationarity, Autocorrelation function (ACF), Partial autocorrelation function (PACF), Autoregressive (AR) models, Moving average (MA) models, ARMA models, ARIMA models: identification, estimation, diagnostics, forecasting, Residual diagnostics	9
4	**Advanced Time Series Models (Applied Overview)** Seasonal ARIMA (SARIMA) models, ARCH and GARCH models, Vector autoregressive (VAR) models, Introduction to state space models, Model selection criteria: AIC, BIC	9
5	**Modern Time Series Forecasting and Applications** Time series regression models, Forecast accuracy measures: MAE, RMSE, MAPE, Machine learning approaches for time series forecasting,	9

	Neural networks for time series forecasting, LSTM models (conceptual), Case studies and applications	

Text Books: 1) Brockwell, P. J., & Davis, R. A. – Introduction to Time Series and Forecasting, 3rd Edition, Springer, 2016
Reference Books: 1) Hyndman, R. J., & Athanasopoulos, G. – Forecasting: Principles and Practice, 3rd Edition, OTexts, 2021 2) Chatfield, C. – The Analysis of Time Series: An Introduction, 6th Edition, Chapman & Hall/CRC, 2003
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus
Semester-VIII

Course Code: MDI41MEL403 **Course Name:** High Performance Computing **Course Category:** Major Elective
Credits: 3 **Teaching Scheme:**L-3 P-0 **Evaluation Scheme:** CA-60, ESE-40
Pre-requisites: Basic Computer Organization and Fundamentals of Operating Systems
Course Objectives: • Understand modern processor architectures and performance-limiting factors. • Analyze and evaluate serial code performance using profiling and benchmarking tools. • Apply optimization techniques for efficient use of memory hierarchies and SIMD/vector units. • Model and optimize data access patterns for bandwidth-limited applications. • Understand parallel computer architectures and interconnection networks.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Explain modern processor architectures, memory hierarchies, pipelining, SIMD, and multicore designs.
CO2: Analyze serial program performance using profiling tools and hardware performance counters
CO3: Apply code optimization techniques such as loop transformations, inlining, SIMD usage, and memory optimizations
CO4: Evaluate bandwidth- and latency-bound algorithms using performance models
CO5: Implement data-parallel and task-parallel programs.

Course Contents –

Unit	Content	Teaching hours
1	**Modern processors:** Stored-program computer architecture, General-purpose cache-based microprocessor architecture, Performance metrics and benchmarks, Transistors galore: Moore's Law, Pipelining, Super scalarity, SIMD, Memory hierarchies, Cache, Cache mapping, Prefetch, Multicore processors, Multithreaded processors, Vector processors, Design principles, Maximum performance estimates, Programming for vector architectures	9
2	**Basic optimization techniques for serial code**: Scalar profiling, Function-and line-based run time profiling, Hardware performance counters, Manual instrumentation, Common sense optimizations, Do less work, Avoid expensive operations, Shrink the working set, Simple measures, large impact, Elimination of common subexpressions, Avoiding branches, Using SIMD instruction sets, The role of compilers, General optimization options, Inlining, Aliasing, Computational accuracy, Register optimizations, Using compiler logs, C++optimizations, Temporaries, Dynamic memory management, Loop kernels and iterators	9
3	**Data access optimization:** Balance analysis and light speed estimates, Bandwidth-based performance modeling, The STREAM benchmarks, Storage order, Case study: The Jacobi algorithm, Case study: Dense	9

	matrix transpose, Algorithm classification and access optimizations, Case study: Sparse matrix-vector multiply, Sparse matrix storage schemes, Optimizing JDS sparse MVM	
4	**Parallel Computers:** Taxonomy of parallel computing paradigms, Shared-memory computers, Cache coherence, UMA, ccNUMA, Distributed memory computers, Hierarchical (hybrid) systems, Networks, Basic performance characteristics of networks, Buses, Switched and fat-tree networks, Mesh networks, Hybrids	9
5	**Parallelization:** Why parallelize, Parallelism, Data parallelism, Functional parallelism, Parallel scalability, Factors that limit parallel execution, Scalability metrics, Simple scalability laws, Parallel efficiency, Serial performance versus strong scalability, Refined performance models, Choosing the right scaling baseline, Case study: Can slower processors compute faster, Load imbalance	9

Text Books: Introduction to High Performance Computing for Scientists and engineers Georg Hager Gerhard Wellein CRC Press Taylor & Francis Group ISBN 978-1-4398-1192-4
Reference Books: High Performance Computing By Charles Severance and Kevin Dowd Edition 2 O'Reilly, 1998 ISBN Number-156592312X, 9781565923126
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus

Semester-VIII

Course code: MDI41MEL404 **Course name:** - Quantum Computing **Course category:** - Major Elective
Credits: 3 **Teaching scheme:** L-3 P-0 **Evaluation scheme:** CA:60 ESE-40
Pre-requisites: Basic Knowledge of quantum computing and programming concept.
Course Objectives : The objective of this course is to provide a strong foundation in quantum computing theory and practical applications.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Able to explain the fundamental concepts of quantum computing.
CO2: Able to represent quantum states and operations mathematically using Dirac notation and matrix representations.
CO3: Build quantum circuits using standard gates and simulate results.
CO4: Implement simple quantum algorithms (Deutsch-Jozsa, Grover, QFT basics).
CO5: Understand noise, NISQ limitations, and basic error correction concepts.

Contents

Unit	Content	Teaching hours
I	**Introduction to Quantum Computing:** History of quantum computation and quantum information, Future directions, Introduction to Quantum bits(Qubits),Single qubits gates, Multiple qubits gates, Measurements in bases other than the computational basis, Quantum circuits, Qubit copying circuit, Example: Bell states, quantum teleportation. Quantum algorithms : Classical computations on a quantum computer, Quantum parallelism, Deutsch's algorithm, The Deutsch–Jozsa algorithm, Quantum algorithms summarized, Experimental quantum information processing, Quantum information theory: example problems.	10
2	**Introduction to Quantum Mechanics:** Linear Algebra, Bases and linear independence, Linear operators and Matrix, Inner products, The Pauli matrices, Eigenvectors and eigenvalues. Ad-joints and Hermitian operators, Tensor products, Operator functions, he commutator and anti-commutator, The polar and singular value decomposition, Postulate Quantum mechanics, State space, Evolutiuon, Quantum measurement, Distinguishing quantum states, Projective measurements, POVM measurements, Quantum Phase, Composite systems, Quantum mechanics: a global view, Application super-dense coding, Ensembles of quantum states, General properties of the density operator, The reduced density operator, The Schmidt decomposition and purification, EPR and the Bell inequality.	10
3	**Quantum computation:** Quantum circuits, Quantum algorithms, Single qubit operations, Controlled operations, Measurement, Universal quantum gates, Two-level unitary gates are universal, Single qubit and CNOT gates are universal, A discrete set of universal operations, Approximating arbitrary unitary gates is generically hard, Quantum computational complexity, Summary of the quantum circuit model of computation, Simulation of quantum systems, Simulation in action, The quantum simulation algorithm, An illustrative example, Perspectives on quantum simulation.	9

4	**The Quantum Fourier transform and its applications:** The quantum Fourier transform, Phase estimation, Performance and requirements, Applications: order-finding and factoring, Application: order-finding, Application: factoring, General applications of the quantum Fourier transform, Period-finding, Discrete logarithms, The hidden subgroup problem, Other quantum algorithms?	8
5	**Quantum Search Algorithms:** The quantum search algorithm, The oracle, The procedure, Geometric visualization, Performance, Quantum search as a quantum simulation, Quantum counting, Speeding up the solution of NP-complete problems, Quantum search of an unstructured database, Optimality of the search algorithm, Black box algorithm limits.	8

Text Books:

1. David McMahon, "Quantum Computing Explained", Wiley-IEEE Computer Society Press, 2007.
2.Venkateswaran Kasirajan, "Fundamentals of Quantum Computing -Theory and Practice", Springer, 2021.

Reference Books:

1. Nielsen, M. A., & Chuang, I. L., Quantum Computation and Quantum Information, Cambridge University Press
2. Dr. NidhiIsmail KeshtaDr. Abhishek AgarwalDr. Vandana Rathore "Quantum Computing For Beginners" Exoofencr Intenatonal Publication.
3. Tyler Soloway "Quantum Computing Explained For Everyone".

Syllabus

Semester-VIII

Course Code: MDI41MMP404 **Course Name:** Practical Based on Cloud Services **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**:CA-30, ESE-20
Pre-requisites: Student should have basic knowledge of computer networks, Database systems, and fundamental of Data Sciences.
Course Objectives: Student should gain hand on experience on cloud computing concepts and service models.
Course Outcomes: At the end of the course, the students will be able to - Manage cloud storage, security, and scalability.
CO1: Explain cloud computing architecture and service models
CO2: Use cloud services for large-scale data storage and processing
CO3: Deploy data science pipelines on cloud platforms
CO4: Implement scalable ML models using cloud tools
CO5: Apply cloud security, cost optimization, and governance concepts

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	**Cloud Account Setup & IAM Configuration** **Objective: To u**nderstand cloud environment and access control (Create a cloud account (AWS / Azure / GCP), Create IAM users, roles, and policies, Assign least-privilege permissions.	2
2	**Virtual Machine Deployment & Management** **Objective:** To Learn Infrastructure as a Service (IaaS) (Launch a VM (EC2 / Azure VM / Compute Engine), Configure OS, storage, and networking, Connect via SSH / RDP	2
3	**Cloud Storage for Big Data:** Store and manage large datasets. **Objective: To** Create object storage (S3 / Blob Storage / Cloud Storage), Upload CSV/JSON datasets, Configure versioning and lifecycle policies.	2
4	**Data Ingestion Pipeline:** Ingest structured and unstructured data **Objective:** Stream or batch data using:, AWS DataSync / Azure Data Factory / GCP Dataflow, Load data into cloud storage.	2
5	**Cloud-Based SQL & NoSQL Databases:** Learn managed database services **Objective:** Create cloud database:, SQL (RDS / Azure SQL / Cloud SQL), NoSQL (DynamoDB / CosmosDB / Firestore), Perform CRUD operations.	2
6	**Data Warehousing on Cloud:** Perform analytical queries on large data **Objective:** Create data warehouse:, Redshift / BigQuery / Azure Synapse, Load data and run OLAP queries, Outcome, Hands-on with cloud data warehouses	2

7	**Distributed Data Processing (Spark on Cloud):** Process big data using distributed systems **Objective:** Use EMR / Databricks / Dataproc, Run Spark jobs (PySpark), Perform data transformations, Outcome, Experience with Big Data analytics	2
8	**Machine Learning Model Training on Cloud:** Train ML models at scale **Objective:** Use SageMaker / Azure ML / Vertex AI, Train a regression or , lassification model, Evaluate model performance, Outcome, Understanding of ML as a Service.	2
9	**Model Deployment & API Creation:** Deploy ML models as web services **Objective:** Deploy trained model,Create REST API endpoint,Test using Postman Outcome,Knowledge of MLOps fundamentals.	2
10	**Serverless Computing for Data Processing:** Learn event-driven architecture **Objective:** Create Lambda / Azure Functions / Cloud Functions, Trigger function on file upload, Process data automatically, Outcome, Understanding of Serverless Computing.	2
11	Project	10

Text Books: 1. The cloud computing book , future of Computing explained : Douglus E. Corner , Cloud Computing: Principles and Paradigms, Rajkumar Buyya 2. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, Ricardo Puttini.
Reference Books: AWS Cloud Practitioner Documentation Microsoft Azure Data Science Documentation, Google Cloud Data Analytics & ML Resources
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus

Semester-VIII

Course Code:MDI41MMP405 **Course Name:** Practical Based on Natural Language Processing **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:**L-0 P-2 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Natural Language Processing (NLP) requires a solid foundation in data science fundamentals to understand how text is processed in computing platform.
Course Objectives: The fundamental concepts and evolution of Natural Language Processing, along with probabilistic and statistical approaches for modeling natural language. Explores language-specific challenges with special emphasis on Indian languages.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Explain the history, stages, approaches, and applications of NLP, including its relationship with Machine Learning and Artificial Intelligence.
CO2: Apply probabilistic models such as Noisy Channel Model and HMM for sequence labeling problems like Part of Speech (POS) tagging.
CO3: Analyze POS tagging challenges, accuracy measures, and morphological considerations with special emphasis on Indian languages
CO4: Evaluate Information Retrieval models, Latent Semantic Indexing (LSI), PCA, and SVD, and analyze how NLP enhances IR performance.
CO5: Design and compare Word Sense Disambiguation and Probabilistic Parsing algorithms, including supervised, unsupervised, and resource-constrained approaches.

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Install and Setup Python Programming	2
2	Read Text Dataset and Implement Pre-Processing text (Word and Sentence Tokenization) using TextBlob	2
3	Implementation of Morphological analysis (Stop word removal) using Natural Language Toolkit	2
4	Implementation of Stemming on Unstructured Data using CoreNLP	2
5	Implementation of Lemmatization on Unstructured Data using Gensim	2
6	Implementation of Parts of Speech Tagging in a sentence using spaCy	2
7	Implementation of Parts of Speech Chunking in a sentence using spaCy	2
8	Implementation of NER Name Entity Recognition using scikit-learn	2
9	Implement N–Gram Language Model using scikit-learn	2
10	Implement Wordnet–Lesk Algorithm for detecting shared vocabulary between the definitions of words using scikit-learn	2
11	Project	10

Reference Book / Hand Books/ Lab Manual
1. Multilingual Natural Language Processing Applications by Daniel M. Bikel Imed Zitouni Published by Pearson plc Publishing as IBM Press
2. Natural Language Processing with Python Steven Bird, Ewan Klein OReilly
3. https://archive.nptel.ac.in/courses/106/101/106101007/Web Resources

Syllabus

Semester-VIII

Course Code: MDI41MMP406 **Course Name:** Practical Based on Time Series Analysis **Course Category:** Major Mandatory
Credits: 1 **Teaching Scheme:**L-0,P-2 **Evaluation Scheme**:CA-30, ESE-20
Pre-requisites: Knowledge of programming in R, and data visualization skills.
Course Objectives: • Develop hands-on skills in analyzing and visualizing time series data using R. • Learn to estimate and remove trend and seasonal components from time series. • Apply classical models like AR, MA, ARMA, and ARIMA for forecasting. • Understand and implement advanced models such as SARIMA, GARCH, and VAR. • Explore modern forecasting approaches including machine learning and neural networks.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Ability to load, visualize, and decompose time series data in R.
CO2: Skill to identify trend and seasonal patterns and perform smoothing.
CO3: Competence in fitting, diagnosing, and forecasting using ARIMA and SARIMA models.
CO4: Ability to apply volatility and multivariate models like GARCH and VAR.
CO5: Understanding of modern forecasting techniques using regression and machine learning.

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Load the AirPassengers dataset, plot the time series, decompose it into trend, seasonal, and irregular components using stl(), and comment on the observed patterns.	2
2	Apply moving average smoothing on the nottem dataset (monthly temperatures) using 3-month, 6-month, and 12-month windows. Plot the results and compare the effects of different window sizes.	2
3	Use the HoltWinters() function on the LakeHuron dataset to fit models with trend only and with trend plus seasonality. Forecast the next 12 periods and plot the forecast against the actual data.	2
4	Test the stationarity of the AirPassengers dataset using adf.test(). If it is non-stationary, apply differencing to make it stationary and plot the ACF and PACF of the transformed series.	2
5	Fit an ARIMA model on the AirPassengers dataset using auto.arima(). Examine the residuals, perform the Ljung-Box test for randomness, forecast the next 12 months, and calculate RMSE and MAE.	2
6	Fit a Seasonal ARIMA (SARIMA) model on the nottem dataset by incorporating appropriate seasonal parameters. Compare the forecast accuracy with that of a non-seasonal ARIMA model.	2

7	Using daily returns of a stock or financial dataset, fit a GARCH(1,1) model with the rugarch package, plot the conditional variance, and analyze the volatility pattern.	2
8	Using three related time series such as GDP, inflation, and unemployment rate, fit a Vector Autoregressive (VAR) model using the vars package and forecast the next four periods for all variables.	2
9	Using the AirPassengers dataset, create a time series regression model with lagged values as predictors. Predict the last 12 months of data and evaluate the model's performance using RMSE or MAPE.	2
10	Forecast the AirPassengers dataset using both ARIMA and a simple machine learning approach such as Random Forest or Gradient Boosting. Compare the forecast accuracy and discuss which method performs better and why.	2
11	Mini Project: Forecasting a Real-World Time Series Choose a real-world dataset such as monthly stock prices, airline passengers, rainfall, temperature, or electricity consumption. Perform the following steps using R: 1. Explore the dataset and visualize the time series, identifying trend, seasonality, and irregular components. 2. Test for stationarity and transform the series if required. 3. Fit appropriate classical models such as ARIMA or SARIMA, and evaluate forecast accuracy using MAE, RMSE, or MAPE. 4. Optionally, implement a modern forecasting method such as time series regression or a simple ML model (Random Forest/Gradient Boosting) and compare performance with classical models. 5. Document your analysis, plots, model selection process, forecast results, and insights in a short report.	10

Reference Book / Hand Books/ Lab Manual

1. Practical Time Series Forecasting with R: A Hands-On Guide by Galit Shmueli and Kenneth C. Lichtendahl Jr

2. Time Series Analysis: With Applications in R integrates theory and practice with R examples and datasets.

3. Introductory Time Series with R by Andrew V. Metcalfe and Paul S.P. Cowpertwait a step-by-step introduction to time series analysis using R

Syllabus

Semester-VIII

Course Code:MDI41MEP403 **Course Name:** Practical Based on High Performance Computing **Course Category:** Major Elective
Credits: 1 **Teaching Scheme:**L-0 P-2 **Evaluation Scheme:** CA-30, ESE-20
Pre-requisites: Basic Computer Organization and Fundamentals of Operating Systems
Course Objectives: • Understand modern processor architectures and performance-limiting factors. • Analyze and evaluate serial code performance using profiling and benchmarking tools. • Apply optimization techniques for efficient use of memory hierarchies and SIMD/vector units. • Model and optimize data access patterns for bandwidth-limited applications. • Understand parallel computer architectures and interconnection networks.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Explain modern processor architectures, memory hierarchies, pipelining, SIMD, and multicore designs.
CO2: Analyze serial program performance using profiling tools and hardware performance counters
CO3: Apply code optimization techniques such as loop transformations, inlining, SIMD usage, and memory optimizations
CO4: Evaluate bandwidth- and latency-bound algorithms using performance models
CO5: Implement data-parallel and task-parallel programs.

List of Practicals:

Sr.No.	Title of the Experiment	Practical Hours
1	Measuring CPU Performance and Moore's Law Effect	2
2	SIMD-like Vector Operations using NumPy	2
3	Identify performance bottlenecks using Python	2
4	Design Loop and Memory Optimization for Multiprocessor task	2
5	Write python code for Memory Access Pattern and Bandwidth	2
6	Design Sparse Matrix–Vector Multiplication and Understand sparse data structures and access optimization	2
7	Demonstrate Shared Memory Parallelism using multiprocessing	2
8	Analyze communication overhead and Communication Cost Simulation	2
9	Evaluate strong scaling behavior and Data Parallelism and Scalability	2

10	Demonstrate impact of uneven workload distribution and Load Imbalance Experiment	2
11	Project	10

Text Books: Introduction to High Performance Computing for Scientists and engineers Georg Hager Gerhard Wellein CRC Press Taylor & Francis Group ISBN 978-1-4398-1192-4
Reference Books: High Performance Computing By Charles Severance and Kevin Dowd Edition 2 O'Reilly, 1998 ISBN Number-156592312X, 9781565923126
Online Resources: 1.NPTEL / SWAYAM lectures.

Syllabus

Semester-VIII

Course code: MDI41MEP404 **Course Name:** - Practical based on Quantum Computing **Course category:** Major Elective
Credits: 1 **Teaching scheme:** L-0 P-2 **Evaluation scheme:** CA:30 ESE-20
Pre-requisites: Basic Knowledge of quantum computing and programming concept.
Course Objectives : The objective of this course is to provide a strong foundation in quantum computing theory and practical applications.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Able to explain the fundamental concepts of quantum computing.
CO2: Able to represent quantum states and operations mathematically using Dirac notation and matrix representations.
CO3: Build quantum circuits using standard gates and simulate results.
CO4: Implement simple quantum algorithms (Deutsch-Jozsa, Grover, QFT basics).
CO5: Understand noise, NISQ limitations, and basic error correction concepts.

Contents-

Sr.No.	Content	Practical Hours
1	Visualization of Single-Qubit States and Rotations on the Bloch Sphere using Qiskit.	2
2	Implementation and Verification of Basic Quantum Logic Gates (Pauli, Hadamard, and Toffoli) and Multi-Qubit Systems.	2
3	Generation and Measurement of Maximum Entanglement (Bell States) and Verification of Quantum Correlations.	2
4	Implementation of the Deutsch-Jozsa Algorithm to Distinguish Constant and Balanced Functions.	2
5	Practical Implementation of the Bernstein-Vazirani Algorithm for Single-Query String Identification.	2
6	Simulation of Grover's Search Algorithm for Unstructured Database Searching using Amplitude Amplification.	2
7	Construction of the Quantum Fourier Transform (QFT) Circuit and Verification of Phase States.	2
8	Implementation of the Three-Qubit Bit-Flip Error Correction Code for Fault-Tolerant Simulation.	2
9	Simulation of the BB84 Quantum Key Distribution (QKD) Protocol for Secure Communication.	2
10	Analysis of Security in Quantum Cryptography: Simulating an Intercept-Resend (Eavesdropping) Attack.	2

Text Books:

1. "Learn Quantum Computing with Python and IBM Quantum" by Robert Loredo
2. "Quantum Computing: An Applied Approach" by Jack D. Hidary.

Reference Books:

Eric Johnston "Programming Quantum Computers: Essential Algorithms and Code" (O'Reilly)
Learn Quantum Computing with Python and IBM Quantum by Robert Loredo (Packt Publishing) Dancing with Qubits by Robert S. Sutor