Master of Computer Science (Artificial Intelligence & Data Science)

1 Year Postgraduate Program

(as per NEP)

(w.e.f. Academic Session 2025-26)

Department of Computer Science & Engineering
Faculty of Engineering and Technology
Chaudhary Devi Lal University,
Sirsa-125055

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Learning Outcomes-based Curriculum Framework
(as per NEP)

For

Batch (2025-26) Onwards

Master of Science
Computer Science (Artificial Intelligence & Data Science)
2 Year Postgraduate Program

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Master of Science
Computer Science (Artificial Intelligence & Data Science)
1 Year Postgraduate Program

Committee

BoS (03/07/2025)

Staff council (16/6/2025)

Faculty of Engg & Tech (4/7/25)

Department of Computer Science & Engineering
Faculty of Engineering and Technology
Chaudhary Devi Lal University, Sirsa-125055

2025

Abbreviations:

1. M.Sc. CS (AI&DS: Master of Computer Science (AI & DS)
2. NHEQF: National Higher Education Qualification Framework
3. DSC: Discipline-Specific Courses
4. DSE: Discipline-Specific Elective Courses
5. SEC: Skill Enhancement Courses
6. RPR: Research Project
7. VOC: Vocational Courses

Note 1: Only the candidates/students who have passed a 4-year degree programme or a postgraduate diploma in computer applications can seek admission in the one-year M.Sc. CS (AI&DS) programme.

Note 2: The M.Sc. CS (AI&DS) one-year program has three different structures. Students have to select one of the following three options:

Option 1: Only Coursework (Table 1.1, Table 2.1)

Option 2: Coursework and Research work (Table 1.2, Table 2.2)

Option 3: Only Research work (Table 1.3, Table 2.3)

Structure for 1-Year M.Sc. CS (AI&DS) Program

Table 1.1: First & Second Semester of the One-year M.Sc. CS (AI&DS) program (NHEQF Level 6.5)
Option 1 (Only Coursework)

	Semester	DSC	SEC/VOC/Internship	Research thesis/project	Total Credits
Option-1 (Only coursework)	Semester- I	Research Methodology (4 credit)	Digital Marketing (2+2 Credit)	---	24
		IoT & Cloud Computing (4credit)			
		Data Science (4 credit)			
		R Programming (4 credit)			
		Data Science Lab (2 credit)			
		R Programming Lab (2 credit)			
	Semester- II	Social Network Analytics (4 credit)	Intellectual Property Rights (4 Credit)	---	24
		Legal & Ethical aspects of Data Science (4 credit)			
		MATLAB (4 credit)			
		Deep Learning (4 credit)			
		MATLAB Practical (2 credit)			
		Deep Learning Lab (2 credit)			

Table 1.2: First & Second Semester of the One-year M.Sc. CS (AI&DS) program (NHEQF Level 6.5)
(Option 2 - Coursework and Research Project)

	Semester	DSC	SEC/VOC/Internship	Research thesis/project	Total Credits
Option-2 (Course work and Research Project)	Semester- I	Research Methodology (4 Credit)	Digital Marketing (2+2 credit)	---	24
		IoT & Cloud Computing (4credit)			
		Data Science (4 Credit)			
		R Programming (4 credit)			
		Data Science Lab (2 Credit)			
		R Programming Lab (2 credit)			
	Semester- II	--	Synopsis and its Presentation (4 credit)	Research Project (20 credit)	24

Table 1.3: First & Second Semester of the One-year M.Sc. CS (AI&DS) program (NHEQF Level 6.5)

(Option 3 – Only Research)

	Semester	DSC	SEC/VOC/Internship	Research thesis/project	Total Credits
Option 3	Semester- I	--	Research Methodology (4 credit)	Research Project Part-1[#] (20 credit)	24
	Semester- II	--	Research & Publication Ethics (4 credit)	Research Project Part-2[##] (20 credit)	24

[#]At the end, and as a part of the first semester, students who opted for Option 3 shall submit a Research Project Report/Synopsis of at least 50 pages comprising a Literature Survey, identification of the Research Problem, Plan of Work, Methodology, and Practical Work (if any), which will be evaluated by internal and external examiners.

[##]The students going for Option 3 shall continue the research work in second semester based on the project work/synopsis submitted at the end of first semester. The final Research Thesis/Research Project Report will be evaluated by internal and external examiners.

Table 2.1: Semester-wise course codes, course titles, workload and credits (First & Second Semester of the M.Sc. CS (AI&DS) 1-year program – Option 1 – Only coursework)

Course Code	Course Title	Workload			Credit
		L	T	P	
Option 1, Semester I					
MSC/CSE/3/DSC/501	Research Methodology	3	1	-	4
MSC/CSE/3/DSC/502	IoT & Cloud Computing (4credit)	3	1	-	4
MSC/CSE/3/DSC/503	Data Science	3	1	-	4
MSC/CSE/3/DSC/504	R Programming	3	1	-	4
MSC/CSE/3/DSC/505	Data Science & R Programming Lab		-	8	4
MSC/CSE/3/SEC/501	Digital Marketing	2	-	4	4
Total		14	4	12	24
Option 1, Semester II					
MSC/CSE/4/DSC/551	Social Network Analytics (4 credit)	3	1	-	4
MSC/CSE/ 4/DSC/552	Legal & Ethical aspects of Data Science (4 credit)	3	1	-	4
MSC/CSE/ 4/DSC/553	MATLAB	3	1	-	4
MSC/CSE/ 4/DSC/554 MSC/CSE/ 4/DSC/551	Deep Learning	3	1	-	4
MSC/CSE/ 4/DSC/555	MATLAB & Deep Learning Lab	-	-	8	4
MSC/CSE/4/SEC/551	Intellectual Property Rights	3	1		4
Total		15	5	8	24

+ Supervision of up to four students' dissertation/research projects will be counted as a workload of one hour per week (two hours of workload per week for supervision of five or more students).

Table 2.2: Semester-wise course codes, course titles, workload and credits (First & Second Semester of the M.Sc. CS (AI&DS) 1-year program – Option 2 – Coursework and Research)

Course Code	Course Title	Workload			Credit
		L	T	P	
Option 2, Semester I					
MSC/CSE/3/DSC/501	Research Methodology	3	1	-	4
MSC/CSE/3/DSC/502	IoT & Cloud Computing (4credit)	3	1	-	4
MSC/CSE/3/DSC/503	Data Science	3	1	-	4
MSC/CSE/3/DSC/504	R Programming	3	1	-	4
MSC/CSE/3/DSC/505	Data Science & R Programming Lab		-	8	4
MSC/CSE/3/SEC/501	Digital Marketing	2	-	4	4
Total		14	4	12	24
Option 2, Semester II					
MSC/CSE/4/SEC/551	Research Methodology	3	-	2	4
MSC/CSE/4/RPR/551	Research Thesis/Project	-	-	-	20
Total		3	-	2	24

+ Supervision of up to four students' dissertation/research projects will be counted as a workload of one hour per week (two hours of workload per week for supervision of five or more students).

Table 2.3: Semester-wise course codes, course titles, workload and credits (First & Second Semester of the M.Sc. CS (AI&DS) 1-year program – Option 3 – Only Research)

Course Code	Course Title	Workload			Credit
		L	T	P	
Option 3, Semester I					
MSC/CSE/3/SEC/501	Research Methodology	3	-	2	4
MSC/CSE/3/RPR/501	Research Project 1[@]	-	-	-	20
Total		3	-	2	24
Option 3, Semester II					
MSC/CSE/4/SEC/551	Research Ethics	2	-	4	4
MSC/CSE/4/RPR/551	Research Project 2[@@]	-	-	-	20
Total		2	-	4	24

Note: Option 3 shall be available only for the students who have completed Postgraduate Diploma in Computer Applications or 4-year Bachelor's program without research.

+ Supervision of up to four students' dissertation/research projects will be counted as a workload of one hour per week (two hours of workload per week for supervision of five or more students).

[@]At the end, and as a part of the first semester, students who opted for Option 3 shall submit a Research Project Report/Synopsis of at least 50 pages comprising a Literature Survey, identification of the Research Problem, Plan of Work, Methodology, and Practical Work (if any), which will be evaluated by internal and external examiners.

[@@]The students going for Option 3 shall continue the research work in the second semester based on the project work/synopsis submitted at the end of the first semester. The final Research Thesis/Research Project Report will be evaluated by internal and external examiners.

M.Sc. CS (AI&DS) 1-Year Program

Semester 1

Course Work (Option 1 &2)

MSC/CSE/3/DSC/501: Research Methodology							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to the paper setter for Final Term Examination: The Final Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper, each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to get the students familiar with different aspects of research methodology, namely, research design, collection and analysis of data, and interpretation of results.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis, sampling.
CO2	**describe**: objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis, sampling.
CO3	**Illustrate:** measurement. data collection, processing, sampling, analysis, and its strategies, reports.
CO4	**categorize:** research, sampling methods, data collection techniques, reports,and data processing strategies.
CO5	**compare:** sampling methods, data collection techniques, reports and data processing strategies.
CO6	**create:** thesis, reports. **design:** research tool. **interpret(drive):** results.

CO-PEO Mapping Matrix

Cos	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	3	-	3	1	3

CO2	2	1	1	3	1	-	-	3	-	3	2	3
CO3	3	1	1	3	3	-	-	3	-	3	3	3
CO4	3	3	1	3	1	-	-	3	-	3	3	3
CO5	3	1	1	3	3	-	-	3	-	3	3	3
CO6	3	3	3	3	3	-	-	3	-	3	3	3
Average	2.5	2	1.3	2.6	2	-	-	3	-	3	2.5	3

CO-PSO Mapping Matrix

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	3
CO2	3	3	2	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	3	3	2.5	3	3

Course Content
MSC/CSE/3/DSC/501: Research Methodology

Unit – I	**Objectives and types of research:** motivation and objectives- research methods vs. methodology, types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs empirical research formulation: defining and formulating the research problem-. selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review- primary and secondary source reviews, hypothesis- definition, qualities of a good hypothesis, null hypothesis and alternatives.
Unit – II	**Research design and methods:** basic principles, need of research design- features of good design, important concepts relating to research design, criteria of selecting a sampling procedure, characteristics of a good sample design, sampling methods, measurement: concept of measurement, problems in measurement in research - validity and reliability, levels of measurement- nominal, ordinal, interval, ratio.
Unit – III	**Data collection and analysis:** execution of the research, observation and collection of data, methods of data collection, data processing and analysis strategies, data analysis with statistical packages, hypothesis testing, generalization and interpretation, univariate analysis (frequency tables, bar charts, pie charts, percentages).
Unit – IV	**Meaning of interpretation**: need of interpretation, technique of interpretation, precaution in interpretation, layout of a research paper, journals in computer science, impact factor of journals, ethical issues related to publishing, plagiarism and self-plagiarism. reports and thesis writing: structure and components of scientific reports, types of report- technical reports and thesis, writing-synopsis, abstract, illustrations and tables, results, summary, reference citing and listing.

Text/Reference Books	
Text Books	1. J. Garg, B.L, Karadia, R, Aggarwal F, An Introduction to Research Methodology, RBSA Publishers, 2002. 2. Kothari,C.R, Research Methodology: Methods and Techniques. New Age International, 1990 3. Santosh Gupta, Research Methodology and Statistical Techniques, Deep & Deep Publications Pvt. Ltd., 2008
Reference Books	1. N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/3/DSC/502: IoT& Cloud Computing							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to the paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper, each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: To study the fundamental concepts of cloud computing, its enabling technologies, cloud service models, and security concerns, to learn core issues of Internet of Things, IOT communication protocols, and security concerns.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**list/define IoT:** framework, architecture, design, communication challenges, applications, principles of web connectivity. list/define cloud computing: evolution, characteristics, working, service models, virtualization, architecture, security challenges and risks.
CO2	**understand and describe IoT:**framework, architecture, design, communication challenges, applications, principles of web connectivity. understand and describe cloud computing: evolution, characteristics, working, service models, virtualization, architecture, security challenges and risks.
CO3	**use:** cloud computing services in different fields of applications.
CO4	**diagrammatise IOT:** framework, architecture, physical and logical design. diagrammatise cloud computing: service models, service-oriented architecture.
CO5	**grade/compareIoT:** communication challenges, security issues, enabling technologies, application areas, and protocols. grade/compare cloud computing: service models. virtualization, and hypervisors.

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	1	3	3
CO2	2	3	1	3	3
CO3	3	3	1	3	3
CO4	3	3	1	3	3
CO5	3	3	1	3	3
Average	2.4	3	1	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	1	3	1	1	1	-	3	1	-	2	-	-
CO2	2	1	1	3	1	-	3	2	-	2	-	-
CO3	3	1	1	3	3	-	3	3	-	2	-	-
CO4	2	1	1	3	1	-	3	3	-	2	-	-
CO5	2	1	3	1	3	-	3	3	-	2	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	2.4	-	2	-	-

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	-
CO2	3	3	3	2	-
CO3	3	3	3	3	-
CO4	3	3	3	3	-
CO5	3	3	3	3	-
Average	3	3	3	2.4	-

Course Content
MSC/CSE/3/DSC/502: IoT& Cloud Computing

Unit - I	**Internet of Things:** what is the IOT and why is it important, IoT conceptual framework, IoT architectural view, technology behind IoT, sources of IoT, examples of IoT, M2M communication, layered architecture (3 & 5 Layered) of IoT, physical design and logical design, domain-specific IoTs, security issues of IoT.
Unit - II	**Communication challenges related to IoT:** enabling technologies for IoT. Applications of IoT: home automation, smart cities, social life and entertainment, health & fitness, smart environment and agriculture, supply chain and logistics, energy conservation. Design principles for web connectivity: web communication protocols for connected devices, message communication protocols for connected devices.
Unit - III	**Introduction to cloud computing:** what is a cloud, definition of cloud computing, evolution of cloud computing, characteristics of cloud computing, how cloud computing works, role of networks in cloud computing. Service models: IaaS, PaaS, SaaS, public, private and hybrid cloud.
Unit - IV	**Introduction to virtualization:** resource virtualization-server, storage, network, load balancing, and virtualization. Hypervisors and their types, service-oriented architecture (SOA), overview of security issues, challenges, and risks of cloud.

Text/Reference Books

Text Books	1.Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing:A Practical Approach, Tata McGraw Hill, New Delhi, 2010 2.Robert Elsenpeter, Toby J. Velte, Anthony T. Velte, Cloud Computing: A Pract Approach, 1e, Tata McGraw Hill Education, 2011. 3.Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Cloud Computing for Dummies, Wiley Publishing, 2010

Reference Books	1.RajkumarBuyya, James Broberg, Andrzej Goscinski, Cloud Computing-Principles and Paradigms, Wiley, 2011. 2.Raj Kamal, Internet of Things-Architectures and Design Principles, McGraw Hill Education, 2017 Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/3/DSC/503: Data Science

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to get the students familiar with the concepts and processes of Data Science including collection, filtering, processing, analysis and visualization.

Course Outcomes	At the end of this course, the student will be able to :
CO1	**define:** data science process, classification of data, big data, web data, sampling, data analysis techniques-correlation, regression, mean, mode, kurtosis, Bayesian inference, etc., neural network, fuzzy logic, rule of mining, Hadoop, Hive, cloud database, and visualization.
CO2	**understand and describe:** graphical representation of data, storage and retrieval of data, evolution of analytic scalability, samplingdistribution, data analysis techniques, Bayesian model and network, induction rule, neural network, fuzzy logic, data mining techniques, data analysis framework, and visualization.
CO3	**use:** data science process, modern data analytic tools, statistical concepts, data analysis techniques, Bayesian network, induction rule, fuzzy logic, data mining techniques, Hadoop file system, Hive, S3, cloud database, inference and visualization.
CO4	**categorize:** analytic processes and tools, analysis, reporting, sampling and resampling, data analysis techniques, linear and non-linear time series, sequential, temporal, and spatial mining, egonets systems and applications.
CO5	**choose:** data science process, data storage, data analytic tools and processes, sampling method, data analysis technique, time series, mining techniques, visual data analysis framework, and a technique suitable in the given situation.

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	1	-	-

CO2	2	1	1	3	1	-	3	-	-	1	-	-
CO3	3	1	1	3	3	-	3	-	-	1	-	-
CO4	2	1	1	3	1	-	3	-	-	1	-	-
CO5	2	1	3	1	3	-	3	-	-	1	-	-
Avg	2	1.4	1.4	2.2	1.8	-	3	-	-	1	-	-

Course Content
MSC/CSE/3/DSC/503: Data Science

Unit I	**Introduction to Data Science:** Introduction, types of data- structured versus unstructured data, quantitative versus qualitative data, the four levels of data, five steps of data science, data science process, exploratory data analysis, collection of data, graphical presentation of data, classification of data, components of data science, evolution of analytic scalability, analytic processes and tools, analysis vs reporting. **Statistical Concepts**: sampling distributions, re-sampling, statistical inference, prediction error.
Unit – II	**Data Analysis:** Correlation, regression, probability, conditional probability, random variables, analysis using mean, median, mode, standard deviation, skewness, kurtosis, regression modeling, multivariate analysis, Bayesian network. **Analysis of Time Series**: linear systems analysis, nonlinear dynamics.
Unit – III	**Data Mining Techniques**: Principal Component Analysis (PCA), Regression, Linear Regression, Multivariate Regression, Subset Selection, Logistic Regression. **Data transformations**: Standardize, Normalize, converting data from one scale to other scales.
Unit – IV	**Data Visualization**: Introduction, importance of data visualization, types of Data visualization, the Five Cs of Data Visualization, seven Stages of Data Visualization, Visualizing Amounts, Visualizing Distributions, Visualizing propositions, Visualizing Associations, Visualizing Time Series, Visualization Trends, Visualizing Geospatial Data.

Text/Reference Books

Text Books.	1.Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. 2.AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
Reference Books	1.Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & Sons, 2012. 2.Jiawei Han, MichelineKamber, "Data Mining Concepts and Techniques", 2e, Elsevier. 3.Rachel Schutt, Cathy O'Neil, "Doing Data Science", O'Reilly Publishers, 2013. 4.Foster Provost, Tom Fawcet, "Data Science for Business", O'Reilly Publishers, 2013.

	5.Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/3/DSC/504: R Programming							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: To study the fundamental concepts in R programming language, data types, operators, decision-making statements and iteration, functions, different data structures like list, vectors, matrices, data frames, charts and graphs, graphics functions and statistical analysis.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**list:** data types, functions in R programming, and visualization.
CO2	**describe:** the syntax of decision-making statements, loops, user-defined functions, user-defined packages; **explain:** the process of import and export of data in text file, Excel file, and MYSQL.
CO3	**use:** various in built, user-defined function and packages. **apply:** R programming constructs to solve real world problems.
CO4	**categorize:** datatypes, conditional & control statements, in built and user defined functions and packages.
CO5	**compare:** datatypes, conditional & control statements, functions, packages in R programming.
CO6	**design:** basic and advanced applications in R programming.

CO-PO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	3	1	-	-	-	-	-	2	3
CO3	3	1	1	3	3	-	-	-	-	-	3	3

CO4	3	3	1	3	1	-	-	-	-	-	3	3
CO5	3	1	1	3	3	-	-	-	-	-	3	3
CO6	3	3	3	3	3	-	-	-	-	-	3	3
Average	2.5	2	1.3	2.6	2	-	-	-	-	-	2.5	3

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	3
CO2	3	3	2	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
CO6	3	3	3	-	3
Average	3	3	2.5	-	3

Course Content
MSC/CSE/3/DSC/504: R Programming

Unit - I	**Basic of R:** Introduction to R, Features of R, Variables in R, In-Built Functions in R (mathematical, trigonometric, logarithmic, Date and Time, Sequence, I/O). Data Types in R: Vectors, Matrices, Arrays, Lists, Factors, Data Frames.
Unit - II	**Programming in R:** Decision making structures (if, Switch), Loops (For, while, repeat), User Defined functions (with argument without argument), User Defined Package. Reports using remark down (direct rendering, in-direct rendering).
Unit - III	**Data Exploration and Manipulation:** Missing Data Management, Data reshaping through melting and casting, special functions across data elements. Import and Export of data: Import and Export of data in text files, excel files and MySQL.
Unit - IV	**Basic Visualization:** Pie chart, bar chart, Histogram, Line chart, Dot Chart, Bubble plot, Image Plot, Violin Plot. Advanced Visualization: Scatter plot, corrgrams, star and segment plots, tree maps, heat map.

Text/Reference Books

Text Books	1. Christian Heumann, Michael Schomaker and Shalabh, Introduction to Statistics and Data Analysis - with Exercises, Solutions and Applications in R, Springer, 2016. 2. Pierre Lafaye de Micheaux, RémyDrouilhet, Benoit Liquet, The R Software-Fundamentals of Programming and Statistical Analysis, Springer 2013.
Reference Books	1. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Use R - A Beginner's Guide to R, Springer 2009. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/3/DSC/505: Data Science (Lab)							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	02	04	Practical	50	-	3 Hours	TEE (Experiment, File, viva)

Instructions to paper setter for Final-Term Examination: The Final-Term examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the basis of practical file, performance in practical exam and a viva-voce exam.

Course Objectives: The objective of this course is to get the students hands-on practice with data science concepts covered in course **MSC/CSE/3/DSC/503**.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** data science process, classification of data, big data, web data, sampling, data analysis techniques-correlation, regression, mean, mode, kurtosis, Bayesian inference, etc., neural network, fuzzy logic, rule of mining, Hadoop, Hive, cloud database, and visualization.
CO2	**understand and describe:** graphical representation of data, storage and retrieval of data, evolution of analytic scalability, samplingdistribution, data analysis techniques, Bayesian model and network, induction rule, neural network, fuzzy logic, data mining techniques, data analysis framework, and visualization.
CO3	**use:** data science process, modern data analytic tools, statistical concepts, data analysis techniques, Bayesian network, induction rule, fuzzy logic, data mining techniques, Hadoop file system, Hive, S3, cloud database, inference, and visualization.
CO4	**categorize:** analytic processes and tools, analysis, reporting, sampling and resampling, data analysis techniques, linear and non-linear time series, sequential, temporal and spatial mining, egonets systems and applications.
CO5	**choose:** data science process, data storage, data analytic tools and processes, sampling method, data analysis technique, time series, mining techniques, visual data analysis framework and technique suitable in given situation.
CO6	**develop:** application using concepts of data science.

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	1	-	-
CO2	2	1	1	3	1	-	3	-	-	1	-	-

CO3	3	1	1	3	3	-	3	-	-	1	-	-
CO4	2	1	1	3	1	-	3	-	-	1	-	-
CO5	2	1	3	1	3	-	3	-	-	1	-	-
Avg	2	1.4	1.4	2.2	1.8	-	3	-	-	1	-	-

MSC/CSE/3/DSC/505: R Programming (Lab)

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	02	04	Practical	50	-	3 Hours	TEE (Expt, File, viva)

Instructions to paper setter for Final-Term Examination: The Final-Term examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of practical file, performance in practical and a viva voce exam.

Course Objectives: The objective of this course is to get the students hands on practice with scripting/programming concepts of R programming language as covered in course **MSC/CSE/3/DSC/504**.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**list**: data types, functions in R programming, and visualization.
CO2	**describe:** the syntax of decision-making statements, loops, and user-defined functions,used to define packages. **explain:** the process of importing and exporting data in a text file, an excel file , and MYSQL.
CO3	**use:** various in-built, user-definedfunctions and packages. **apply:** R programming constructs to solve real-world problems.
CO4	**categorize:** datatypes,conditional& control statements, in-built and user-defined functions and packages.
CO5	**compare**: datatypes, conditional & control statements,functions, and packages in R programming.
CO6	**design:** basic and advanced applications in R programming.

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	3	3	3
CO2	2	3	3	3	3
CO3	3	3	3	3	3

CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	3	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	1	-	-	-	-
CO2	2	1	1	3	1	-	3	2	-	-	-	-
CO3	3	1	1	3	3	-	3	3	-	-	-	-
CO4	3	3	1	3	1	-	3	3	-	-	-	-
CO5	3	1	1	3	3	-	3	3	-	-	-	-
CO6	3	3	3	3	3	-	3	3	-	-	-	-
Average	2.5	2	1.3	2.6	2	-	3	2.5	-	-	-	-

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	1	-
CO2	3	2	2	2	-
CO3	3	3	3	3	-
CO4	3	3	3	3	-
CO5	3	3	3	3	-
CO6	3	3	3	3	-
Average	3	2.5	2.5	2.5	-

MSC/CSE/3/SEC/501: Digital Marketing

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Skill Enhancement Course	02	02	Lecture	30	20	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for the Final-Term Examination: The term-end examination of theory part the total number of questions shall be NINE. Question number one will be compulsory and will be consisting of SIX short/objective-type questions from the complete syllabus. In addition to the compulsory question, there shall be EIGHT questions (two questions from each unit). The student will attempt one question from each unit in addition to the compulsory question. All questions will be of SIX marks each.

Course Objectives: The objective of this course is to learn the concepts of digital marketing, social media marketing and other online marketing strategies.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**Define**: the basic concepts of digital marketing, social media marketing and other online marketing strategies.
CO2	**Explain:** the effective usage of digital marketing, social media marketing and other online marketing strategies.
CO3	**Use:** different strategies in digital marketing.
CO4	**Classify:** strategies and tools used in digital marketing.
CO5	**Compare and select types of:** tools, strategies, digital editing tools.

CO-PO Mapping Matrix

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**3**	**1**	**1**	**1**	**-**	**3**	**1**	**-**	**2**	**-**	**-**
CO2	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**2**	**-**	**2**	**-**	**-**
CO3	**3**	**1**	**1**	**3**	**3**	**-**	**3**	**3**	**-**	**2**	**-**	**-**
CO4	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**3**	**-**	**2**	**-**	**-**
CO5	**2**	**1**	**3**	**1**	**3**	**-**	**3**	**3**	**-**	**2**	**-**	**-**

Avg	**2**	**1.4**	**1.4**	**2.2**	**1.8**	**-**	**3**	**2.4**	**-**	**2**	**-**	**-**

Course Content

MSC/CSE/3/SEC/501 Digital Marketing

Unit – I	**Introduction Digital Marketing:** Changing face of advertisement, technology behind digital marketing, need of digital marketing, defining your digital marketing strategy, understanding digital consumer.
Unit II	**Website for Digital Marketing:** Need of website, steps of building website, choosing domain name, hosting website, arranging information and writing effective web content, advertising on search engine.
Unit III	**Social Media and Email Marketing:** Introduction to social media, different forms of social media, rules of engagement, Introduction to email marketing, planning your campaign, measuring success.
Unit – IV	**Other Marketing Strategies:** Introduction to mobile marketing, mobile application, performance marketing, understanding content marketing, content strategy and content promotion.
Text Books	1.Chaffey, D., & Ellis-Chadwick, F. (2022). Digital Marketing: Strategy, Implementation and Practice (8th ed.). Pearson Education Limited. 2.Duckett, J. (2011). HTML and CSS: Design and Build Websites. John Wiley & Sons. 3.Barker, M., Barker, D., Bormann, N., &Neher, K. E. (2020). Social Media Marketing: A Strategic Approach (3rd ed.). Cengage Learning. 4.Pasqua, R., & Elkin, N. (2019). Mobile Marketing: An Hour a Day (2nd ed.). John Wiley & Sons.
Reference Books	1.Scott, D. M. (2020). The New Rules of Marketing and PR (7th ed.). Wiley. 2.Moran, M., & Hunt, H. (2014). Search Engine Marketing, Inc.: Driving Search Traffic to Your Company's Website. IBM Press. 3.White, C. (2019). Email Marketing Rules: A Step-by-Step Guide to the Best Practices that Power Email Marketing Success. John Wiley & Sons. 4.Glazer, R. (2019). Performance Partnerships: The Checkered Past, Changing Present and Exciting Future of Affiliate Marketing. Entrepreneur Press. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/3/SEC/501 Digital Marketing (Lab)

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Skill Enhancement	02	04	Lab work	50	-	3 Hours	TEE (Experiment., File, Viva)

Instructions to paper setter for Final-Term Examination: The Final-Term examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated based on the

practical file, performance in the practical exam, and a viva voce exam.

Course Objectives: The objective of this course is to learn the concepts of digital marketing, social media marketing and other online marketing strategies.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define**: the basic concepts of digital marketing, social media marketing and other online marketing strategies.
CO2	**explain:** the effective usage of digital marketing, social media marketing and other online marketing strategies.
CO3	**use:** different strategies in digital marketing.
CO4	**classify:** strategies and tools used in digital marketing.
CO5	**compare and select types of :** tools, strategies, and digital editing tools.

CO-PO Mapping Matrix

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**3**	**1**	**1**	**1**	**-**	**3**	**1**	**-**	**2**	**-**	**-**
CO2	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**2**	**-**	**2**	**-**	**-**
CO3	**3**	**1**	**1**	**3**	**3**	**-**	**3**	**3**	**-**	**2**	**-**	**-**
CO4	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**3**	**-**	**2**	**-**	**-**
CO5	**2**	**1**	**3**	**1**	**3**	**-**	**3**	**3**	**-**	**2**	**-**	**-**
Avg	**2**	**1.4**	**1.4**	**2.2**	**1.8**	**-**	**3**	**2.4**	**-**	**2**	**-**	**-**

M.Sc. CS (AI&DS) 1-Year Program

Semester 1

Research Work (Option 3)

MSC/CSE/3/SEC/501: Research Methodology							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Skill Enhancement Course	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to the paper setter for Final Term Examination: The Final Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper, each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to get the students familiar with different aspects of research methodology, namely, research design, collection and analysis of data, and interpretation of results.

Course Outcomes	At the end of this course, the student will be able to :
CO1	**define:** objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis, sampling.
CO2	**describe**: objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis, sampling.
CO3	**Illustrate:** measurement. data collection, processing, sampling, analysis, and its strategies, reports.
CO4	**categorize:** research, sampling methods, data collection techniques, reports,and data processing strategies.
CO5	**compare:** sampling methods, data collection techniques, reports and data processing strategies.
CO6	**create:** thesis, reports. **design:** research tool. **interpret(drive):** results.

CO-PEO Mapping Matrix

Cos	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	3	-	3	1	3

CO2	2	1	1	3	1	-	-	3	-	3	2	3
CO3	3	1	1	3	3	-	-	3	-	3	3	3
CO4	3	3	1	3	1	-	-	3	-	3	3	3
CO5	3	1	1	3	3	-	-	3	-	3	3	3
CO6	3	3	3	3	3	-	-	3	-	3	3	3
Average	2.5	2	1.3	2.6	2	-	-	3	-	3	2.5	3

CO-PSO Mapping Matrix

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	3
CO2	3	3	2	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	3	3	2.5	3	3

Course Content
MSC/CSE/3/SEC/501: Research Methodology

Unit – I	**Objectives and types of research:** motivation and objectives- research methods vs. methodology, types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs empirical research formulation: defining and formulating the research problem. selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review- primary and secondary source reviews, hypothesis- definition, qualities of a good hypothesis, null hypothesis, and alternatives.
Unit – II	**Research design and methods:** basic principles, need of research design- features of good design, important concepts relating to research design, criteria of selecting a sampling procedure, characteristics of a good sample design, sampling methods, measurement: concept of measurement, problems in measurement in research - validity and reliability, levels of measurement- nominal, ordinal, interval, ratio.
Unit – III	**Data collection and analysis:** Execution of the research, observation and collection of data, methods of data collection, data processing and analysis strategies, data analysis with statistical packages, hypothesis testing, generalization and interpretation, univariate analysis (frequency tables, bar charts, pie charts, percentages).
Unit – IV	**Meaning of interpretation**: Need of interpretation, technique of interpretation, precaution in interpretation, layout of a research paper, journals in computer science, impact factor of journals, ethical issues related to publishing, plagiarism, and self-plagiarism. reports and thesis writing: structure and components of scientific reports, types of reports- technical reports and thesis, writing- synopsis, abstract, illustrations and tables, results, summary, reference citing and listing.

Text/Reference Books	
Text Books	1. J. Garg, B.L Karadia, R, Aggarwal F, An Introduction to Research Methodology, RBSA Publishers, 2002. 2. Kothari,C.R, Research Methodology: Methods and Techniques. New Age International, 1990 3. Santosh Gupta, Research Methodology and Statistical Techniques, Deep & Deep Publications Pvt. Ltd., 2008
Reference Books	1.N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers. Montgomery, Douglas C, Design and Analysis of Experiments,Wiley India Pvt. Ltd Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/3/RPR/501: Research Project						
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks	Exam Duration	Assessment Methods
Research	20	-	-	500	-	-

Instructions for evaluation: At the end, and as a part of the third semester, students who opted for Option 3 shall submit a Research Synopsis of at least 50 pages comprising a Literature Survey, identification of the Research Problem, Plan of Work, Methodology, and Practical Work (if any), which will be evaluated by internal and external examiners.

Course Objectives: To guide students through the processes of literature review, problem identification, research gap analysis, and methodology selection, culminating in the preparation and presentation of a well-structured research synopsis.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**conduct a comprehensive literature review** to identify research gaps and formulate relevant, researchable questions.
CO2	**select and refine a viable research topic** aligned with disciplinary relevance, feasibility, and originality.
CO3	**define clear research objectives and hypotheses**, establishing the scope, rationale, and significance of the proposed study.
CO4	**demonstrate familiarity with appropriate research methodologies,** including qualitative, quantitative, or mixed-method approaches, and justify their selection.
CO5	**develop a structured research synopsis** that includes background, objectives, methodology, expected outcomes, and a preliminary bibliography, following academic conventions.

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	3	3	3
CO2	2	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	2.4	3	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	3	3	3	3	3	-	3	3
CO2	2	2	2	3	3	3	3	3	3	-	3	3
CO3	3	2	2	3	3	3	3	3	3	-	3	3

CO4	3	2	2	3	3	3	3	3	3	-	3	3
CO5	3	2	2	3	3	3	3	3	3	-	3	3
Average	2.4	2	2	3	3	3	3	3	3	-	3	3

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3

M.Sc. CS (AI&DS) 1-Year Program

Semester 2

Course Work (Option-1)

MSC/CSE/4/DSC/551: Social Network Analytics							
Course Type	Course Credits	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to the paper setter for the Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to understand the concept of Social Media Analytics, NLP techniques, analytics of Facebook, and the collection and analysis of data related to social media.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** Social Media Analytics, Web analytics tools, Network Analysis (LinkedIn, Instagram, YouTube, Twitter, etc., Google Analytics).
CO2	**understand and describe:** Link Prediction, Collective Classification, Applications in Advertising and Game Analytics.
CO3	**apply and use:** techniques of Processing and Visualizing Data, Natural Language Processing Techniques for Micro-text Analysis.
CO4	**classify:** Social Media Analytics, Web analytics, and Facebook Analytics.
CO5	**compare:** techniques of Processing and Visualizing Data, Natural Language Processing Techniques for Micro-text Analysis.

CO-PO Mapping Matrix

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**3**	**1**	**1**	**1**	**-**	**3**	**-**	**-**	**1**	**-**	**-**
CO2	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**1**	**-**	**-**
CO3	**3**	**1**	**1**	**3**	**3**	**-**	**3**	**-**	**-**	**1**	**-**	**-**
CO4	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**1**	**-**	**-**
CO5	**2**	**1**	**3**	**1**	**3**	**-**	**3**	**-**	**-**	**1**	**-**	**-**

Avg	**2**	**1.4**	**1.4**	**2.2**	**1.8**	**-**	**3**	**-**	**-**	**1**	**-**	**-**

Course Content **MSC/CSE/4/DSC/551: Social Network Analytics**	
Unit-I	**Introduction to Social Media Analytics (SMA):** Social media landscape, Need for SMA; SMA in small organizations, SMA in large organizations, application of SMA in different areas. **Network fundamentals and models:** The social networks perspective - nodes, ties and influencers, social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization.
Unit–II	**Making connections:** Link analysis. Random graphs and network evolution. **Social contexts:** Affiliation and identity. **Web analytics tools:** Click stream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis.
Unit–III	**Facebook Analytics:** Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post-performance on FB. Social campaigns. Measuring and analyzing social campaigns, defining goals and evaluating outcomes, and Network Analysis. (LinkedIn, Instagram, YouTube, Twitter, etc. Google Analytics. Introduction. (Websites)
Unit–IV	**Data Collection and Analysis:** Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective Classification, Applications in Advertising and Game Analytics Introduction to Python Programming, Collecting and analyzing social media data; visualization and exploration.
Text/Reference Books	
Textbooks	1.Matthew Ganis, AvinashKohirkar, "Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media", Pearson.
Reference Books	1.Jim Sterne, Jim Sterne, "Social Media Metrics: How to Measure and Optimize Your Marketing", Wiley. 2.Oliver Blanchard, "Social Media ROI: Managing and Measuring Social Media Efforts in Your Organization (Que Biz-Tech)", Que Publishing. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/4/DSC/552: Legal & Ethical Aspects of Data Science

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to the paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper, each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: This course is designed to help students understand the ethical and legal challenges inthe field of data science. It provides a structured foundation for ethical reasoning, legal compliance, and responsible data practices in digital environments. The course explores historical data misuse, modern data protection laws, digital trust, and governance frameworks to prepare students for ethical decision-making in their professional roles as data scientists.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**Define:** the concepts of data ethics, privacy, trust, cybersecurity, and governance in the context of data science.
CO2	**Understand and explain:** the importance of legal frameworks such as GDPR, HIPAA, and CCPA, as well as the historical and contemporary relevance of ethical data practices.
CO3	**Illustrate:** different types of ethical challenges and strategies, such as responsible data sharing, digital trust mechanisms, data breaches, and encryption protocols.
CO4	**Classify:** legal and ethical risks, data governance structures, privacy safeguards, and professional responsibilities in data science.
CO5	**Compare and choose (and justify):** a particular ethical framework, governance model, or privacy-compliant approach for a given real-world data scenario.

CO-PO Mapping Matrix

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
CO 1	**1**	**3**	**1**	**1**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**

2												
CO 3	**3**	**1**	**1**	**3**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO 4	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO 5	**2**	**1**	**3**	**1**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
Avg	**2**	**1.4**	**1.4**	**2.2**	**1.5**	**-**	**3**	**-**	**-**	**2**	**-**	**-**

Course Content
MSC/CSE/4/DSC/552: Legal and Ethical Aspects of Data Science

Unit – I	**Introduction to Data Ethics**: Overview and Importance of Data Ethics. The significance of data ethics in modern technology, its impact on individuals and society. Historical Examples of Data Ethics Violations: A historical perspective on data ethics violations, such as data breaches and misuse of data.
Unit – II	**Data Privacy:** Data Privacy and Legal Frameworks, Data Privacy Laws and Regulations, GDPR, CCPA, and HIPAA, Understanding the key principles and requirements of privacy laws, Data Storage and Secure Handling: Encryption, and data handling protocols, Strategies for ensuring data security and integrity, Cybersecurity and Data Breaches, Handling Data Breaches Responsibly.
Unit - III	**Data Ethics and Trust:** Introduction to digital trust, the snowden effect, the sharing economy, ethical data use, sharing and access, ethical considerations when sharing data with partners, stakeholders, and the public, Strategies for ensuring responsible data sharing and access Best Practices for Responsible Data Use, Strategies for integrating data ethics into professional practices, software development, system design, and decision-making processes.
Unit – IV	**Data Governance and Regulation:** Introduction to Data Governance, Importance of Governance, Examples of Data Governance in action, The Business value of Data Governance, why data Governance is easier in the public cloud, Ingredients of Data Governance.
Text/Reference Books	
Text Books	1. Christoph Stückelberger, Pavan Duggal, Data Ethics: Building Trust: How 2. Digital Technologies Can Serve Humanity, Globethics Publications, 1st Ediiton, 2023. 3. GryHasselbalch&PernilleTranberg, Data Ethics, PubliShare, 1st Edition, 2016.

Reference Books	1. Ian Foster, Rayid Ghani, Ron S. Jarmin, FraukeKreuter, Julia Lane, Big Data and Social Science:Data Science Methods and Tools for Research and Practice, Chapman and Hall/CRC, 2nd Edition,2020. 2. EvrenEryurek, Uri Gilad, ValliappaLakshmanan, Data Governance: The Definitive Guide - People, Processes, and Tools to Operationalize Data Trustworthiness, Shroff/O'Reilly, 1st Edition, 2021. 3. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, O'Reilly Media., "Doing Good Data Science" Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/4/DSC/553: MATLAB

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to the paper setter for Final Term Examination: The Final Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper, each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to study, learn, and understand the major concepts of MATLAB Programming, namely, data types, data structure, matrices, data import/export, graphics, control structure, toolboxes, image and video processing.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** features, commands, data types, hierarchy of operations, matrix, tools, functions related to input/output, file handling and graphics, control structure and toolboxes used in MATLAB.
CO2	**describe:** history, origin, features, commands, data types, hierarchy of operations, matrix, tools, functions related to file, function related to graphics, control structure and various toolboxes of MATLAB.
CO3	**use:** commands, operations, tools, menus, toolbars, input/output functions, file handling, functions related to graphics, 2D and 3D plotting, control structure, debugging, simulink and image & video processing toolboxes in MATLAB.
CO4	**analyze:** commands, data types, operations, control structure, matrix, tools, different functions related to graphics and file handling in given MATLAB program.
CO5	**determine:** command, data type, tool, menu, control structure, debugging technique, function, feature or toolbox of MATLAB to use in given condition.
CO6	**create:** basic or advanced program in MATLAB using different commands, 2D and 3D plotting, functions, tools, features, simulink, fuzzy logic, neural network and image & video processing toolbox of MATLAB.

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	3	1	-	-	-	-	-	2	3
CO3	3	1	1	3	3	-	-	-	-	-	3	3
CO4	3	3	1	3	1	-	-	-	-	-	3	3
CO5	3	1	1	3	3	-	-	-	-	-	3	3
CO6	3	3	3	3	3	-	-	-	-	-	3	3
Average	2.5	2	1.33	2.67	2	-	-	-	-	-	2.5	3

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	3
CO2	3	3	2	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
CO6	3	3	3	-	3
Average	3	3	2.5	-	3

Course Content
MSC/CSE/4/DSC/553: MATLAB

Unit I	**MATLAB:** Introduction, history, origin, growth and development, features, menus and the toolbar, computing, types of file, editor debugger, useful commands, help system, creating directory and saving files, constants variables and expressions-character set, data type, constants, variables and expressions, operators, hierarchy of operations, built-in-function, assignment statements. Vectors and matrices: scalars and vectors, entering data in matrices, line continuation, matrices subscripts, multi-dimensional matrices and arrays, matrix manipulation, special matrices, commands related to matrices, structure arrays, cell arrays.
Unit - II	**Polynomials:** entering, evaluation, roots, operations. Input/output statements: data input, interactive inputs, reading/storing data files, output commands, low level input output functions. Introduction to data import and export, supported file format, working with audio/video file, importing audio/video data, reading audio/video data from a file, exporting audio/video data, example, working with spreadsheets, writing to an xls file, reading from an xls files, working with graphics file, importing graphics data, exporting graphics data, creating a simple GUI programmatically, dissertations of different components in guide, creating menus.
Unit - III	**MATLAB graphics:** 2d/3d plotting visualization, 2d plot , multiple plot, style options, legends, subplots, specialized 2d plot- logarithmic, polar, area, bar, barh, hist, rose, pie, stairs, stem, compass. 3d plot - plot3, bar3, bar3h, pie3, stem 3, meshgrid, mesh, surf, contour, contour3. Control Structures: for, nested for, while, branch control structure- if, switch, break, continue, error, try-catch, debugging.
Unit - IV	**Introduction to MATLAB toolboxes:** Simulink, image & video processing

	toolbox, application level image processing techniques, mri image processing, fuzzy logic toolbox, neural network toolbox.
Text/Reference Books	
Text Books.	1.Raj Kumar Bansal, Ashok Kumar Goel, ManojKumar,MATLAB and its Application in Engineering, Pearson Education. 2.Ram N.Patel, Ankush Mittal, Programming in MATLAB, A Problem Solving Approach, Pearson Education. 3.Duane Hanselman, Bruce L Littlefield, Mastering MATLAB 7, Prentice Hall. 4.Amos Gilat, MATLAB: An Introduction with Application, Wiley Publisher.
Reference Books	1.Jim Sizemore, John P.Mueller, MATLAB for Dummies, Wiley. 2.Stephen J.Chapman, Matlab Programming for Engineers, Thomson-Engineering Publisher, CENGAGE Learning. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/4/DSC/551
MSC/CSE/4/DSC/554: Deep Learning

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to the paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper, each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** the terms of machine learning: deep learning, regression, classification, regression, neurons, CNN and RNN.
CO2	**explain:** architecture of ANN and deep learning, variants of the basic convolution function, Long short-term memory.
CO3	**apply:** classification, regression, clustering techniques, Feed forward multilayer neural network, CNN, RNN according to their problem.
CO4	**classify:** regression, classification, Convolutional Neural networks, RNN
CO5	**compare:**Single-layer and Multi-layer Perceptron, CNN and RNN

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	1	3	3
CO2	2	3	1	3	3
CO3	3	3	1	3	3
CO4	3	3	1	3	3
CO5	3	3	1	3	3
Average	2.4	3	1	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	1	-
CO2	3	1	3	2	-
CO3	3	1	3	3	-
CO4	3	1	3	3	-
CO5	3	1	3	3	-
Average	3	1	3	2.6	-

Course Content
MSC/CSE/4/DSC/554: Deep Learning

Unit – I	**Introduction:** Introduction to Machine learning, Deep learning and AI , Historical trends in Deep learning ,Architecture of deep learning, Significance of Deep learning, application of deep learning, challenges of Deep learning. **Neural Network**: Introduction, architecture, difference between Biological Neuron Network and Artificial Neuron Network.
Unit – II	**Foundation of Deep Learning:** Vectors, scalars, matrices, statistics, probability. Regression, classification, underfitting, overfitting, gradient descent, logistic regression, and confusion matrix. Activation functions of Neural Network (linear, sigmoid, tanh, softmax).
Unit – III	**Fundamentals of Deep Learning:** common architectural principles of deep learning, Single-layer and Multi-layer Perceptron, Cross-entropy loss functions for Neural net, Matrix representation of Neural nets. **Building block of deep network**: Feed forward multilayer neural network, RBMs, Autoencoders.
Unit – IV	**Convolutional Neural Networks:** Deep Learning and Neural Networks. Perceptron, Convolutional networks, variants of the basic convolution function, efficient convolution algorithms. **Recurrent Neural Networks:** Bidirectional RNNs, Deep recurrent networks, recursive neural networks, the Long short-term memory, and other gated RNNs.
Text/Reference Books	
Text Books	1. David Foster, Generative Deep Learning, O'Reilly, 2019. 2. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016. 2. Patterson, Josh, and Adam Gibson. Deep learning: A practitioner's approach. " O'Reilly Media, Inc.", 2017. 3 .Charu, C. Aggarwal. Neural networks and deep learning: a textbook. 2018.
Reference Books	1. Buduma, Nithin, Nikhil Buduma, and Joe Papa. Fundamentals of deep learning. " O'Reilly Media, Inc.", 2022. 2. Weidman, Seth. Deep learning from scratch: building with python from first principles. O'Reilly Media, 2019. 3.Ian Goodfellow, YoshuaBengio and Aaron Courville. Deep learning, The MIT Press, 2016. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/4/DSC/555: MATLAB (Lab)

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	02	04	Lab Work	50	-	3 Hours	TEE (Experiment, File, Viva)

Instructions to paper setter for Final Term Examination: The Final Term examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of practical file, performance in practical and a viva voce exam.

Course Objectives: The objective of this course is to get the students hands on practice with programming constructs of MATLAB and their usage. This course is based on **MSC/CSE/4/DSC/553: MATLAB.**

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** features, commands, data types, hierarchy of operations, matrix, tools, functions related to input/output, file handling and graphics, control structure and toolboxes used in MATLAB.
CO2	**describe:** history, origin, features, commands, data types, hierarchy of operations, matrix, tools, functions related to file, function related to graphics, control structure and various toolboxes of MATLAB.
CO3	**use:** commands, operations, tools, menus, toolbars, input/output functions, file handling, functions related to graphics, 2D and 3D plotting, control structure, debugging, simulink and image & video processing toolboxes in MATLAB.
CO4	**analyze:** commands, data types, operations, control structure, matrix, tools, different functions related to graphics and file handling in given MATLAB program.
CO5	**determine:** command, data type, tool, menu, control structure, debugging technique, function, feature or toolbox of MATLAB to use in given condition.
CO6	**create:** basic or advanced program in MATLAB using different commands, 2D and 3D plotting, functions, tools, features, simulink, fuzzy logic, neural network and image & video processing toolbox of MATLAB.

CO-PEO Mapping Matrix

Cos	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	-	-	-	1	3

CO2	2	1	1	3	1	-	-	-	-	-	2	3
CO3	3	1	1	3	3	-	-	-	-	-	3	3
CO4	3	3	1	3	1	-	-	-	-	-	3	3
CO5	3	1	1	3	3	-	-	-	-	-	3	3
CO6	3	3	3	3	3	-	-	-	-	-	3	3
Average	2.5	2	1.33	2.67	2	-	-	-	-	-	2.5	3

CO-PSO Mapping Matrix

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	3
CO2	3	3	2	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
CO6	3	3	3	-	3
Average	3	3	2.5	-	3

MSC/CSE/4/DSC/555: Deep Learning (Lab)							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Discipline Specific	02	04	Lab Work	50	-	3 Hours	TEE(Experiment File, Viva)

Instructions to paper setter for Final Term Examination: The Final Term examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the basis of practical file, performance in practical and a viva voce exam.

Course Objectives: The objective of this course is to get the students hands on practice with programming constructs of MATLAB and their usage. This course is based on **MSC/CSE/1/DSC/554: Deep Learning.**

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** basic machine learning and deep learning models using appropriate tools and libraries.
CO2	**describe:** a neural network using activation functions and loss functions like softmax and cross-entropy.
CO3	**demonstrate:** the ability to preprocess data and handle issues like overfitting and underfitting using appropriate regularization or data augmentation techniques.
CO4	**construct:** and evaluate feedforward neural networks, autoencoders, and Restricted Boltzmann Machines for pattern recognition tasks.
CO5	**build:** convolutional neural networks (CNNs) for image classification using various convolutional functions and evaluate their performance.
CO6	**implement:** recurrent neural networks (RNNs) and LSTM architectures for sequence prediction tasks such as time series or text generation.

CO-PEO Mapping Matrix

Cos	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	3	1	-	-	-	-	-	2	3
CO3	3	1	1	3	3	-	-	-	-	-	3	3
CO4	3	3	1	3	1	-	-	-	-	-	3	3
CO5	3	1	1	3	3	-	-	-	-	-	3	3

CO6	3	3	3	3	3	-	-	-	-	-	3	3
Average	2.5	2	1.33	2.67	2	-	-	-	-	-	2.5	3

CO-PSO Mapping Matrix

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	3
CO2	3	3	2	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
CO6	3	3	3	-	3
Average	3	3	2.5	-	3

MSC/CSE/4/SEC/551: Intellectual Property Rights							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Skill Enhancement Course	04	04	Lecture	70	-	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will consist of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide a foundational understanding of Intellectual Property Rights (IPR), covering key concepts, legal frameworks, and practical applications related to patents, copyrights, and trademarks. It aims to familiarize students with the evolution, significance, and enforcement of IPR, while encouraging critical analysis of its role in balancing innovation, private rights, and public interest.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define** the fundamental concepts, types, and theories of Intellectual Property Rights.
CO2	**describe:** the legal frameworks and historical evolution of patent, copyright, and trademark laws.
CO3	**demonstrate:** an understanding of procedures for registration, protection, and enforcement of various IPRs.
CO4	**construct:** case-based analyses to evaluate issues related to patentability, copyright exceptions, and trademark infringements.
CO5	**build:** awareness of the economic and social implications of IPR, including the balance between public and private interests.
CO6	**implement:** appropriate legal provisions and strategies for managing IPR in real-world professional or entrepreneurial settings.

CO-PEO Mapping Matrix

Cos	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
CO6	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	1	3	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	3	1	-	-	-	-	-	2	3
CO3	3	1	1	3	3	-	-	-	-	-	3	3
CO4	3	3	1	3	1	-	-	-	-	-	3	3
CO5	3	1	1	3	3	-	-	-	-	-	3	3
CO6	3	3	3	3	3	-	-	-	-	-	3	3
Average	2.5	2	1.33	2.67	2	-	-	-	-	-	2.5	3

CO-PSO Mapping Matrix

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	-	3
CO2	3	3	2	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
CO6	3	3	3	-	3
Average	3	3	2.5	-	3

Course Content
MSC/CSE/4/SEC/551: Intellectual Property Rights

Principles of IPR: Introduction to Intellectual Property Rights, Concept and Theories, Kinds of Intellectual Property Rights, Advantages and Disadvantages of IPR, Criticisms of Intellectual Property, Rights.

Patent Law and Practices: Introduction, Overview, Historical Development Concepts, Patent Act 1970 – amendments of 1999, 2000, 2002 and 2005, Patentability criteria, Software Patents, Rights of patentee, Procedure for granting a patent and obtaining patents, Transfer of patent rights.

Copyright Law and Practices: Concept and Principles, Historical background and Development of Copyright Law, Copyright Act, 1957 Terms of Copyright conditions for grant of copyright, extent of rights exception to copyright protection, fair use provision, assignment and licensing, Copyright in Computer Programme, Author Special Rights, Copyright Registrar and Copyright Board-Power and Procedure.

Trademark Law and Practices: Introduction to Trademarks, Need for Protection, Kinds of trademarks, Concept of Well-known trademark, Registration of trademark, Grounds of refusal of registration, Infringement of trademark, Defences Remedies for infringement.

Text/Reference Books

1. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow
2. Dr. B.L. Wadhera, Law Relating to Patent, Trademarks, Copyright & Designs
3. P. Narayanan (Eastern Law House), Intellectual Property Law

M.Sc. CS (AI&DS) 1-Year Program

Semester 2

Research Work (Option 2)

MSC/CSE/4/SEC/551: Synopsis and Presentation						
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks	Exam Duration	Assessment Methods
Skill Enhancement Course	2 Synopsis	-	Presentation	50 Synopsis	-	-
	2 Presentation			50 Presentation		

Instructions for evaluation: The students shall prepare and submit his/her research synopsis/proposal within one month of commencement of classes. The proposal will be evaluated by a panel of three teachers of the department through documentation and presentation.

Course Objectives: To prepare students for undertaking independent research by enabling them to develop a well-defined research proposal or synopsis. The course aims to strengthen their ability to identify a research problem, formulate research questions or hypotheses, review relevant literature, and design an appropriate research methodology. In addition, the course enhances students' academic writing and oral presentation skills, equipping them to confidently articulate and defend their research ideas in academic and professional forums.

Course Outcomes	At the end of this course, the student would be able to:
CO1	**Recognize and define:** the key components of a research synopsis, including the problem statement, objectives, methodology, and expected outcomes.
CO2	**Understand:** and describe the steps involved in formulating a research

	problem and conducting a literature review.
CO3	**Classify:** the various types of research (e.g., empirical, theoretical, applied) and distinguish appropriate methodologies for each.
CO4	**Compare:** the structure, format, and requirements of research proposals across academic disciplines and justify the choice of a suitable format for their own work.
CO5	**Recognize:** and define the key components of a research synopsis, including the problem statement, objectives, methodology, and expected outcomes.

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	3	3	3
CO2	2	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	2.4	3	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	3	3	3	3	3	-	3	3
CO2	2	2	2	3	3	3	3	3	3	-	3	3
CO3	3	2	2	3	3	3	3	3	3	-	3	3
CO4	3	2	2	3	3	3	3	3	3	-	3	3
CO5	3	2	2	3	3	3	3	3	3	-	3	3
Average	2.4	2	2	3	3	3	3	3	3	-	3	3

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3

MSC/CSE/4/RPR/551: Research Project						
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks	Exam Duration	Assessment Methods
Research	20	-	-	500	-	-

Instructions for evaluation: The evaluation of Research Thesis will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of the documentation and a presentation based viva voce exam.

Course Objectives: To develop students' capacity for independent, original research by engaging them in the systematic investigation of a significant academic or practical problem. Through this course, students will learn to apply appropriate research methodologies, critically analyze data, and effectively communicate their findings in the form of a well-structured thesis adhering to academic standards.

Course Outcomes	At the end of this course, the student would be able to:
CO1	**identify and formulate a research problem** through critical literature review, gap analysis, and topic selection aligned with academic and societal relevance.
CO2	**design a coherent research plan**by defining objectives, selecting appropriate methodologies, and justifying ethical and theoretical frameworks in a structured synopsis.
CO3	**conduct independent research**using appropriate tools for data collection, organization, and analysis to generate valid and reliable findings.
CO4	**interpret and synthesize research outcomes** in the context of existing knowledge, drawing meaningful conclusions and implications for theory and/or practice.
CO5	**communicate research effectively** through a well-structured thesis, adhering to academic writing standards, ethical guidelines, and disciplinary conventions.

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	3	3	3
CO2	2	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	2.4	3	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	3	3	3	3	3	-	3	3
CO2	2	2	2	3	3	3	3	3	3	-	3	3

CO3	3	2	2	3	3	3	3	3	3	-	3	3
CO4	3	2	2	3	3	3	3	3	3	-	3	3
CO5	3	2	2	3	3	3	3	3	3	-	3	3
Average	2.4	2	2	3	3	3	3	3	3	-	3	3

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3

M.Sc. CS (AI&DS) 1-Year Program

Semester 2

Research Work (Option 3)

MSC/CSE/4/SEC/551: Research & Publication Ethics							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
SEC Theory + Practical	04	05 (3T+2P)	Lecture/ Practical	50 Theory	25 15 | 5 | 5	3 Hours	TEE/MTE/ Assignment/ Attendance
				25 Practical	-	3 Hours	TEE (Experiment, File, Viva)

Instructions to paper setter for term-end theory examination: The term-end examination of theory part the total number of questions shall be NINE. Question number one will be compulsory and will be consisting of FIVE short/objective-type questions from the complete syllabus. In addition to the compulsory question, there shall be EIGHT questions (two questions from each unit). The student will attempt one question from each unit in addition to the compulsory question. All questions will be of TEN marks each.

Course Objectives: The objective of this course is to get the students familiar with different aspects of research methodology, namely, research design, collection and analysis of data, and interpretation of results.

Course Outcomes	By the end of this course, the student will be able to:
CO1	**Define:** the key concepts of research ethics, scientific misconduct, and academic integrity.
CO2	**Understand and explain:** the principles of ethical research conduct, including honesty, objectivity, openness, and citation ethics; and the roles of regulatory bodies such as

	UGC, COPE, and institutional ethics committees.
CO3	**Illustrate different types of** scientific misconduct (e.g., plagiarism, data fabrication, unethical authorship), publication fraud, and common violations of academic standards.
CO4	**Classify:** types of ethical issues in research, types of plagiarism, categories of predatory journals, and levels of authorship contributions.
CO5	**Compare and choose (and justify) a particular:** plagiarism detection tool, referencing style (APA, MLA, etc.), peer-reviewed publication venue, or ethical approach for data sharing and reporting.

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	1	3	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	2.5	2.5	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	3	-	-	-	-	1	-	2
CO2	3	3	2	2	3	-	-	-	-	2	-	2
CO3	3	3	-	-	2	2	-	3	1	2	-	2
CO4	2	3	-	-	2	2	1	3	2	3	-	3
CO5	2	2	-	-	2	3	-	3	-	3	-	3

CO-PSO Mapping Matrix

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	3
CO2	3	3	2	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Course Content: Research Publication &Ethics

Unit – I	**Research and Publication Ethics:** Principles and Misconduct: Definition, importance, and historical development of research ethics. Ethical principles: honesty, objectivity, integrity, carefulness, openness, respect for intellectual property.

Unit II	**Types of scientific misconduct:** plagiarism, falsification, fabrication, redundant publication, unethical authorship. Understanding authorship criteria and contributor ship. Citation ethics and proper referencing. UGC and COPE guidelines for ethical research practices. Peer review ethics, conflict of interest, and whistleblower protection.
Unit III	**Academic Integrity, Publication Standards, and Institutional Mechanisms:** Ethics in data collection, use, and sharing. Tools for plagiarism detection and content originality (e.g., Turnitin, Grammarly, AI-detection tools). Identifying predatory journals; impact factor, h-index, and other publication metrics.
Unit – IV	**Ethical issues in collaborative, funded, and interdisciplinary research. IRBs, Ethics Committees, and institutional ethical clearance. Research reporting:** structure of thesis, dissertations, and research papers; writing synopsis, abstracts, references (APA/MLA), tables, illustrations, and results. UGC and institutional policies on research integrity.
Text/Reference Books	
Text Books	1.Brian Christian, The Alignment Problem: Machine Learning and Human Values, W. W. Norton & Company, 2020. 2.S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Pearson, 4th edition, 2020. 3.Terence Parr and Keith Instone, The Definitive Guide to GPT-3 and LLMs, Manning Publications, 2023.
Reference Books	1.N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers. Montgomery, Douglas C, Design and Analysis of Experiments, Wiley India Pvt. Ltd. 2.Brian Christian, The Alignment Problem: Machine Learning and Human Values, W. W. Norton & Company, 2020. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/4/RPR/552: Research Project (Final)								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
Research	20			-	-	500	-	-

Instructions for evaluation: The students going for research work in the fourth semester will be based on the project submitted at the end of the third semester. The final Research Thesis/Project will be evaluated by the internal and external examiners.

Course Objectives: The objective of this course is to enable students to carry out independent and in-depth research based on their approved synopsis. It focuses on the systematic execution of the research plan, data collection and analysis, interpretation of findings, and the scholarly presentation of results in the form of a comprehensive thesis that meets academic and ethical standards.

Course Outcomes	At the end of this course, the student will be able to:	
CO1	**implement the approved research design** by systematically collecting, organizing, and analyzing data using appropriate tools and techniques.	
CO2	**apply critical thinking and analytical skills** to interpret results in relation to the stated research objectives and hypotheses.	
CO3	**integrate theoretical frameworks and empirical findings** to build coherent, evidence-based arguments.	
CO4	**maintain academic integrity and ethical standards** throughout the research process, including data management, authorship, and citation practices.	
CO5	**draft and revise the thesis** in accordance with disciplinary standards, demonstrating clarity, originality, and scholarly depth.	

CO-PEO Mapping Matrix

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	3	3	3
CO2	2	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	2.4	3	3	3	3

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	3	3	3	3	3	-	3	3
CO2	2	2	2	3	3	3	3	3	3	-	3	3
CO3	3	2	2	3	3	3	3	3	3	-	3	3
CO4	3	2	2	3	3	3	3	3	3	-	3	3
CO5	3	2	2	3	3	3	3	3	3	-	3	3
Average	2.4	2	2	3	3	3	3	3	3	-	3	3

CO-PSO Mapping Matrix

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3