Master of Computer Science
(Artificial Intelligence & Data Science)

2 Year Postgraduate Program

(As per NEP-2020)

For programme run in UTD (Dept. of CSE)

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

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

(V) 24 (VI)

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

&

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
8. BRC: Bridge Course

Structure for 2-Year M.Sc. CS (AI&DS) Program

Table 1: First Year of 2-Year Program (NHEQF Level 6)

	Sem	DSC	SEC/VOC/Internship	Research thesis/project	Total Credits
First year for all options	I	Mathematics for Data Science (4 credit) Database System (4 credit) Python (4 credit) Data Structures & Algorithms (4 credit) Python Lab (2 credit) Data Structure & Algorithms Lab (2 credit)	Generative AI in Digital Literacy (4 credit) (2+2)	---	24
	II	Artificial Intelligence (4 credit) Big Data Analytics (4 credit) Data Mining (4 credit) Machine Learning (4 credit) Data Mining Lab (2 credit) Machine Learning Lab (2 Credit)	Digital Forensic (4 credit) (2+2)	---	24

Note 1: The M.Sc. CS (AI&DS) two-year program has three different structures. Students have to select one of the following three options for the second year of the M.Sc. CS (AI&DS) program.

Option 1: Only coursework (Table 2.1, Table 5.1, and Table 7.1)

Option 2: Coursework and research work (Table 2.2, Table 5.2, and Table 7.2)

Option 3: Only research work (Table 2.3, Table 5.3, and Table 7.3)

Table 2.1: Second year of the two-year M.Sc. CS (AI&DS) program (NHEQF Level 6.5) Option 1 (Only Coursework)

	Sem	DSC	SEC/VOC/Internship	Research thesis/project	Total Credits
Option-1 (Only coursework)	III	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)			
	IV	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 2.2: Second year of the two-year M.Sc. CS (AI&DS) program (NHEQF Level 6.5) (Option 2 - Coursework and Research Project)

	Sem	DSC	SEC/VOC/Internship	Research thesis/project	Total Credits
Option-2 (Course work and Research Project)	III	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)			
	IV	--	Synopsis and its Presentation (4 credit)	Research Project (20 credit)	24

Table 2.3: Second year of the two-year M.Sc. CS (AI&DS) program (Option 3 – Only Research)

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

[#]At the end, and as a part of the third 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 4th semester based on the project work/synopsis submitted at the end of 3rd semester. The final Research Thesis/Research Project Report will be evaluated by the internal and external examiners.

Table 3: Bridge Courses for M.Sc. CS (AI&DS)

Course Code	Course Title	Workload			Credit
		L	T	P	
Semester I					
MSC/CSE/1/BRC/301 MCA/CSE/1/BRC/301	Bridge Course 1	3	1	4	6
Semester II					
MSC/CSE/2/BRC/302 MCA/CSE/1/BRC/302	Bridge Course 2	3	1	4	6
Total		6	2	8	12

Note 2: Non-computer background students admitted to the 2-year MSc program shall pass the bridge courses and earn 12 mandatory credits as outlined in Table 4, above.

Table 4: Semester-wise course codes, course titles, workload and credits (Year 1 of the M.Sc. CS (AI&DS) 2-year program)

Course Code	Course Title	Workload			Credit
		L	T	P	
Year: 1, Semester: I					
MSC/CSE/1/DSC/401	Mathematics for Data Science	3	1	-	4
MSC/CSE/1/DSC/402	Database System	3	1	-	4
MSC/CSE/1/DSC/403	Python	3	1	-	4
MSC/CSE/1/DSC/404	Data Structure & Algorithms	3	1	-	4
MSC/CSE/1/DSC/405	Python & Data Structure Lab	-	-	8	4
MSC/CSE/1/SEC/401	Generative AI in Digital Literacy	2	-	4	4
Total		14	4	12	24
Year: 1, Semester: II					
MSC/CSE/2/DSC/451	Artificial Intelligence	3	1	-	4
MSC/CSE/2/DSC/452	Big Data Analytics	3	1	-	4
MSC/CSE/2/DSC/453	Data Mining	3	1	-	4
MSC/CSE/2/DSC/454	Machine Learning	3	1	-	4
MSC/CSE/2/DSC/455	Data Mining & Machine Learning Lab	-	-	8	4
MSC/CSE/2/SEC/451	Digital Forensic	2	-	4	4
Total		14	4	12	24

Table 5.1: Semester-wise course codes, course titles, workload and credits
(Year 2 of the M.Sc. CS (AI&DS) 2-year program – Option 1 – Only coursework)

Course Code	Course Title	Workload			Credit
		L	T	P	
Option: 1, Semester: III					
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: IV					
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 MCA/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 5.2: Semester-wise course codes, course titles, workload and credits
(Year 2 of the M.Sc. CS (AI&DS) 2-year program – Option 2 – Coursework and Research)

Course Code	Course Title	Workload			Credit
		L	T	P	
Option: 2, Semester: III					
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: IV					
MSC/CSE/4/SEC/551	Research Methodology	3	-	2	4
MSC/CSE/4/RPR/551	Research 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 5.3: Semester-wise course codes, course titles, workload and credits (Year 2 of the M.Sc. CS (AI&DS) 2-year program – Option 3 – Only Research)

Course Code	Course Title	Workload			Credit
		L	T	P	
Option: 3, Semester: III					
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: IV					
MSC/CSE/4/SEC/551	Research Ethics	2	-	4	4
MSC/CSE/4/RPR/551	Research Project 2[@@]	-	-	-	20
Total		2	-	4	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).

[@]At the end, and as a part of the third 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 fourth semester based on the project work/synopsis submitted at the end of the third semester. The final Research Thesis/Research Project Report will be evaluated by internal and external examiners.

M.Sc. CS (AI&DS) 2-Year Program

Year 1, Semester I

Bridge Course - 1

MSC/CSE/1/BC/301: Bridge Course – 1
MCA/CSE/1/BRC/301

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks				Exam Duration		Assessment Methods
				External	Internal					
Bridge Course	4 Theory	4 Theory (3L+1T)	Lecture	70	30			TEE 3 Hours	MTE 2 Hours	TEE/MTE/ Assignment/ Attendance
					20	5	5			
	2 Practical	4 Practical	Practical	50	-			TEE 3 Hours		TEE (Practical File, Experiment-written and execution, Viva)

Instructions for Mid-Term examination: The mid-term examination shall cover the first two units of the course content. The question paper will be set by the internal teacher.

Instructions to the paper setter for Term-End Examination: The term-end 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 seven 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 the course is to bridge the gap between subjects studied by the BCA/Bachelor of CSE students and the BA/BSc/BCom students. The students taking this bridge course shall be taught in foundational mathematics, fundamental concepts of computers and C programming language

Course Outcomes	At the end of this course, the student will be able to:
CO1	name and enlist various programming constructs of C language; enumerate fundamental concepts of computer system and computer networks; and concepts of numbers, set theory, group theory and graph theory.
CO2	understand and describe various programming constructs of C language; describe fundamental concepts of computer system and computer networks; and concepts of numbers, set theory, group theory and graph theory.
CO3	use various programming constructs of C language and mathematical concepts to solve simple problems through C programs;
CO4	differentiate between various data types, flow-control constructs, structures and unions, computer types, storage types, problem solving tools, types of networks, numbers, sets, groups and graphs.
CO5	choose between various flow-control constructs, standard/user defined data type of C language, design representation tools, transmission media, network topologies, mathematical structures that suits better in a given

	situation.
CO6	design and represent the solutions of simple problems and create C programs therefor.

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	3	1	3	-	3	3	-	-	-	-
CO6	3	3	3	3	3	-	3	3	-	-	-	-
Average	2.5	2	1.66	2.33	2	-	3	2.5	-	-	-	-

CO-PSO Mapping Matrix for Course MCA/BC/301

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	-

Course Content MCA/CSE/1/BRC/301 MSC/CSE/1/BRC/301: Bridge Course – 1	
Unit - I	**Elements of C language**: C character set, identifiers & keywords, data types: declaration & definition. Operators: Arithmetic relational, logical, bitwise, unary, assignment and conditional operators & their hierarchy & associativity, Data input/output. Control statements: Sequencing, Selection: if and switch statement; iteration, repetition: for, while, and do-while loop; break, continue, go to statement.
Unit - II	**Functions in C language**: Definition, prototype, passing parameters, recursion, Data structure: arrays, structures, union, string, data files. Pointers: Delectation, operations on pointers, array of pointers, pointers to arrays.C pre-processors.
Unit - III	**Computer Fundamentals**: introduction, characteristics of computers, the evolution of computers, the computer's generations, basic computer organization, storage hierarchy, primary & secondary storage, input-output devices. **Computer Software:** introduction, relationship between hardware and software, types of software, planning the computer program: purpose of program planning, algorithm, flowcharts, decision tables, pseudocodes, application software packages. **Data Communications and Computer Networks:** Introduction, data transmission modes, data transmission speed, transmission media, digital and analog transmission, the internet, multimedia.
Unit – IV	**Foundational Mathematics**: Types of numbers and their properties, natural numbers, whole numbers, integers, real numbers, rational numbers, irrational numbers, complex numbers, imaginary numbers. **Set theory:** Basic concepts, set types, set operations, cardinality, and notation. **Group theory:** Basic concepts, subgroups, group axioms, subgroups, cosets, normal subgroups, semigroups. **Graph theory:** Directed and undirected graphs, chains, circuits, paths, cycles, connectivity, adjacency matrix.
Text/Reference Books	
Text Books	1. Pradeep K. Sinha & Priti Sinha, Computer Fundamentals, BPB Publications 2. Rajaraman V, Fundamentals of Computers, Prentice Hall of India. 3. Seymour Lipschutz, Marc Lars Lipson, Discrete Mathematics, McGraw-Hill International Editions, Schaum's Outline Series. 4. Yashwant Kanetkar, Let us C, BPB Publications. 5. Behrouz, Frozen, Introduction to Data Communications and Networking, Tata McGraw Hill.
Reference Book	1.Thomas C. Bartee. 1985. Digital computer fundamentals (6th ed.). McGraw-Hill,Inc., USA. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

M.Sc. CS (AI&DS) 2-Year Program

Year 1, Semester II

Bridge Course -2

MSC/CSE/2/BRC/302: Bridge Course – 2
MCA/CSE/2/BRC/302

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration		Assessment Methods
				External	Internal			
Bridge Course	4 Theory	4 Theory (3L+1P)	Lecture	70	30 (20, 5, 5)	TEE 3 Hours	MTE 2 Hours	TEE/MTE/ Assignment/ Attendance
	2 Practical	4 Practical	Practical	50	-	TEE 3 Hours		TEE (Practical File, Experiment-written and execution, Viva)

Instructions for Mid-Term examination: The mid-term examination shall cover the first two units of the course content. The question paper will be set by the internal teacher.

Instructions to the paper setter for Term-End Examination: The term-end 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 seven 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 the course is to bridge the gap between subjects studied by the BCA/Bachelor of CSE students and the BA/BSc/BCom students. The students taking this bridge course shall be taught in foundational mathematics, fundamental concepts of computers and C programming language

Course Outcomes	At the end of this course, the student will be able to:
CO1	list/name various topics/terms/concepts in object orientation, C++ language, digital fundamentals, and computer organisation.
CO2	understand and describe various topics/terms/concepts in object orientation, C++ language and relate the features of C++ to concepts of object orientation as also the working of digital systems and organisation of a digital computer.
CO3	apply/use various constructs of C++ language and digital principles to write simple object oriented programs.
CO4	classify and illustrate various programming constructs of C++, computer codes, binary operations, logic gates, and digital circuits.
CO5	choose and justify a particular C++ feature, a Boolean simplification method, a particular digital circuit, an instruction format or an addressing mode.
CO6	use the knowledge of C++, digital fundamentals and computer organisation to create solutions for simple problems in an object oriented manner.

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	3	1	3	-	3	3	-	-	-	-
CO6	3	3	3	3	3	-	3	3	-	-	-	-
Average	2.5	2	1.66	2.33	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	-

Course Content

MSC/CSE/BRC/302: Bridge Course – 2 MCA/CSE/BRC/302	
Unit - I	**Object-oriented concept:** Data abstraction, encapsulation, classes and objects modularity, hierarchy, typing, concurrency, object-oriented methodology: advantages and disadvantages of OO methodologies. aggregation, generalization and inheritance, abstract class, meta data, object diagram, dynamic model – events, states, scenarios, event traces, state diagram; functional model- data flow diagram, analysis, system design and object design.
Unit - II	**C++ Programming:** Data types, structures vs classes, static data and member function, constant parameters and destruction, dynamic objects, operator overloading, function overloading, abstract class, virtual class, inheritance, virtual functions, template functions & template classes, exception handling, I/O streams.
Unit - III	**Digital Fundamentals:** Information representation - number systems, codes, binary arithmetic operations; number systems - non positional number system, positional number system, number system conversion, fractional number conversion; computer codes - BCD code, EBCDIC code, ASCII, binary arithmetic - addition, subtraction, multiplication, division; binary logic - Boolean algebra, Boolean functions, truth table, simplification of Boolean functions, digital logic gates.
Unit - IV	**Computer Organisation:** Combinational logic - adders, subtractors, encoder, decoder, multiplexer, demultiplexer and comparators; processor organisation - machine instructions, instruction cycles, instruction formats and addressing modes, microprogramming concepts, microprocessor sequence; sequential logic - flip flops, shift registers and counters; I/O organisation - I/O interface, interrupt structure, transfer of information between CPU, memory and I/O devices.
Text/Reference Books	
Text Books	1. Rumbaugh. J. et. al., Object Oriented Modeling and Design, Prentice Hall of India 1998. 2. Balaguruswami, Object Oriented Programming in C++ : Tata McGraw 3. Pradeep K. Sinha & Preeti Sinha, Computer Fundamentals, BPB Publications 4. Rajaraman V, Fundamentals of Computers, Prentice Hall of India 5. Mano. M. Morris Digital Logic & Computer Systems Design, Prentice Hall of India Pvt. Ltd., 2000.
Reference Book	1. Stroustrup, B., The C++ programming language, Addison –Wesley1993. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

M.Sc. CS (AI&DS) 2-Year Program

Semester 1

MSC/CSE/1/DSC/401: Mathematics for 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 equip students with foundational mathematical knowledge essential for AI and Data Science. The course covers key topics in linear algebra, calculus, probability, and statistics and applies them to machine learning and data science problems.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define**: core mathematical concepts from linear algebra, calculus, probability, and statistics that are essential for data science applications.
CO2	**explain:** how mathematical tools such as matrix operations, gradient-based optimization, and probability distributions are used in data analysis and machine learning.
CO3	**apply:** matrix operations, eigenvalue decomposition, and dimensionality reduction techniques like PCA to real-world datasets.
CO4	**use:** statistical techniques including hypothesis testing, confidence intervals, and inferential statistics for making data-driven decisions.
CO5	**analyze and evaluate:** machine learning models using mathematical frameworks such as optimization, convergence of algorithms, and statistical validity.

CO-PO Mapping Matrix

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**
CO1	**1**	**3**	**1**	**1**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO2	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO3	**3**	**1**	**1**	**3**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**-**

CO4	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO5	**2**	**1**	**3**	**1**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
Avg	**2**	**1.4**	**1.4**	**2.2**	**1.5**	**-**	**3**	**-**	**-**	**2**	**-**	**-**

Course Content **MSC/CSE/1/DSC/401: Mathematics for Data Science**	
Unit – I	Linear Algebra and Applications: Vectors, norms, inner products, Matrix operations: inverse, rank, determinant, trace, linear transformations and vector spaces, Eigenvalues and eigenvectors, diagonalization, Singular Value Decomposition (SVD), Applications: Principal Component Analysis, Latent Semantic Analysis (LSA)
Unit – II	Calculus and Optimization: Functions of single and multiple variables, Limits, continuity, and differentiability, Partial derivatives, directional derivatives, and gradient, Taylor series approximation, Unconstrained and constrained optimization, Convex functions and optimization algorithms (gradient descent, Newton's method)
Unit - III	Probability and Statistical Inference: Probability theory: axioms, conditional probability, Bayes' Theorem. Discrete and continuous distributions: Binomial, Normal, Poisson, Exponential, Expectation, variance, covariance, and correlation, Sampling distributions, Central Limit Theorem, Estimation theory: point and interval estimation, Hypothesis testing: z-test, t-test, chi-square test, p-values, Linear regression and least squares estimation.
Unit – IV	Discrete Mathematics for Data Science: Propositional and predicate logic, Sets, relations, and functions, Graph theory: types of graphs, paths, connectivity, trees, Boolean algebra and applications in logic circuits.
Text/Reference Books	
Text Books	1. Gilbert Strang, "Linear Algebra and Its Applications", Cengage Learning. 2. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Press. 3. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw-Hill Education.
Reference Books	1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer. 2. Norman Biggs, "Discrete Mathematics", Oxford University Press. 3. Tom M. Apostol, "Mathematical Analysis", Narosa Publishing House. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/1/DSC/402: Database Systems							
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: Final-Term examination shall cover the whole content of the course. 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. Students 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, models, architecture and applications of database systems.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** schema architecture, ER diagrams, EER model, functional dependencies, normal forms, data types, views in SQL, concurrency control techniques, database security issues, semantic data models, and client server architecture.
CO2	**describe:** ER diagram, relational model, EER model, functional dependencies, normal forms, SQL constraints and views, recovery algorithm.
CO3	**apply:** inheritance, SQL queries, constraints, recovery techniques. justify: architecture, relational schema, recovery technique and data model shall be better suited in different situations.
CO4	**differentiate:** subclass and superclass, specialization and generalization, functional dependencies, normal forms.

CO-PO Mapping Matrix

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

Avg	2	1.4	1.4	2.2	1.5	-	3	-	-	2	-	-

Course Content MSC/CSE/1/DSC/402: Database Systems	
Unit I	**Basic concepts:** a historical perspective, file system vs. DBMS, characteristics of the database approach, abstraction and data integration, database users, advantages and disadvantages of a DBMS, implication of database approach. Database system concepts and architecture- data models, schemas and instances, DBMS architecture and data independence database languages & interfaces, DBMS functions and component modules.
Unit - II	**Entity-relationship model:** entity types, entity sets, attributes & keys, relationships, relationship types, roles and structural constraints, design issues, weak entity types, E-R diagrams, design of an E-R database schema. Conventional data models- an overview of network and hierarchical data models. relational data model- relational model concepts, integrity constraints over relations, relational algebra – basic operations.
Unit – III	**SQL:** data definition, constraints, & schema changes in SQL, insert, delete & update statements in SQL, view in SQL, specifying constraints and indexes in SQL, queries in SQL. **Relational database design:** functional dependencies, decomposition, desirable properties of decomposition, normal forms based on primary keys (1 NF, 2 NF, 3 NF and BCNF). **Practical database design:** role of information systems in organizations, database design process, physical database design in relational databases.
Unit – IV	**Transaction processing concepts:** introduction to transaction processing, transaction & system concepts, properties of transaction, schemes and recoverability, serializability of schedules. **Concurrency control techniques:** locking techniques, timestamp ordering, multiversion techniques, and optimistic techniques. **Recovery techniques:** recovery concepts, recovery techniques in centralized DBMS. **Database security:** introduction to database security issues.
Text/Reference Books	
Text Books	1. Elmasri & Navathe, "Fundamentals of Database System", 3e, Addison Wesley, New Delhi. 2. Korth & Silberschatz, "Database System Concept", 4e, McGraw Hill International.
Reference Books	1.C.J. Date, "An Introduction to Database System", 7e, Addison Western. 2. Abbey Abramson, Cory, "ORACLE SI-A Beginner's Guide", Tata McGraw Hill Publishing Company Ltd. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/1/DSC/403: Python							
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 objectives of this course is to get the students familiar with basic concepts of Python programming, decision making and functions, file handling and object oriented programming concepts, database programming and to implement machine learning concepts.

Course Outcomes	At the end of this course, the student will be able to
CO1	**define:** installations, working, structures, control statements, operators, lists, object oriented programming concepts, python libraries.
CO2	**explain:** conditional & control statements ,strings, OOPs ,file handling concepts ,libraries and packages of python programming.
CO3	**use:** various python libraries such as numpy, matplotlib, pandas. apply: python programming constructs to solve real world problems.
CO4	**categorize:** data types, dictionaries, conditional & control statements, functions, python libraries.
CO5	**compare:** data types, dictionaries, conditional & control statements, functions, python libraries.
CO6	**design:** basic and advanced applications in python.

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**	**-**	**-**	**-**	**-**
Avg	**2.5**	**2**	**1.3**	**2.6**	**2**	**-**	**3**	**2.5**	**-**	**-**	**-**	**-**

Course Content
MSC/CSE/1/DSC/403: Python

Unit – I	**Installation and Working with Python:** Using Help, Structure of a Python Program, Control flow, Interpreter shell, Tokens, Identifiers, Reserved keywords, Literals, Variables, Python basic Operators, Declaring and using Numeric data types: int, float, complex, using string data type. Python Casting, Scope of a Variable, Working with: String, List, Tuples and Dictionaries.
Unit – II	**Conditional blocks:** Conditional blocks using if, else and elif, For loops in python, While loops, Continue, Break and Else, organizing python codes using functions. **Modules:** Creating Modules, using Modules and Built-in Modules. **Packages:** Package Types, Importing Package, Viewing Package Content and Documentation. Powerful Lambda Function in python. **Programming:** Using Functions, Modules and Packages.
Unit – III	**Object Oriented Programming:** Concept of Class, Object and Instances, Constructor, Class Attributes and Destructors, Built-in Class Attributes, Inheritance, Method Overriding, Data Encapsulation, Overloading Operators, Data Hiding, Exception Handling, Programming using Oops concepts. **File Handling:** Creating, Opening, Closing, Writing & Reading File Content, Deleting a File. Programming using file operations.
Unit – IV	**Python NumPy:** Array Slicing, Array Indexing, Data Types, Array Shape & Reshape, Array Join, Array Split, Random. **Python Pandas:** Data Frames, Read CSV, Analyzing Data and Cleaning Data. **Python Matplotlib:** Line, Grid, Scatter, Bars, Histograms and Pie Charts. **Machine Learning:** Mean, Median, Mode, Standard Deviation, Percentile, Normal Data Distribution, Scatter Plot and Linear Regression.
Text/Reference Books	
Text Books	1.Chun, J Wesley, "Core Python Programming", 2e, Pearson, 2007. 2.E. Balagurusamy, "Introduction to Computing and Problem Solving Using Python", McGraw Hill Education, 2016.
Reference Books	1. Barry and Paul, "Head First Python", 2e, O Reilly, 2010. 2. Lutz and Mark, "Learning Python", 4e, O Reilly, 2009 Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/1/DSC/404: Data Structures & Algorithms							
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 various types of data structure and different techniques to implement the data structures and their real-life applications.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** abstract data types, algorithms, complexity of algorithms, linear data structures, non-linear data structures, searching, sorting, hashing.
CO2	**give:** original examples of data structures and their types; explain: sorting techniques, searching methods, hashing, and collision resolution techniques.
CO3	**calculate:** (complexity of algorithm). use array, stack, queue, linked list, tree, graph, linear search, binary search, bubble sort, selection sort, insertion sort, radix sort, shell sort, merge sort, quick sort, heap sort, and hash function to solve the given problems.
CO4	**differentiate:** data structure, searching techniques, sorting techniques, hash functions; analyze: time and space complexity.
CO5	**evaluate:** the complexity oflinear search, binary search, bubble sort, selection sort, insertion sort, radix sort, shell sort, merge sort, quick sort, heap sort , hash function, and select the best one for a given problem.

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**	**-**	**-**	**-**	**-**	**-**
CO 2	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**
CO 3	**3**	**1**	**1**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**

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

Course Content
MSC/CSE/1/DSC/404: Data Structures & Algorithms

Unit – I	**Data structure and algorithm preliminaries:** Definitions, time and space analysis of algorithms, time-space tradeoffs, mathematical notation and functions, asymptotic notations for complexity of algorithms, recursion, divide and conquer strategy.
Unit – II	**Linear data structures**: abstract data types, array-based implementation, **Stack:** operations and applications of stacks. **Queues:** operation on queues, circular queue, priority queues, and de-queue, **Linked list:** implementation of linked list, header linked list for polynomial manipulation.
Unit – III	**Non-linear data structures:** **Trees:** binary tree, tree traversals, binary search tree, threaded binary tree, AVL tree, B-tree, B+ tree, heap, and its applications, Huffman coding. **Graph:** representation of graphs, types of graphs, graph traversals, topological sort, minimum spanning trees, Kruskal and Prim's algorithm, application of graphs.
Unit – IV	**Searching, sorting and hashing techniques:** **Searching:** linear search, binary search. **Sorting:** bubble sort, selection sort, insertion sort, radix sort, shell sort, merge sort, quick sort, heap sort, **Hashing:** hash functions, open addressing, chaining, rehashing.
Text/Reference Books	
Text Books	1.Seymour Lipschutz, "Data Structures (Schaum's Outline Series)", McGraw-Hill Book Company. 2.Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 2002.
Reference Books	1. Tanenbaum A.M., Langsam Y, Augenstein M.J., "Data Structures using C & C++'', Prentice Hall of India, 2002. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/1/DSC/405: Python (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

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

Course Objectives: The objective of this course is to get the students hands-on practice with Python programming concepts covered in course **MSC/CSE/1/DSC/403**.

Course Outcomes	At the end of this course, the student will be able to
CO1	**define:** installations, working, structures, control statements, operators, lists, object-oriented programming concepts, Python libraries.
CO2	**explain:** conditional & control statements,strings, OOPs,file handling concepts,libraries, andpackages of Python programming.
CO3	**use:** various Python libraries such as numpy, matplotlib, and pandas. apply: Python programming constructs to solve real-world problems.
CO4	**categorize:** data types, dictionaries, conditional & control statements, functions, Python libraries.
CO5	**compare:** data types, dictionaries,conditional& control statements, functions, Python libraries.
CO6	**design:** basic and advanced applications in python.

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**	**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**	**-**	**-**	**-**	**-**
Avg	**2.5**	**2**	**1.3**	**2.6**	**2**	**-**	**3**	**2.5**	**-**	**-**	**-**	**-**

MSC/CSE/1/DSC/405: Data Structures & Algorithms (Lab)

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	50		3 Hours	TEE

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

Course Objectives: The objective of this course is to get the students hands-on practice with data structure concepts covered in course **MSC/CSE/1/DSC/404** using 'C'.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** abstract data types, algorithms, complexity of algorithms, linear data structures, non-linear data structures, searching, sorting, hashing.
CO2	**give:** original examples ofdata structures and their types; explain: sorting techniques, searching methods, hashing, and collision resolution techniques.
CO3	**calculate:** (complexity of algorithm). use array, stack, queue, linked list, tree, graph, linear search, binary search, bubble sort, selection sort, insertion sort , radix sort, shell sort, merge sort, quick sort, heap sort , hash function to solve given problems.
CO4	**differentiate:** data structure, searching techniques, sorting techniques, hash functions; analyze: time and space complexity.
CO5	**evaluate:** the complexity oflinear search, binary search, bubble sort, selection sort, insertion sort, radix sort, shell sort, merge sort, quick sort, heap sort, hash function, and select the best one for a given problem.
CO6	**develop:** programs based on the application of stack, queue, searching, and sorting.

CO-PO Mapping Matrix

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
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**	**-**	**-**	**-**	**-**	**-**
Avg	**2**	**1.4**	**1.4**	**2.2**	**1.5**	**-**	**3**	**-**	**-**	**-**	**-**	**-**

MSC/CSE/1/SEC/401: Generative AI in Digital Literacy

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 the paper setter for Term-End Examination: The term-end examination of theory part the total number of questions shall be NINE. Question number one will be compulsory and will consist 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: This course aims to cultivate digital fluency and empower learners to harness the capabilities of generative artificial intelligence (AI) across diverse professional, academic, and creative contexts. Through immersive exploration of AI tools and platforms, By the end of this course, learners will be prepared to responsibly and effectively integrate AI tools into real-world scenarios, contributing to more innovative, efficient, and ethical digital practices.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**Explain:** the evolution of digital literacy towards AI-assisted productivity and understand the foundational concepts of Artificial Intelligence, including its history, scope, and ethical considerations.
CO2	**Identify and utilize:** various AI tools and platforms to enhance productivity in tasks such as writing, data summarization, and presentation creation.
CO-3	**Apply:** advanced search strategies and AI-based tools for effective information retrieval, verification, and critical evaluation of AI-generated content.
CO4	**Demonstrate:** the use of AI tools in professional and creative communication, including text, image, and multimedia content generation.
CO5	**Create and manage**: a digital portfolio or blog by integrating AI tools to showcase personal or professional achievements.
CO6	**Analyze:** ethical implications related to AI usage, including issues of data privacy, algorithmic bias, transparency, and responsible use.

Course Content:
MSC/CSE/1/SEC/401: Generative AI in Digital Literacy

Unit - I	**Digital Literacy and the Role of AI:** Digital fluency, Evolution from digital literacy to AI-assisted productivity, Introduction to Generative AI**,** Definition, history, and scope of Artificial Intelligence, AI tools and platforms overview, Ethical use of AI: Data privacy, bias in algorithms, transparency, and accountability
Unit II	**Productivity Tools Enhanced by Generative AI**: Document editing and formatting with AI (e.g., ChatGPT for writing, Grammarly), AI-assisted spreadsheets and data summaries (e.g., Excel Copilot, ChatGPT), AI for creating presentations and summaries (e.g., PowerPoint Designer, Tome AI).

Unit III	**Information Search and Evaluation**: Advanced online search techniques, Using AI for fact-checking and information synthesis, Evaluating AI-generated content: accuracy, reliability, and bias.
Unit - IV	**Communication and Collaboration with AI Tools**: Professional communication: AI-generated emails, memos, reports, Text generation: poetry, storytelling, dialogue, Image generation, Audio/video synthesis, Building a digital portfolio or blog using AI tools: overview and examples.
Text/Reference Books	
Text Books	1. Digital Fluency: Dr. R.G. Saha, Dr. Kantesha S., Niha Asif; Himalaya Publishing House Pvt. Ltd. 2. Applied Generative AI for Beginners: Practical Knowledge on Diffusion Models, ChatGPT, and Other LLMs; Akshay Kulkarni, Adarsha Shivananda, Anoosh Kulkarni, Dilip Gudivada; Apress Publishers.
Reference Books	1. Russell, S., &Norvig, P. (2020). Artificial intelligence: A modern approach (4th ed.).Pearson. 2. Miller, T. (2019). Explaining AI: How to make artificial intelligence Understandable Springer. 3. Colarusso, A. (2023). The art of prompt engineering with ChatGPT: Crafting effective prompts for better results. Independently published. 4. Marr, B. (2023). Generative AI in practice: 100 amazing ways generative artificial intelligence is changing business and society. Wiley. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**
	Recommended Online Resources 1. OpenAI Learning Resources – https://openai.com/learn 2. Google Applied Digital Skills – https://applieddigitalskills.withgoogle.com 3. Microsoft Copilot and Excel AI Docs – https://support.microsoft.com 4. E Tutorials – https://www.canva.com/learn, https://openai.com/dall-e

MSC/CSE/1/SEC/401: Generative AI in Digital Literacy (Lab)

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Skill Enhancement Course	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 the practical file, performance in the practical exam, and a viva-voce exam.

Course Objectives: The objective of this course is to get the students hands-on practice with Office automation tools and the Concept of AI.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**Demonstrate:** digital fluency by navigating and utilizing AI platforms and tools to enhance personal and academic productivity.
CO2	**Apply:** generative AI tools to create and format documents, spreadsheets, and presentations for real-world tasks and projects.
CO-3	**Perform:** effective online searches using advanced techniques, and utilize AI tools for fact-checking, summarization, and content evaluation.
CO4	**Use:** AI tools to generate professional communication content such as emails, reports, and memos, as well as creative outputs like stories, poems, and multimedia.
CO5	**Develop and maintain:** a digital portfolio or blog by integrating text, image, and video content generated through AI tools.
CO6	**Practice:** responsible and ethical use of AI technologies, with awareness of data privacy, algorithmic bias, and content transparency in practical applications.

M.Sc. CS (AI&DS) 2-Year Program

Semester 2

MSC/CSE/2/DSC/451: Artificial Intelligence							
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 provide an understanding of Artificial Intelligence techniques and their applications. Various search techniques and expert systems along with other components of artificial intelligence in computer science will be covered.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** artificial intelligence terms, types of search strategy, production system, knowledge representation, learning techniques and genetic algorithm terminologies.
CO2	**explain:** the types and properties of search algorithm, predicate calculus, knowledge representation and explore the theories that demonstrate intelligent behavior including intelligent editor, learning by induction and dealing with uncertainty.
CO3	**use:** search strategy/genetic algorithm/ fuzzy logic and learning technique.
CO4	**classify:** search strategy, production system, learning, operator of genetic algorithm, knowledge representation and approaches that deal with uncertainty.
CO5	**compare:** search strategy, production system, learning, operator of genetic algorithm, knowledge representation and approaches that deal with uncertainty.

CO-PO Mapping Matrix

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	**1**	**3**	**1**	**1**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**
CO 2	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**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/2/DSC/451: Artificial Intelligence

Unit – I	**Introduction**: background and history, overview of AI applications areas. **Inference**: Inference rules (PL and FOPL) , Resolution and Unification. **Knowledge representation**: Introduction, type of Knowledge, Structured representation of Knowledge (Semantic network representation, conceptual graphs, Constraint satisfaction: crypto arithmetic problem, frames & scripts), Knowledge representation schemes: propositional logic(PL) and FOPL. Knowledge Acquisition techniques.
Unit – II	**Search strategies**: strategies for state space search, data-driven and goal driven Search. **Search algorithms**: uninformed search (depth-first, breadth-first, depth-first with iterative deepening) and informed search (hill climbing, best first, A* algorithm, AO*,Beam search) Game tree :Mini-max, Mean max with alpha-beta pouring, Properties of search algorithms(admissibility, monotonicity, optimality, dominance).
Unit - III	**Production system**: Architecture, types of production system (commutative and non-commutative production systems, decomposable and non-decomposable production systems). **Rule-based expert systems**: architecture, development, uncertainty in expert systems, Bayesian probability, Bayesian Network, Dempster/Shaffer and Monti Hall problem of uncertainty.
Unit – IV	**Knowledge acquisition**: types of learning (supervised, Unsupervised and Reinforcement), learning by induction, Fuzzy logic. **Agent**: Simple reflex agents, model-based reflex agents, goal-based agents, utility-based agents, and learning agents. **Genetic algorithms**: problem representation, encoding schemes, operators: selection, crossover, mutation, replacement.
Text/Reference Books	
Text Books	1.George F. Luger, “Artificial Intelligence”, Pearson Education. 2.Dan W. Patterson. “Introduction to Artificial Intelligence and Expert System”, PHI.
Reference Books	1.Eugene Charniak, Drew McDermott, “Introduction to Artificial Intelligence” Addison Wesley. 2.Wils J. Nilsson, “Principles of Artificial Intelligence”, Narosa Publishing house. 3.Jackson Peter, “Introduction to Expert Systems”, 3e, Addison Wesley, 2000. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/2/DSC/452: Big Data 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 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 concepts of Big Data and their realization/implementation using Hadoop and Map Reduce tool sets.

Course Outcomes	At the end of this course, the student will be able to :
CO1	**define:** Big Data and Hadoop, digital data, Apache Hadoop, analyzing Data with Unix tools and Hadoop, Hadoop Streaming, Hadoop Ecosystem, IBM Big Data Strategy, HDFS, Hadoop Ecosystem, Pig, Hive shell and services, HBasics, Big SQL.
CO2	**understand and describe:** Big Data and Hadoop, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Ecosystem, IBM Big Data Strategy, Hadoop Distributed File System, command line interface, job scheduling, shuffle and sort, task execution, Hadoop Ecosystem, Pig, HiveQL, Hbase.
CO3	**apply and use:** Apache Hadoop, HDFC,HBasic, Big Data and Hadoop,HDFS command line interface, Hadoop file system interfaces, data flow, Hive services.
CO4	**classify:** Big Data and Hadoop, Big Data Analytics, Apache Hadoop, HDFS ,Hive shell, Hive services.
CO5	**compare**: the feature set of Pig, Hadoop, HDFS.

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/2/DSC/452: Big Data Analytics**	
Unit -I	**Introduction to Big Data and Hadoop:** Types of digital data, introduction to Big Data,Vs of Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, analyzing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Ecosystem, IBM Big Data Strategy, Big Data applications.
Unit–II	**HDFS (Hadoop Distributed File System):** The design of HDFS, HDFS concepts, command line interface, Hadoop file system interfaces, data flow, data ingest with flume and Sqoop and Hadoop archives. **Hadoop I/O:** compression, serialization, Avro and file-based data structures.
Unit –III	**Map Reduce:** Anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types and formats, Map Reduce features.
Unit –IV	**Hadoop Ecosystem:**Introduction,features. **Pig:** Introduction to Pig, execution modes of Pig, comparison of Pig with databases, grunt, Pig latin, user defined functions, data processing operators. **Hive:** Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions. **Hbase:**HBasics, concepts, clients, example, Hbase Vs RDBMS. **Big SQL:** Introduction
Text/Reference Books	
Text Books	1.Tom White, "Hadoop: The Definitive Guide", 3e, O'reilly Media, 2012. 2.Seema Acharya, SubhasiniChellappan, "Big Data Analytics", Wiley 2015. 3.Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", MC Press.
Reference Books	1.Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. 2.Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications. 3.AnandRajaraman and Jeffrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012. 4.Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & Sons, 2012. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/2/DSC/453: Data Mining							
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: Final-Term examination shall cover the whole content of the course. 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. Students 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 concepts of data mining namely, OLAP, Association rule mining, classification and prediction.

Course Outcomes	At the end of this course, the student will be able to :
CO1	**define:** the concepts of data mining, data pre-processing, outliers, data warehouse,OLAP, association rule mining, data classification, prediction and cluster Analysis.
CO2	**describe:** key processes of data mining, data warehousing, OLAP, data warehousing to data mining, association rule, classification, and prediction methods.
CO3	**apply:** OLAP technology and association rules. use: decision induction, Bayesian, and back propagation classification methods.
CO4	**differentiate:** operational database systems and data warehousing, single-dimensional and multidimensional association rules, and various data mining classification methods.
CO5	**evaluate:** datamining and data warehouse, OLAP technology, single and multidimensional association rules.

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/2/DSC/453: Data Mining	
Unit I	**Data Mining:** Introduction: Motivation, Importance, Knowledge discovery process, data mining, kind of data, Functionalities, interesting patterns, classification of data mining system, Major issues, Data Mining Primitives. Data Pre-processing: Data cleaning, Data Integration and transformation, Data reduction, Discretization and concept hierarchy generation. Data visualization. Outliers, Types of Outliers and Challenges of Outlier Detection.
Unit - II	**Data warehouse and OLAP Technology for data mining:** data warehouse, difference between operational database systems and data warehouse, A Multidimensional Data Model, Data warehouse Architecture, Data warehouse Implementation, data warehousing to data mining, Data warehouse usage.
Unit - III	**Association Rule Mining:** Mining single-dimensional Boolean association rules from transactional databases, mining multilevel association rules from transaction databases, Mining multidimensional association rules from relational databases and data warehouses, From association mining to correlation analysis, constraint-based association Mining.
Unit - IV	**Data Mining Classification and Prediction:** issues regarding classification and prediction, classification by decision induction, Bayesian classification, classification by back propagation, classification based on concepts from association rule mining and other classification methods. **Cluster Analysis:** What is Cluster Analysis, Types of Data in Cluster Analysis, Applications and Trends in Data Mining.
Text/Reference Books	
Text Books.	1.Ale Berson, Stephen Smith, KorthTheorling, "Data Mining", Tata McGraw Hill. 2.Pieter Adriaans and DolfZantinge, "Data Mining", Addison-Wesley Longman. 3.Sam Anahory, "Data Warehousing in the Real World", Addison-Wesley Longman.
Reference Books	1. Chanchal Singh, "Data Mining and Warehousing", Wiley. 2. Relevant book may be searched at CDLU Online Library : http://vlibrary.cdlu.ac.in

MSC/CSE/2/DSC/454: Machine 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 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 Outcomes	At the end of this course, the student will be able to :
CO1	**define:** the terms of machine learning: types of machine learning, data

	preprocessing, classification, regression, and neurons.
CO2	**explain:** learning types, data preprocessing, and architecture of ANN.
CO3	**apply:** training and testing data using data pre-processing and model selection techniques, and classification, regression, and clustering techniques according to their problem.
CO4	**classify:** data preprocessing, model selection, regression, classification, and unsupervised learning techniques.
CO5	**compare:** Data Preprocessing techniques, Supervised and unsupervised learning.

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/2/DSC/454: Machine Learning

Unit – I	**Basics of Machine Learning:** Introduction to artificial Intelligence and machine

	learning, types of machine learning and its comparisons, applications of machine learning, issues in machine learning.
Unit – II	**Preparing to Model:** Introduction, machine learning activities, types of data in machine learning, exploring the structure of data, data pre-processing (dimension reduction and feature subset selection)
Unit – III	**Supervised Learning:** Introduction, classification (introduction, classification model, learning steps. **Classification algorithm**:Logistic Regression, Naive Bayes, K-Nearest Neighbours, Decision Tree, Support Vector Machines. **Regression:** linear regression, multivariable regression, logistic regression.
Unit – IV	**Unsupervised Learning:** Introduction and its applications, K-means, KNN (k-nearest neighbors), Hierarchical clustering,Apriori Algorithm. **Neural Network:** Introduction, architecture of an artificial neural network.
Text/Reference Books	
Text Books	1.Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited. 2.EthemAlpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press.
Reference Books	1.Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press. 2.Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press. 3.Peter Harrington, Machine Learning in Action, Manning 4.ShaiShalevShwartz and Shai Ben David, Understanding Machine Learning from Theory to Algorithms, Cambridge University Press Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/2/DSC/455: Data Mining (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 the practical file, performance in the practical exam, and a viva-voce exam.

Course Objectives: The objective of this course is to get the students hands-on practice with data mining concepts covered in course **MSC/CSE/2/DSC/453**.

Course Outcomes	At the end of this course, the student will be able to:
CO1	**define:** the concepts of data mining, data pre-processing, outliers, data warehouse,OLAP, association rule mining, data classification, prediction, and cluster Analysis.

CO2	**describe:** key processes of data mining,data warehousing, OLAP, data mining, association rule, classification, and prediction methods.
CO3	**apply:** OLAP technology and association rules. use: decision induction, Bayesian, and back propagation classification methods.
CO4	**differentiate:** operational database systems and data warehousing, single-dimensional and multidimensional association rules, and various data mining classification methods.
CO5	**evaluate:** datamining and data warehouse, OLAP technology, single and multidimensional association rule.
CO6	**demonstrate:** classification rule, association rule, and clustering.

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/2/DSC/455: Machine Learning (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 the practical file, performance in the practical exam, and a viva-voce exam.

Course Objectives: The objective of this course is to provide students with practical hands-on experience in machine learning concepts, data pre-processing, implementation of classification, regression, clustering, and neural network models covered in **MSC/CSE/2/DSC/454.**

Course Outcomes	At the end of this course, the student will be able to:
CO1	**understand:** and implement basic machine learning algorithms using Python/MATLAB.
CO2	**perform**: data preprocessing including feature scaling, dimensionality reduction, and feature selection.
CO3	**apply**: supervised learning algorithms such as Logistic Regression, Naive Bayes, KNN, Decision Tree, and SVM for classification and regression problems.
CO4	**implement:** unsupervised learning algorithms including K-means, hierarchical clustering, and Apriori algorithm.
CO5	**build**: simple Artificial Neural Networks for classification problems.
CO6	**evaluate and interpret** machine learning model performance using metrics like accuracy, precision, recall, F1-score

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/2/SEC/451: Digital Forensic

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 the 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: This course aims to introduce students to the principles, tools, and practices of digital forensics, emphasizing the recovery, analysis, and presentation of digital evidence in investigative and legal contexts. It equips students with hands-on and theoretical knowledge essential for identifying cybercrimes, conducting forensic investigations, and maintaining legal and procedural integrity in handling digital data.

Course Content
MSC/CSE/2/SEC/451: Digital Forensic

Unit – I	**Introduction to Digital Forensics:** Definition, digital crimes, digital investigation, evidence, and the overall process. **Computer Systems Fundamentals**: Overview of hardware and operating systems (Windows/Macintosh/Linux), structure of storage media/devices.
Unit II	**Disk and File System Analysis**: Understanding file systems for forensic purposes. **Data Recovery Basics:** Identifying hidden data and the fundamentals of recovering deleted files. Digital Evidence Controls.
Unit III	**Advanced Data Recovery Techniques:** Evade detection by standard tools, disk imaging, recovering swap files, temporary files, and cache files. **Mobile Network Forensics**: Introduction, investigations, collecting evidence from mobile devices, and identifying data sources.
Unit – IV	**Email and Database Forensics:** investigating email and database systems. Computer Crime and Legal Issues: Intellectual property, privacy issues, the criminal justice system for forensic and audit/investigative situations.

Text/Reference Books

Text Books	1.Chirillo, J. Holt, Austin M. Boidol, Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge, 2015. 2.Eoghan Casey, Digital Evidence and Computer Crime Forensic Science, Computers, and the Internet, Academic Press, 2011.
Reference Books	1.B. Nelson, A. Phillips, F. Enfinger, C. Steuart, Guide to Computer Forensics and Investigations 4th Edition, Thomson, 2009. 2.Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters, The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory, July 2014. Relevant book may be searched at CDLU Online Library: **http://vlibrary.cdlu.ac.in**

MSC/CSE/2/SEC/451: Digital Forensic (Lab)							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	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 based on their practical file, performance in the practical exam, and a viva voce exam.

Course Objectives: The objective of this course is to provide the students with hands-on practice with Digital forensic concepts.

Course Outcomes	At the end of this course, the student will be able to
CO1	**Define:** the concepts of digital forensics, digital crimes, computer systems architecture, and data acquisition techniques.
CO2	**Understand and explain:** the internal structure of operating systems (Windows, macOS, Linux), file systems, and the legal framework surrounding digital evidence and crime.
CO3	**Illustrate:** different types of forensic analysis techniques, including disk imaging, mobile forensics, email/database investigations, and memory analysis.
CO4	**Classify:** forensic tools, evidence types, data recovery methods, and legal protocols involved in digital investigations.
CO5	**Compare and choose (and justify):** a particular forensic methodology or legal process for evidence acquisition, recovery, and presentation in investigative or courtroom settings.

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	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**	**-**	**-**	**-**	**-**
Avg	**2.5**	**2**	**1.3**	**2.6**	**2**	**-**	**3**	**2.5**	**-**	**-**	**-**	**-**

M.Sc. CS (AI&DS) 2-Year Program

Option 1 & 2, Semester 3

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. 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/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, AndrzejGoscinski, 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, sampling distribution, 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) 2-Year Program

Option 1, Semester 4

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	
Text Books	1.Matthew Ganis, Avinash Kohirkar, "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	**2**	**1**	**1**	**3**	**1**	**-**	**3**	**-**	**-**	**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 Digital Technologies Can Serve Humanity, Globethics Publications, 1st Ediiton, 2023. 2. 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 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 Problrm 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/554: Deep Learning
MCA/CSE/4/DSC/551

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 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
MCA/CSE/4/DSC/551

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) 2-Year Program

Option 2, Semester 4

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 2 Presentation	-	Presentation	50 Synopsis 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/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

M.Sc. CS (AI&DS) 2-Year Program

Option 3, Semester 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/4/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: 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

M.Sc. CS (AI&DS) 2-Year Program

Option 3, Semester 4

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			3 Hours	TEE/MTE/ Assignment/ Attendance
					15	5	5		
				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 contributorship. 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