Master of Computer Applications (2 Year)
Postgraduate Program

Learning Outcomes-based Curriculum Framework
(as per NEP)

w.e.f.- 2025-26

Department of Computer Science & Engineering
Faculty of Engineering and Technology
Chaudhary Devi Lal University
Sirsa-125055
2025

Learning Outcomes-based Curriculum Framework
(as per NEP)

Committee.

24-05-2025

24-05-2025

24/5/25

Staff Council (16/6/2025)

For

Master of Computer Applications (2 Year)
Postgraduate Program

&

Master of Computer Applications (1 Year)
Postgraduate Program

BoS (03/07/2025)

03/07/2025

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. MCA: Master of Computer Application
2. NHEQF: National Higher Education Qualification Framework
3. DSC: Discipline-specific courses
4. SEC: Skill enhancement courses
5. VOC: Vocational courses
6. INT: Internship
7. PRW: Project Work
8. RPR: Research Project

Structurefor2-yearMCAProgram

Table 1: First year of 2-year program (NHEQF Level 6)

	Sem	DSC	SEC/VOC/Internship	Research Thesis	TotalCredits
First year for all options	I	Computer Architecture & Parallel Processing (4 credit)	Web Development (4 credit)	---	24
		Advance Database System (4 credit)			
		Data Structure (4 credit)			
		Operating System (4 credit)			
		Database & Data Structure Lab (4 credit)			
	II	Computer Network(4 credit)	Internship/Industrial Training (4 credit)	---	24
		Software Engineering (4 credit)			
		Artificial Intelligence (4 credit)			
		Computer Graphics (4 credit)			
		Java Programming (4 credit)			

Note 1: Studentswhoexitafter the firstyearoncompletionof48creditswillbeawarded a Postgraduate Diplomain Computer Applications

Note 2: Students of MCA two-year program will undergo a 6-8 week internship/industrial training during the summer vacations after the term-end examination of the second semester and submit a report to that effect. The report will be evaluated by a panel of three examiners (internal) appointed by the Chairperson/Head of the Department, within the first week of commencement of classes after summer vacations.

Note 3: MCA two-year program has three different structures. Students have to selectone of the following three optionsforthesecondyearof the MCAprogram.

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

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

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

Table 2.1: Second year of the two-year MCA program (NHEQF Level 6.5)
Option 1 (Only Coursework)

	Sem	DSC	SEC/VOC/Internship	Research Thesis	TotalCredits
Option-1 (Only coursework)	III	Discrete Mathematics (4 credit)	Android Development (4 credit) OR Linux and Shell Script (4 credit)	---	24
		Machine Learning (4 credit)			
		Network Security (4 credit) OR Wireless Network (4 credit)			
		Theory of Computation (4 credit) OR Compiler Construction (4 credit)			
		Python Programming (4 credit)			
	IV	Deep Learning (4 credit)	Project Work (4 credit)	---	24
		IoT & Cloud Computing (4 credit)			
		Data Science (4 credit) OR Big Data Analysis (4 credit)			
		Soft Computing (4 credit) OR Bioinspired Computing (4 credit)			
		R Programming (4 credit)			

Table 2.2: Secondyearof the two-yearMCAprogram (NHEQF Level 6.5)
(Option 2 – CourseworkandResearch Thesis/Project)

	Sem	DSC	SEC/VOC/Internship	Research Thesis	TotalCredits
Option –2	III	Discrete Mathematics (4 credit)	Android Development (4 credit) OR Linux and Shell Script (4 credit)	---	24
		Machine Learning (4 credit)			
		Network Security (4 credit) OR Wireless Network (4 credit)			
		Theory of Computation (4 credit) OR Compiler Construction (4 credit)			
		Python Programming (4 credit)			
	IV	--	Research Methodology (4 credit)	Research Thesis/Project (20 credit)	24

Table 2.3: Secondyearof the two-yearMCAprogram (Option 3 – Only Research)

	Sem	DSC	SEC/VOC/Internship	Research Thesis	TotalCredits
Option3	III	--	Research Methodology (4 credit)	Research Thesis(Synopsis)[#] (20 credit)	24
	IV	--	LLM & Generative AI and Research & Publication Ethics (4 credit)	Research Thesis(Final)[##] (20 credit)	24

Note4 :
[#]At the end, and as a part of the third semester, students who opted for Option 3 shall submit a Research Synopsis of at least 50 pages comprising a Literature Survey, identification of the Research Problem, Plan of Work, Methodology, and Practical Work (if any), which will be evaluated by internal and external examiners.

[##]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 will be evaluated by the internal and external examiners.

Table 3: Bridge Courses for MCA

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

Note 5: Non-computer background students admitted to the 2-year MCA program shall pass the bridge courses and earn 12 mandatory credits as outlined in Table 3, above.

Table 4: Semester-wise course codes, course titles, workload and credits
(Year 1 of the MCA 2-year program)

Course Code	Course Title	Workload			Credit
		L	T	P	
Year: 1, Semester: I					
MCA/CSE/1/DSC/401	Computer Architecture and Parallel Processing	3	1	-	4
MCA/CSE/1/DSC/402	Advance Database System	3	1	-	4
MCA/CSE/1/DSC/403	Data Structure	3	1	-	4
MCA/CSE/1/DSC/404	Operating System	3	1	-	4
MCA/CSE/1/DSC/405	Database and Data Structure Lab	-	-	8	4
MCA/CSE/1/SEC/401	Web Development	2	-	4	4
Total		14	4	12	24
Year: 1, Semester: II					
MCA/CSE/2/DSC/451	Computer Network	3	1	-	4
MCA/CSE/2/DSC/452	Software Engineering	3	1	-	4
MCA/CSE/2/DSC/453	Artificial Intelligence	3	1	-	4
MCA/CSE/2/DSC/454	Computer Graphics	3	1	-	4
MCA/CSE/2/DSC/455	Java Programming	2	-	4	4
MCA/CSE/2/SEC/451	Internship/Industrial Training	-	-	-	4
Total		14	4	4	24

Table 5.1: Semester-wise course codes, course titles, workload and credits
(Year 2 of the MCA 2-year program – Option 1 – Only coursework)

Course Code	Course Title	Workload			Credit
		L	T	P	
Year: 2, Semester: III, Option: 1					
MCA/CSE/3/DSC/501	Discrete Mathematics	3	1	-	4
MCA/CSE/3/DSC/502	Machine Learning*	3	1	-	4
MCA/CSE/3/DSC/503(i) OR MCA/CSE/3/DSC/503(ii)	Network Security OR Wireless Network	3	1	-	4
MCA/CSE/3/DSC/504(i) ORMCA/CSE/3/DSC/504(ii)	Theory of Computation OR Compiler Construction	3	1	-	4
MCA/CSE/3/DSC/505	Python Programming*	2	-	4	4
MCA/CSE/3/SEC/501(i) ORMCA/CSE/3/SEC/501(ii)	Android Development OR Linux and Shell Script	2	-	4	4
Total		16	4	8	24
Year: 2, Semester: IV, Option: 1					
MCA/CSE/4/DSC/551 MSc/ CSE/4/DSC/554	Deep Learning*	3	1	-	4
MCA/CSE/4/DSC/552	IoT and Cloud Computing	3	1	-	4
MCA/CSE/4/DSC/553(i) OR MCA/CSE/4/DSC/553(ii)	Data Science* OR Big Data Analysis*	3	1	-	4
MCA/CSE/4/DSC/554(i) OR MCA/CSE/4/DSC/554(ii)	Soft Computing OR Bioinspired Computing	3	1	-	4
MCA/CSE/4/DSC/555	R Programming*	2	-	4	4
MCA/CSE/4/PRW/551	Project Work	-	-	-+	4
Total		14	4	4	24

*Machine Learning and Deep Learning exercises will be implemented using Python, whereas Data Science and Big Data Analytics exercises will be implemented using the R language.

+ Supervision of up to four students' dissertation/research thesis/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 MCA 2-year program – Option 2 – Coursework and Research)

Course Code	Course Title	Workload			Credit
		L	T	P	
Semester: III, Option: 2					
MCA/CSE/3/DSC/501	Discrete Mathematics	3	1	-	4
MCA/CSE/3/DSC/502	Machine Learning**	3	1	-	4
MCA/CSE/3/DSC/503(i) OR MCA/CSE/3/DSC/503(ii)	Network Security OR Wireless Network	3	1	-	4
MCA/CSE/3/DSC/504(i) ORMCA/CSE/3/DSC/504(ii)	Theory of Computation OR Compiler Construction	3	1	-	4
MCA/CSE/3/DSC/505	Python Programming**	2	-	4	4
MCA/CSE/3/SEC/501(i) ORMCA/CSE/3/SEC/501(ii)	Android Development OR Linux and Shell Script	2	-	4	4
Total		16	4	8	24
Semester: IV, Option: 2					
MCA/CSE/4/SEC/551	Research Methodology	3	-	2	4
MCA/CSE/4/RPR/552	Research Project	-	-	-+	20
Total		3	-	2	24

****** Machine Learning exercises will be implemented using the Python language.

+ Supervision of up to four students' dissertation/research thesis/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 MCA 2-year program – Option 3 – Only Research)

Course Code	Course Title	Workload			Credit
		L	T	P	
Year: 2, Semester: III, Option: 3					
MCA/CSE/3/SEC/501	Research Methodology	3	-	2	4
MCA/CSE/3/RPR/502	Research Project 1[@]	-	-	-+	20
Total		3	-	2	24
Year: 2, Semester: IV, Option: 3					
MCA/CSE/4/SEC/551	LLM & Generative AI and Research & Publication Ethics	3	-	2	4
MCA/CSE/4/RPR/552	Research Project 2 (Final)[@@]	-	-	-+	20
Total		3	-	2	24

Note 6: Option 3 shall be available only for the students who have completed Postgraduate Diploma in Computer Applications.

+ Supervision of up to four students' dissertation/research thesis/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 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 will be evaluated by the internal and external examiners.

MCA 2-Year Program
Semester I
Bridge Course - 1

Note: Candidates admitted under category **3a(ii)**[1] of the MCA ordinance shall have to pass bridge courses designed and offered by the University during the duration of MCA programme failing which their MCA degree shall get delayed till the time they pass these courses.

Bridge Courses' examination will be conducted by the University. The student has to secure 40% marks in both theory and practical examination in order to pass the bridge course(s). Examination fee shall be made applicable as per University rules. The respective University Teaching Department/Affiliated College shall arrange for the contact sessions for completing the bridge course(s). The University/College/Institute shall not charge any fee for the conduct of bridge course(s), however, the contact classes for bridge course(s) shall count towards teaching workload.

Candidates belonging to category **3a(ii)** of the MCA ordinance and having earned a diploma or a degree of at least 6-months duration in computer science, or information technology, or computer science & engineering, or software engineering shall be exempted from the requirement of studying and passing the bridge courses.

[1] 3. A person who has passed one of the following examinations of this University or an examination recognized as equivalent thereto shall be eligible to join the First Semester of the programme:

a(i) Passed BCA/Bachelor Degree in Computer Science Engineering or equivalent Degree[1].

OR

a(ii) Passed BSc/BCom/BA with Mathematics at 10+2 Level or at Graduation level (with additional bridge courses as per the norms of Ch. Devi Lal University, Sirsa).

Bridge Course –1

MSc/ CSE/1/BC/301
MCA/CSE/1/BC/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 (20, 5, 5)	TEE 3 Hours	MTE 2 Hours	TEE/MTE/ Assignment/ Attendance
	2 Practical	4 Practical	Practical	50	-	TEE 3 Hours		TEE (Experiment, Practical File, 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 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 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: 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 for Course MCA/CSE/1/BC/301 & MSc/ CSE/1/BC/301

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 for Course MCA/CSE/1/BC/301 & MSc/ CSE/1/BC/301

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/CSE/1/BC/301 & MSc/ CSE/1/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

MSc/ CSE/1/BC/301:
MCA/CSE/1/BC/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 preprocessors
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 concept, set types, set operations, cardinality, and notation. Group theory: Basic concept, subgroups, group axioms, subgroups, co-sets, 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.

MCA 2-Year Program
Semester II
Bridge Course -2

MSc/ CSE/2/BC/302:
MCA/CSE/2/BC/302: **Bridge Course - 2**

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 (Experiment, Practical File, 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 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 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: 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 for Course MCA/CSE/2/BC/302 & MSc/ CSE/2/BC/302

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 for Course MCA/CSE/2/BC/302 & MSc/ CSE/2/BC/302

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/CSE/2/BC/302 & MSc/ CSE/2/BC/302

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/2/BC/302:
MCA/CSE/2/BC/302: Bridge Course – 2

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.

MCA 2-Year Program

Semester I

MCA/CSE/1/DSC/401: Computer Architecture and Parallel Processing								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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 of computer architecture, various computational models, evolution of instruction level processors, classification of parallel architectures and MIMD architectures.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define the concepts of: computer architecture including types of computer architecture, computational model, instruction level processors, code scheduling for ILP processors, distributed and shared MIMD architectures.
CO2	understand and explain: different types of computational model, parallel and distributed computing, instruction level processors, distributed and shared MIMD architectures.
CO3	illustrate different types ofcomputationalmodels,architecture, processors, and memory models.
CO4	classify: computational models, computer architectures, processors, and memory models.
CO5	Compare and choose (and justify) a particular: computational model, architecture and memory model in a given situation.

CO-PEO Mapping Matrix for Course MCA/CSE/1/DSC/401

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 for Course MCA/CSE/1/DSC/401

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 for Course MCA/CSE/1/DSC/401

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	2.4	-

Course Content
MCA/CSE/1/DSC/401: Computer Architecture and Parallel Processing

Unit – I	Concurrent and Parallel Execution: Von-Neumann computational model, evolution and interpretation of the concept of computer architecture at different levels of abstraction, introduction to parallel processing, types and levels of parallelism, Flynn's classification of parallel architectures.
Unit – II	Instruction level Processors: Overview of ILP processors, dependencies between instructions, instruction scheduling, concepts of pipeline processing, introduction to VLIW and superscalar architectures, code scheduling for ILP processors.
Unit – III	Distributed Memory MIMD Architectures: introduction, direct interconnection networks, interconnection topologies, switching techniques-packet and circuit switching, routing- deterministic and adaptive routing.
Unit – IV	Shared Memory MIMD Architectures: Dynamic interconnection networks-shared path, switching networks-crossbar and multistage networks, Cache coherence problem, Hardware based cache coherence protocol-snoopy cache protocol, Directory scheme, Hierarchical cache coherence protocol, software-based protocols.
Text/Reference Books	
Text Books	1. D. Sima, Advanced Computer Architectures, Pearson Education
Reference Books	1. Kai Hwang, Advanced Computer Architecture – Parallelism, Scalability, Programmability, Tata McGraw Hill.

MCA/CSE/1/DSC/402: Advance Database Systems

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

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 paper setter for term-end examination: term-end examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to 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.
CO4	differentiate: subclass and super class, specialization and generalization, functional dependencies,normal forms.
CO5	justify: architecture, relational schema, recovery technique and data model shall be better suited in different situation.

CO-PO Mapping Matrix for Course MCA/CSE/1/DSC/402

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	-	-
Average	2	1.4	1.4	2.2	1.5	-	3	-	-	2	-	-

CO-PSO Mapping Matrix for Course MCA/CSE/1/DSC/402

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	-

CO-PEO Mapping Matrix for CourseMCA/CSE/1/DSC/402

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

Course Content
MCA/CSE/1/DSC/402: Advance 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. ORACLE – a historical perspective, basic structure, database structure and its manipulation in Oracle, storage organization in Oracle programming,Oracle applications. Relational database design: functional dependencies, decomposition, desirable properties of decomposition, normal forms based on primary keys (1 NF, 2 NF, 3 NF and BC NF). 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, 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 Edition.
Reference Books	1. C.J. Date, An Introduction to Database System 7e, Addison Western, New Delhi. 2. Abbey Abramson & Cory, ORACLE SI-A Beginner's Guide, Tata McGraw Hill Publishing Company Ltd.

MCA/CSE/1/DSC/403: Data Structures								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/Attendance
					20	5 5		

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 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 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: 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 its 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 of linear 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 given problem.

CO-PEO Mapping Matrix for Course MCA/CSE/1/DSC/403

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 for Course MCA/CSE/1/DSC/403

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	1.5	-	3	-	-	-	-	-

CO-PSO Mapping Matrix for Course MCA/CSE/1/DSC/403

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
MCA/CSE/1/DSC/403: Data Structures

Unit – I	Data structure and algorithm preliminaries: Definitions, time and space analysis of algorithms, time-space tradeoff, 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 application 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 graph, 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, McGraw-Hill Book Company,Schaum's Outline series, NewYork (1986). 2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, 2002.
Reference Books	1. Tanenbaum A.M., Langsam Y, Augenstien M.J., Data Structures using C & C++, Prentice Hall of India, 2002. 2. SartajSahni, Data structures, Algorithms and Applications in C++, University Press (India) Pvt.Ltd, 2e, Universities Press Orient Longman Pvt. Ltd.

MCA/CSE/1/DSC/404: Operating Systems								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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: The objective of this course is to get the students familiar with fundamental concepts of operating systems, namely, types of operating systems, functions of memory management module, process management module, deadlock management and file protection, etc.

Course Outcomes	At the end of this course, the student will be able to:
CO1	outline and define: the goals, functions and types of operating system, interprocess communication, deadlock; identify the techniques of allocation of memory, processor, and disk space.
CO2	describe and discuss: the goals, functions and types of operating system, interprocess communication, deadlock management, techniques of allocation of memory, processor, and disk space.
CO3	illustrate: the concepts of operating system like process scheduling, memory management, virtual memory, directory structure, disk space allocation, and process deadlocks.
CO4	classify: operating systems, deadlock management approaches, process scheduling algorithms, disk scheduling algorithms, page replacement algorithms, directory structure, disk space allocation methods.
CO5	determine and argue the suitability of a particular types of: operating system, deadlock management approach, process scheduling algorithm, disk scheduling algorithm, page replacement algorithm, disk space allocation method, directory structure, memory management, disk scheduling algorithm in a given situation.

CO-PEO Mapping Matrix for Course MCA/CSE/1/DSC/404

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 for Course MCA/CSE/1/DSC/404

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 for Course MCA/CSE/1/DSC/404

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

Course Content
MCA/CSE/1/DSC/404: Operating Systems

Unit - I	Introductory concepts: Operating system goals and functions, types of operating systems – batch operating system, multitasking operating system, time-sharing operating systems, real-time operating systems, distributed operating systems, system calls and their types, layered architecture of operating system; modules of kernel of operating system their functions.
Unit - II	Memory management: Functions of memory management module, memory allocation methods – contiguous and non-contiguous memory allocation; real and virtual memory allocation; fragmentation – internal and external, paging, segmentation, virtual memory concepts, demand paging, page replacement algorithms, thrashing, Belady's anomaly.
Unit - III	Process management: Process concept, PCB, Process switch and mode switch; system state and state space, state transition diagram; scheduling criteria, preemptive and non-preemptive scheduling, starvation and its mitigation, process scheduling algorithms, levels of scheduling, comparison of scheduling algorithms, inter-process communication, critical code section, mutual exclusion and its implementation, semaphore, hardware support for mutual exclusion.
Unit - IV	Deadlock - concept, conditions; deadlock management – prevention, avoidance, deadlock detection and recovery, practical considerations – ostrich approach; file – concept, file protection, file access control, file access methods; directory structure; disk space allocation; disk scheduling algorithms and their performance comparison.

Text/Reference Books

Text Books	1. Silberschatz A., Galvin P. B., Gagne G., Operating System Concepts, Wiley India Pvt. Ltd. 2. ChauhanNaresh, Principles of Operating Systems, Oxford University Press. 3. Tanenbaum A.S., Operating System- Design and Implementation, PHI Learning.
Reference Books	1. Deitel H.M., Operating Systems, Pearson Education. 2. Stallings William, Operating System, PHI Learning. 3. Godbole A.S., Operating Systems, Tata McGraw-Hill, New Delhi

MCA/CSE/1/DSC/405: DatabaseSystems and Data Structure Lab						
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks	Exam Duration	Assessment Methods
DSC Practical	04	08	Lab Work	100	3 Hours	TEE (Experiment, Practical file/report, Viva voce)

Instructions for term-end examination: The term-end 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 hand on practice with the concepts, queries, architecture and applications of database systems.

Course Outcomes	At the end of this course, the student will be able to:
Database Lab	
CO1	Apply SQL commands to create, manipulate, and query relational databases.
CO2	Design and implement database schemas using DDL and DML operations.
CO3	Analyze and optimize SQL queries using constraints, joins, subqueries, and aggregate functions.
CO4	Demonstrate practical skills in using a relational database management system (RDBMS) like MySQL or Oracle.
Data Structure Lab	
CO1	Implement linear data structures such as arrays, stacks, queues, and linked lists in a programming language.
CO2	Develop and test algorithms for non-linear data structures like trees and graphs.
CO3	Evaluate the performance of data structure operations in terms of time and space complexity.
CO4	Solve real-world problems by choosing appropriate data structures and implementing efficient algorithms.

CO-PO Mapping Matrix for Course MCA/CSE/1/DSC/405(Database Lab)

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

CO-PO Mapping Matrix for Course MCA/CSE/1/DSC/405(Data Structure Lab)

CO1	3	2	2	1	3	-	-	-	-	1	-	1

CO2	3	2	3	2	2	-	-	-	-	1	1	2
CO3	3	3	2	3	2	-	-	-	-	2	-	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

<table>
<tr><th colspan="8">MCA/CSE/1/SEC/401: Web Development</th></tr>
<tr><td rowspan="2">Course Type</td><td rowspan="2">Course Credit</td><td rowspan="2">Contact Hours/Week</td><td rowspan="2">Delivery Mode</td><td colspan="2">Maximum Marks</td><td rowspan="2">Exam Duration</td><td rowspan="2">Assessment Methods</td></tr>
<tr><td>External</td><td>Internal</td></tr>
<tr><td rowspan="2">SEC Theory + Practical</td><td rowspan="2">04</td><td rowspan="2">06 (2T+4P)</td><td rowspan="2">Lecture/ Practical</td><td>30 Theory</td><td>20
10 | 5 | 5</td><td>3 Hours</td><td rowspan="2">TEE/MTE/ Assignment/ Attendance</td></tr>
<tr><td>50 Practical</td><td>-</td><td>3 Hours</td></tr>
</table>

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 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 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 get the students familiar with different concepts related with information architecture, HTML5 and XML for web development.

Course Outcomes	At the end of this course, the student will be able to:
CO1	outline: information architecture, role of architect, collaboration, organizing information, navigation design, designing search interface, indexing, grouping content, conceptual design, html tags, layouts, basics of xml, html5 fundamentals.
CO2	summarize: information architecture, role of architect, collaboration and organizing information, navigation design, designing search interface, indexing, grouping content, conceptual design, html tags, layouts, basics of xml, html5 fundamentals.
CO3	illustrate: web application navigation, design architecture, html tags, audio support in browser, style sheets, form controls, features & structure of XML, relationship between html, sgml and xml, overview of html5.
CO4	categorize: information system, navigation system, organization system, different elements of html and xml, video format and binary format, attributes of xml objects, generation of web development.
CO5	determine: information system, navigation system, organization system, different elements of html & xml, video format and binary format, attributes of xml objects, generation of web development.
CO6	create: web applications using html and xml, development of web services.

CO-PEO Mapping Matrix for Course MCA/CSE/1/SEC/401

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 for Course MCA/CSE/1/SEC/401

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/CSE/1/SEC/401

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/SEC/401: Web Development

Unit-I	Introduction to the World Wide Web, **Basic Concepts**: URLs, HTTP/HTTPS, DNS, Web Servers, Web Browsers, Overview of HTML: Common Tag of HTML and HTML 5.
Unit – II	**CSS**: Syntax, Selectors ,Ways to Apply CSS: Inline, Internal, External Stylesheets, Basic CSS. **Properties**: Color, Background, Font, Text, Border. Basic XML, ways to use XML , XML relationship between HTML, SGML, and XML, The future of XML. JavaScript fundamentals, Fundamentals of ASP.NET.
Unit – III	**Web Hosting and Publishing Concepts:** The Need for Hosting, The Role of a Web Server, The Web Hosting Ecosystem, The Publishing Process.
Unit – IV	**CMS**: Introduction, Evolution of Web Content Management, Key Components of a CMS, Core Concepts and Features of a CMS. **Popular CMS Platforms**: WordPress, Drupal, Joomla, Search Engines: Searching techniques used by search engines, Keywords, Search Engine Optimization (SEO), Effective content writing plan, Achieving high rankings.
Text/Reference Books	
Text Books	1. Steven Holzner,"HTML Black Book", Dreamtech Press India Pvt. Ltd. 2000. 2. Savaliya, Developing Web Applications, 2e, Wiley India Ltd 3. Web Technologies - Black Book, Dreamtech Press India Pvt. Ltd.
Reference Books	1. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book by Kogent, Wiley India Ltd. 2. P.J. Deitel& H.M. Deitel, Internet and World Wide Web How to program, Pearson.

MCA 2-Year Program
Semester II

MCA/CSE/2/DSC/451: Computer Networks								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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: The objective of this course is to make the students familiar with the topics of networking, data communication, modes of transmission, communication media, routing, error control and congestion control.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define the terms and concepts of data communication and computer networking including types of network topologies, reference models, protocols used in data communication, transmission modes and media, switching and multiplexing.
CO.2	understand and describe various concepts of data communication and computer networking including network topologies, reference models, protocols used in data communication, data transmission modes and transmission media, switching and multiplexing.
CO3	apply the techniques learnt here in the design and evaluation of computer and communication networks and decide which competing communication media, and network topology/switching/protocol/technology will suit a particular situation.
CO4	differentiate various types of: computer and data communication networks, network topologies, switching and multiplexing mechanisms, error control mechanisms, routing protocols, transmission modes, transmission media, congestion control techniques.
CO5	compare, evaluate and choose between candidate: network topologies, transmission media, switching and multiplexing techniques, protocols and different layers, error control mechanisms, congestion control techniques.

CO-PEO Mapping Matrix for Course MCA/CSE/2/DSC/451

COs	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	1	3	1	3	3
CO.2	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 for Course MCA/CSE/2/DSC/451

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	1	-	2	-	-
CO.2	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 for Course MCA/CSE/2/DSC/451

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

Course Content
MCA/CSE/2/DSC/451: Computer Networks

Unit - I	Network concepts: goals applications and history of computer networks; Network Topologies; Network type - LAN, MAN, WAN etc.; point-to point, and broadcast networks. Networks architecture: concepts of protocols & services; OSI model and functions of its layers; TCP/IP reference model. TCP/IP: elements of transport protocols; transmission control protocol (TCP); user datagram protocol (UDP); Internet protocol (IP).
Unit - II	Data communication concepts: components of a data communication system; transmission modes; Transmission media – guided and wireless media; Switching: introduction to switching (circuit, message and packet) , Multiplexing: (frequency division wavelength division and time division); Modems.
Unit - III	Framing and error control: framing techniques; error control - error detection & correction. Data link control: acknowledgments, sliding window protocols. Multiple Access Control, flow and error control, token bus, token ring. Congestion control: principles of congestion control; traffic shaping; choke packets; load shading.
Unit - IV	Routing: deterministic and adaptive routing; centralized and distributed routing; Unicast Routing: Routing algorithm (Distance vector, Link state routing, Path vector routing) , Unicast routing protocols (RIP,OSPF and BGP4); Multicast Routing : Introduction , Multicasting basic (multicast address, multicast

	forwarding, approach of multicasting), multicast protocols (DVMRP, MOSPF, PIM).
Text/Reference Books	
Text Books	2. Andrews, Tananbaum, Computer Networks – PHI. 3. Fred Halsall, Data Communications, Computer Networks and Open Systems, 4e, Addison Wesley. 4. William Stalling, Data and Computer Communications, 5e, PHI.
Reference Books	2. Behrouz, Frozen, Introduction to Data Communications and Networking, Tata McGraw Hill.

MCA/CSE/2/DSC/452: Software Engineering								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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: The objective of this course is to make the students familiar with the topics of software crisis, software engineering paradigms, software configuration management, design, coding, testing and maintenance.

Course Outcomes	At the end of this course, the student will be able to:
CO1	enumerate/define the concepts of: software and software engineering, software development paradigms, phases of software development, methods of assessing quality and reliability.
CO2	describe and summarize: phases of software development process, testing techniques, relationship between reliability and quality.
CO3	illustrate various techniques of: requirement analysis, design, coding, testing and maintenance, quality and reliability.
CO4	analyse and classify: software engineering paradigms, cost estimation models, design methodologies, testing techniques, maintenance process, reliability and quality models.
CO5	compare and select from amongst candidate: software engineering paradigms, cost estimation models, design methodologies, testing techniques, maintenance process, reliability and quality models.
CO6	design and develop simple software using the concepts, techniques and principles of software engineering.

CO-PEO Mapping Matrix for Course MCA/CSE/2/DSC/452

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 for Course MCA/CSE/2/DSC/452

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

CO-PSO Mapping Matrix for Course MCA/CSE/2/DSC/452

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
MCA/CSE/2/DSC/452: Software Engineering

Unit - I	Software and software engineering, software characteristics, software crisis, software engineering paradigms, planning a software project, software cost estimation, project scheduling, personnel planning, team structure.
Unit - II	Software requirement analysis: structured analysis, object-oriented analysis and data modeling, software requirement specification, validation. Software configuration management, quality assurance, project monitoring, risk management. .
Unit - III	Design and implementation of software: software design fundamentals, structured design methodology and object-oriented design, design verification, monitoring and control, coding. Software Reliability: metric and specification, fault avoidance and tolerance, exception handling, defensive programming.
Unit - IV	Testing: testing fundamentals, white box and black box testing, software testing strategies: unit testing, integration testing, validation testing, system testing, debugging. Software maintenance: maintenance characteristics, maintainability, maintenance tasks, maintenance side effects. CASE tools. agile development.

Text/Reference Books

Text Books	5. Mall, Rajib, Fundamentals of Software Engineering, PHI Learning Pvt. Ltd 6. Aggarwal, K.K, and Singh, Yogesh, Software Engineering, New Age International 7. Jalote, Pankaj, An Integrated Approach to Software Engineering, Narosa Publishing House.
Reference Books	3. Pressman, S. Roger, Software Engineering, Tata McGraw-Hill.

MCA/CSE/2/DSC/453: Artificial Intelligence							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
DSC Theory	04	04	Lecture/ Tutorial	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

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 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 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: The objective of this course is to providean 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 types of: search strategy, production system, learning, operator of genetic algorithm, knowledge representation and approaches that deals with uncertainty.
CO5	compare and select types of: search strategy, production system, learning, operator of genetic algorithm, knowledge representation and approaches that deals with uncertainty.

CO-PEO Mapping Matrix for Course MCA/CSE/2/DSC/453

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 for Course MCA/CSE/2/DSC/453

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	-	-
Average	2	1.4	1.4	2.2	1.5	-	3	-	-	2	-	-

CO-PSO Mapping Matrix for CourseMCA/CSE/2/DSC/453

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	2.4	-

Course Content
MCA/CSE/2/DSC/453: Artificial Intelligence

Unit – I	Introduction: background and history, overview of AI applications areas. The predicate calculus: syntax and semantic for propositional logic and FOPL, clausal form, inference rules, resolution and unification. Knowledge representation: network representation, associative network & conceptual graphs, structured representation, frames & scripts.
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, mini-max etc.), computational complexity, properties of search algorithms, admissibility, monotonicity, optimality, dominance.
Unit - III	Production system: types of production system-commutative and non-commutative production systems, decomposable and non-decomposable production systems, control of search in production systems. Rule-based expert systems: architecture, development, managing uncertainty in expert systems, Bayesian probability theory, Stanford certainty factor algebra, nonmonotonic logic and reasoning with beliefs.
Unit – IV	Fuzzy logic, Dempster/Shaffer Monti Hall problem of uncertainty. Knowledge acquisition: types of learning, learning by automata, intelligent editors, learning by induction. Genetic algorithms: problem representation, encoding schemes, operators: selection, crossover, mutation, replacement etc.
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.

MCA/CSE/2/DSC/454:Computer Graphics							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
DSC Theory	04	04	Lecture/ Tutorial	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

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

Course Objectives: Objective of this course is to make the students familiar with the basic concepts of Computer Graphics and the working of various graphic devices and their applications.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define: computer graphics, soft copy computer devices, hard copy computer devices use in computer graphics, 2D graphics, 3D graphics, multimedia, 2D transformation, 3D transformation, resolution, graphic operation.
CO2	describe: computer graphic application, random scan, raster scan, coordinate system, homogeneous coordinate system, scan conversion , DDA, Bresenham line drawing algorithm, 2D and 3D transformation, positioning, pointing, rubber band techniques, clipping operation on line , polygon clipping, hidden surface removal, parallel and perspective projection, shading.
CO3	apply algorithms: line drawing, clipping, hidden surface removal, projection.
CO4	categorize: scan conversion methods, projection techniques, clipping algorithms, shading methods.
CO5	compare and evaluate:scan conversion methods, projection techniques, clipping algorithms, shading methods.

CO-PEO Mapping Matrix for Course MCA/CSE/2/DSC/454

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 for Course MCA/CSE/2/DSC/454

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	1.5	-	3	-	-	-	-	-

CO-PSO Mapping Matrix for Course MCA/CSE/2/DSC/454

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	2.4	-

Course Content
MCA/CSE/2/DSC/454: Computer Graphics

Unit I	Introduction: survey of computer graphics and its applications; Interactive and passive graphics; Introduction to GKS primitives; display processors; graphic devices: display system-refresh CRTs, raster scan and random scan monitors grey shades, Interlacing, beam penetration shadow mask monitors, look up tables, plasma panel, LED and LCD monitors, LCD monitors, VGA and SVGA resolution; hard copy devices-printers, plotters
Unit - II	Drawing geometry: coordinate system,resolution, use of homogeneous coordinate system; Scan conversion: symmetrical DDA, simple DDA, Bresenham's line drawing algorithm, generation of ellipse; 2-D Transformations: translation; rotation; scaling; mirror reflection; shearing: zooming; panning;input techniques-pointing, positioning, rubber and methods and dragging; tweezing.
Unit - III	Graphic operations: clipping-line clipping using Sutherland-Cohen and midpoint sub-division algorithm, polygon clipping; window and view port; windowing transformation; filling-stack based fill algorithm; Multimedia: concepts of hypertext/hypermedia; multimedia applications; multimedia authoring; multimedia hardware; images; bitmaps; windows paint brush.
Unit - IV	3-D Graphics: 3D modeling of objects; 3D display techniques; coordinate system; 3D transformation matrices for translation, scaling and rotation; parallel projection; perspective projection; hidden surface removal, z-buffer, back face, scan line, depth sorting, area subdivision; shading- modelling light intensities, gouraud shading, phong shading.

Text/Reference Books

Text Books.	1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI. 2. Newman &Sproull, Principles of Interactive Computer Graphics, McGraw Hill.
Reference Books	1.John F. KoegelBufore, Multimedia Systems, Addison Wesley. 2. Foley, Computer Graphics Principles & Practice, Addison Wesley. 3. Rogers, Procedural elements of Computer Graphics, McGraw Hill. 4. D.P. Mukherjee, Fundamentals of computer Graphics and Multimedia, PHI.

MCA/CSE/2/DSC/455: Java Programming							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
DSC Theory + Practical	04	06 (2T+4P)	Lecture/ Practical	30 Theory	20 (10 | 5 | 5)	3 Hours	TEE/MTE/ Assignment/ Attendance
				50 Practical	-	3 Hours	TEE (Experiment, Practical file, 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 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 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 get the basic concepts and building blocks of Core Java.Net programming languages using the modular approach which emphasizes on small programs. Learn how to write moderately complex programs efficiently. Learn making GUI-based applications in Core Java.

Course Outcomes	By the end of this course, the student will able to:
CO1	outline: programming environment, data types, control constructs, loops, arrays, programming approaches, threads in programming, file system for data storing, data structure library, graphical user interface concepts.
CO2	summarize: programming fundamentals, programming approaches, multithreaded programming, data storing using file system, data structure library, GUI concepts.
CO3	apply: basic programming concepts: to solve basic mathematical operations, data structure operations, concurrent execution of threads, user friendly interfaced programs.
CO4	categorize: data types, programming approaches, flow controls constructs, loops, single and multithreaded programming, various classes in collection framework, GUI controls.
CO5	choose: data types, programming approaches, branching and iteration methods, serial or concurrent programming, data structures supporting classes in collection framework.
CO6	create: programs using basic concepts, multithreading and GUI based concepts.

CO-PEO Mapping Matrix for Course MCA/CSE/2/DSC/455

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 for Course MCA/CSE/2/DSC/455

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/CSE/2/DSC/455

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/2/DSC/455: Java Programming

Unit - I	Java :introduction, basic concepts, data types, reference types, operators and its types, decision controls, control statements, loops, array, string, functions, boxing unboxing, scope of variables.
Unit - II	OOPS concepts in Java: encapsulation, class, object, constructors, destructors, Polymorphism: function overloading and operator overloading, inheritance, interface, abstract class, packages, exception handling.
Unit - III	Multithreading in Java: thread model, multithreading supporting classes and methods, creating single and multiple threaded program, context switching, thread synchronization, inter thread communication. Working with GUI in Java: containers and components.
Unit – IV	Collection framework in Java: interfaces and classes for collection framework, list, set, map.I/O stream in Java:input and output stream, file handling operations.

Text/Reference Books

Text Books	1. Darrel Ince& Adam Freeman, Programming the Internet with Java, 2e, Addison Wesley. 2. K.A. Mughal, R.W. Rasmussen, A Programmer's Guide to Java Certification, Addison Wesley. 3. E. Balagurusamy, Programming with Java, 6e, Tata McGraw Hill.
Reference Books	1. Herbert Schildt, The Complete Reference Java, 10e, Tata McGraw Hill.

MCA/CSE/2/INT/451: Internship/Industrial Training							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Internship/IndustrialTraining	04	-	Internship/ Training	100	-	-	Training Report/ Viva Voce

Instructions evaluation/examination: The term-end examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of the Internship/Training Report and a presentation based viva voce exam.

Course Objectives: To expose students to real work of environment experience and at the same time, to gain the knowledge through hands-on observation and job execution and allows them to relate the theory to practice. The interns/trainees will also develop skills in work ethics, communication, management and others.

Course Outcomes	At the end of this course, the student would be able to:
CO1	apply foundational concepts of computer applications (e.g., programming, data structures, databases) in real-world industry or organizational settings.
CO2	demonstrate understanding of workplace practices such as project workflows, team collaboration, software development cycles, and organizational communication.
CO3	use appropriate tools, technologies, or platforms relevant to the assigned tasks, such as version control systems, IDEs, database systems, or front-end/back-end frameworks.
CO4	analyze and document technical problems and solutions encountered during the internship, reflecting on challenges and learning outcomes.
CO5	prepare a professional internship report and presentation**,** articulating the scope of work, key contributions, skills acquired, and insights gained into industry practices.

CO-PEO Mapping Matrix for Course MCA/CSE/2/INT/451

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 for Course MCA/CSE/2/INT/451

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 for Course MCA/CSE/2/INT/451

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

MCA 2-Year Program
Semester III
Options 1 & 2

MCA/CSE/3/DSC/501: Discrete Mathematics

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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: This course is aimed at making the students familiar with various discrete structures, operations performed thereupon and their implementation mechanism.

Course Outcomes	By the end of this course, the student will be able to
CO1	define: sets and elements, introduction and representation of relations, types of functions, graphs and multigraphs, Boolean algebra, group, and subgroups
CO2	describe and discuss:inclusion-exclusion principle, finite and Infinite sets., types & composition of relations, types of graphs, sorting and searching, Boolean algebra and groups.
CO3	solve: various mathematical problems related to sets, graphs, Boolean algebra and groups, directed and undirected graphs, basic logical operations on propositions and truth tables.
CO4	illustrate: sets and elements, representation of relations, types of graphs and multigraph, Boolean algebra operations, group and subgroups lattices.
CO5	determine: complex problem related to sets and elements, graphs and multigraphs, Boolean algebra, groups and subgroups.

CO-PEO Mapping Matrix for Course MCA/CSE/3/DSC/501

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 for Course MCA/CSE/3/DSC/501

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 for Course MCA/CSE/3/DSC/501

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
MCA/CSE/3/DSC/501: Discrete Mathematics

Unit - I	Sets and elements, inclusion-exclusion principle, finite and Infinite sets, power sets, multisets, introduction and representation of relations, types of relations, composition of relations: introduction to functions, types of functions.
Unit - II	Graphs and multigraphs, sequential and linked representation of graphs, Directed and Undirected graphs: Types of graphs, labelled and weighted graphs, complete, regular and bipartile graphs, planar graphs, tree graphs, paths, connectivity, depth first search, breadth first search, topological sort.
Unit - III	Boolean algebra, basic definitions, duality, truth tables, boolean functions, basic logical operations on propositions, proposition and truth tables, tautologies and contradictions, algebra of propositions, rules of inference.
Unit - IV	Group and subgroups, semigroups groups, normal subgroups, homomorphisms, rings, integral domain, ordered sets, hasse diagram of partially ordered sets, lattices, bounded lattices, distributive lattices, complemented lattices.

Text/Reference Books

Text Books	1. Seymour Lipschutz, Marc Lars Lipson, Discrete Mathematics, McGraw-Hill International Editions, Schaum's Series. 2. Bernard Kolman, Robert C. Busbym, Discrete Mathematical Structures for Computer Science, Prentice-Hall of India Pvt. Ltd.
Reference Books	1. Alan Doerr, Kenneth Levaseur, Applied Discrete Structures for Computer Science, Galgotia Publication Pvt. Ltd. 2. Kennech G. Rosen, Discrete Mathematics and its Applications, McGraw-Hill International Editions, Mathematics Series.

MCA/CSE/3/DSC/502: Machine Learning								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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, 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 for Course MCA/CSE/3/DSC/502

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 for Course MCA/CSE/3/DSC/502

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 for Course MCA/CSE/3/DSC/502

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
MCA/CSE/3/DSC/502: 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 structure of data, data pre-processing (dimension reduction and feature subset selection), model selection.
Unit – III	Supervised Learning: Introduction, classification (introduction, classification model, learning steps, common classification algorithm: kNN, decision tree, naïve Bayes, SVM, logistic regression. Regression method, linear regression.
Unit – IV	Unsupervised Learning: Introduction and its applications, techniques in unsupervised learning. Clustering algorithms: K-means, hierarchical, DBSCAN. Neural Network: Introduction, architecture of 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

MCA/CSE/3/DSC/503(i): Network Security								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSE Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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: computer security, security standards, cipher model, encryption techniques, data encryption standards, public-key cryptography, security at transport layer, SSL/TSL attacks, wireless security and IEEE 802.11i.
CO2	explain: computer concepts related withthe security, symmetric techniques, advanced encryption standard, RSA, concept of digital signature, security protocols, wireless security measures and email security.
CO3	illustrate: the different features related with computer security, encryption and symmetric techniques, data encryption standards, security at transport layer and wireless LAN security.
CO4	classify: the information about security, its architecture, types of attacks, security mechanism, encryption standards, protocols at transport layer and wireless LAN security.
CO5	evaluate:the security trends, security mechanisms, cipher model, RSA, Diffie-Hellman key exchange, transport layer security, SSL/TSL attacks, wireless security and IP security.

CO-PEO Mapping Matrix for Course MCA/CSE/3/DSC/503(i)

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 for Course MCA/CSE/3/DSC/503(i)

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 for Course MCA/CSE/3/DSC/503(i)

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

Course Content
MCA/CSE/3/DSC/503(i): Network Security

Unit – I	Computer Security Concepts – Introduction, security, security trends, components of information system, OSI security architecture, security attacks, goals for security, security mechanisms, security standards. Cipher model, cryptanalysis and brute-force attack, classical encryption techniques – symmetric techniques – substitution techniques, transposition techniques, rotor machines, steganography.
Unit – II	Traditional block cipher; data encryption standard – encryption and decryption, advanced encryption standard – structure and expansion functions. Public-key cryptography – principles, applications and requirements; RSA, Diffie-Hellman key exchange. Concept of digital signature.
Unit – III	Security at Transport Layer, web security considerations, Transport Layer Security, TLS record protocol, change cipher spec protocol, alert protocol, handshake protocol, heart-beat protocol; SSL/TSL attacks; HTTPS; Secure shell; user authentication protocol, connection protocol.
Unit – IV	Wireless Security, wireless security measures, mobile device security - threats and strategy. Wireless LAN security, IEEE 802.11i - services, operation and phases. Email security, S/MIME, PGP, overview of IP security.
Text/Reference Books	
Text Books	1. William Stallings, Cryptography And Network Security Principles And Practice, Pearson Education

	2. Forouzan, Mukhopadhyay, Cryptography & Network Security, McGraw Hill
Reference Books	1. AtulKahate, Cryptography and Network Security, TMH 2. Godbole, Information Systems Security, Wiley India Mark Stamp, Information Security Principles and Practice, Willy India

MCA/CSE/3/DSC/503(ii): Wireless Network								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSE Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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 fundamental concepts in wireless network, various LAN standards, IP and IPV6 Layer, Transmission protocols and WAN standards.

Course Outcomes	At the end of this course, the student will be able to :
CO1	define: wireless LAN, architecture, mobile network layer, mobile transport layer and wireless wide area network.
CO2	describe: WLAN technologies, IEEE 802.11 types , IEEE 802.16, Bluetooth, IPV6, mobile ad-hoc network, TCP enhancements for wireless network, UTMS, 3G-MSC, 3G-SGSN, 3G-GGSN, applications of 4G, features and challenges of 5G.
CO3	illustrate: wireless LAN, system architecture, physical layer, Mac layer, Bluetooth architecture, mobile IP, mobile ad-hoc network, mobile transport layer, TCP improvements, wireless wide area network, HSDPA, features and challenges of 4G, 5G.
CO4	analyze: WLAN technologies, 802.11b, 802.11a, IEEE 802.16, IPV6, Routing, TCP enhancements, TCP improvements, UMTS core network architecture, firewall, 3G, 4G and 5G networks.
CO5	compare: different Wireless LAN technologies, mobile network layer, mobile transport layer, Mobile IP, mobile ad-hoc networks, protocols, TCP improvements and wireless WAN types.

CO-PEO Mapping Matrix for Course MCA/CSE/3/DSC/503(ii)

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 for Course MCA/CSE/3/DSC/503(ii)

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 for Course MCA/CSE/3/DSC/503(ii)

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

Course Content
MCA/CSE/3/DSC/503(ii): Wireless Network

Unit – I	Wireless LAN: Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum -IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security - IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX.
Unit – II	Mobile Network Layer: Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6- Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing
Unit – III	Mobile Transport Layer :TCP enhancements for wireless protocols - Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility - Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP - TCP over 3G wireless networks.
Unit – IV	Wireless Wide Area Network: Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)- LTE network architecture and protocol, features and challenges of 4G, Applications of 4G, Introduction to 5G vision,5G features and challenges.
Text/Reference Books	
Text Books	1. Jochen Schiller, "Mobile Communications", 2e, Pearson Education 2012. 2. Vijay Garg, "Wireless Communications and Networking", 1e, Elsevier, 2007

Reference Books	1. William Stallings, Wireless Communications and Networks, Pearson/Prentice Hall of India. 2. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", 2e, Academic Press, 2008. 3. Anurag Kumar, D. Manjunath, Joy Kuri, "Wireless Networking", 1e, Elsevier 2011. 4. Simon Haykin, Michael Moher, David Koilpillai, "Modern Wireless Communications", 1e, Pearson Education, 2013.

MCA/CSE/3/DSC/504(i): Theory of Computation								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSE Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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 understand fundamental concepts of finite automata, regular grammar, mealy and Moore machine, context free language and grammar their properties, context free language and grammar.

Course Outcomes	By the end of this course, the student will be able to
CO1	define: fundamental concept of finite automata, pushdown automata, Linear bound automata, Turing machine,context free language &grammar, context sensitive language & grammar.
CO2	discuss: concept of context free language and grammar, pushdown automata, equivalence of deterministic and non-deterministic finite automata, ambiguity in grammars and languages, concept of Turing machine.
CO3	use: Pumping lemma to check language is not regular, pushdown automata to check context free language ,Turing machine to solve basic calculation.
CO4	classify: finite automata, regular grammar, context free grammar, context free language, context sensitive grammar, normal forms, pushdown automata, Turing machine.
CO5	Compare and contrast: NFA & DFA, mealy and Moore machine ,CNF&GNF, languages, grammars, different automata, Turing machine.

CO-PEO Mapping Matrix for Course MCA/CSE/3/DSC/504(i)

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 for Course MCA/CSE/3/DSC/504(i)

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 for Course MCA/CSE/3/DSC/504(i)

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
MCA/CSE/3/DSC/504(i): Theory of Computation

Unit - I	Finite Automata: Deterministic and non-deterministic finite automata, applications of finite automata, equivalence of deterministic and non-deterministic finite automata, state minimization of DFA, Kleen's characterization theory for sets accepted by finite automata, regular grammar, mealy and Moore machine.
Unit - II	Context Free Language and Grammar: Context free grammar, parse tree, application of context free grammars, ambiguity in grammars and languages. Pushdown Automata: Deterministic pushdown automata and Non-deterministic pushdown automata, language of pushdown automata, equivalence of PDA's and CFG's.
Unit - III	Properties of Context-Free Languages: Normal form of context free grammars, pumping lemma for context-free grammars, closure properties of context-free languages, decision properties of context free languages. Context Sensitive Language and Grammar: Introduction, closure properties of CSL.
Unit - IV	Turing machine: Construction of Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine (multi-tape Turing machine, equivalence of one-tape and multi-tape Turing machine, Non Deterministic Turing machine), restricted Turing machine (multi-stack machines, counter machines).

Text/Reference Books

Text Books	1. John C. Martin, Introduction to Languages and the Theory of Computation, McGraw Hill. 2. Peter Linz, An introduction to formal language & automata, Jones & Bartlett publications.
Reference Books	1. Hopcroft J. E. & Ullman J. D, Formal languages and their relation to Automata, Pearson Education. 2. Lewis, H.R. &Papadimitrious, C. H., Elements of the theory of computation, PHI Learning. 3. Michael Sipser, Introduction to the Theory of Computation, Cengage Learning.

MCA/CSE/3/DSC/504(ii): Compiler Construction								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSE Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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 fundamental concepts of compiler, interpreters, assemblers, lexical analysis, syntax analysis, intermediate code generation and code optimization techniques used in compiler design.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define: syntax analysis, grammar, intermediate code, code optimization, code generation ,syntax directed translation.
CO2	explain: basics of compilers, interpreters, assemblers, compiler construction tools, process of lexical analysis, syntax analysis, types of grammar, code optimization and code generation.
CO3	illustrate: various analysis-synthesis model of translation, lexical analysis, syntax analysis, optimization of basic blocks, loops optimization, peephole optimization and blocks code generation from directed acyclic graphs.
CO4	analyze: phase of compilation, finite state automata recognition of regular expressions, parser generator, optimization technique of code and management of code.
CO5	contrast: compiler, interpreters and assemblers, finite state automata recognition, process of syntax analysis, code improving transformations and syntax directed translation scheme.

CO-PEO Mapping Matrix for Course MCA/CSE/3/DSC/504(ii)

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 for Course MCA/CSE/3/DSC/504(ii)

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 for Course MCA/CSE/3/DSC/504(ii)

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
MCA/CSE/3/DSC/504(ii): Compiler Construction

Unit - I	Introduction to Compilers: Basics of compilers, interpreters, assemblers, phases of compilation, analysis-synthesis model of translation, compiler construction tools. Lexical Analysis: Process of lexical analysis, finite state automata recognition of regular expressions.
Unit – II	Syntax Analysis: Process of syntax analysis, types of grammars, top-down and bottom-up parsing techniques, Parser generator.
Unit – III	Intermediate Code Generation: Intermediate languages, generating intermediate code for assignment statement, Boolean expression, and case statement. Code Optimization: Introduction to code optimization, potential cases of code optimization, optimization of basic blocks, loops optimization, code improving transformations.
Unit – IV	Code Generation: Basics, dynamic storage management, translating basic blocks, a simple code generator, peephole optimization, directed acyclic graphs and basic blocks code generation from directed acyclic graphs. Syntax Directed Translation: Overview of syntax directed translation scheme.

Text/Reference Books

Text Books	1. Alfred V Aho, Principles of Compiler Design, Narosa Publishing House. 2. Aho, Sethi, & Ullman, Compilers Principles, Techniques and Tools, Pearson Education.
Reference Books	1. Dhamdhere D.M, System programming and operating system, McGraw Hill. 2. Beck L. Leland, System Software, Pearson Education. 3. Fischer, Crafting a Compiler in C, Pearson Education. 4. Jean Paul Tremblay and Sorenson, The Theory and Practice of Compiler Writing, McGraw Hill.

MCA/CSE/3/DSC/505: Python Programming

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
DSC Theory + Practical	04	06 (2T+4P)	Lecture/ Practical	30 Theory	20 (10, 5, 5)	3 Hours	TEE/MTE/ Assignment/ Attendance
				50 Practical	-	3 Hours	TEE (Experiment, Practical file, 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 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 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 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 possess an understanding of:
CO1	define:installations,working,structures,controlstatements,operators,lists ,object oriented programming concepts,python libraries.
CO2	explain: conditional & control statements ,strings, OOPs ,file handling concepts,librariesand 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:datatypes,dictionaries,conditional&controlstatements,functions,python libraries.
CO5	compare:datatypes,dictionaries,conditional&controlstatements,functions,python libraries.
CO6	design:basic and advanced applications in python.

CO-PEO Mapping Matrix for Course MCA/CSE/3/DSC/505

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 for Course MCA/CSE/3/DSC/505

COs	PO1	PO2	PO3	PO4	PO5	PO	PO7	PO8	PO9	PO1	PO1	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 for Course MCA/CSE/3/DSC/505

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/3/DSC/505: Python Programming

Unit – I	Introduction andFeatures of Python, Tokens, Identifiers, Reserved keywords, Literals, Variables, Python basic Operators, Data Types in Python, Casting in Python, Scope of a Variable. **Decision Control Statements**: Selection Control, Loop Control, Continue, Break ,Pass statement.
Unit – II	**Functions and Modules**: Creating Module and function, Built-in Modules (Math, random, Statistics) and user defined modules. Packages: Package Types, Importing Package, Viewing Package Lambda Function in python.
Unit – III	**Object Oriented Programming**: Concept of Class & Object, Constructor, Class Attributes and Destructors, Inheritance, Method Overloading, Overriding, Data Hiding, Exception Handling. **File Handling**: Creating, Opening, Closing, Writing & Reading File Content, Deleting a File, dump module.
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, Scatter Plot and Pie Charts.
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

MCA/CSE/3/SEC/501(i): Android Development							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
SEC Theory + Practical	04	06 (2T+4P)	Lecture/ Practical	30 Theory	20 (10 / 5 / 5)	3 Hours	TEE/MTE/ Assignment/ Attendance
				50 Practical	-	3 Hours	TEE (Experiment, Practical file, 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 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 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 provide in-depth coverage of various concepts of android application development. This course will help the students in learning to develop and publish their own android applications.

Course Outcomes	At the end of this course, the student will able to:
CO1	define: android, features, development environment, architecture, software development platform and the framework related to android applications.
CO2	explain: versions of android, architecture, software development platform, JAVA SE, the Dalvik virtual machine and various android services.
CO3	demonstrate: android SDK, IDE, AVDs, project configuration settings, directory structure of android project, activities and services of android.
CO4	illustrate: android versions, features, system requirements, applications, directory structures, resource folders, android services, screen sizes and android framework.
CO5	compare and contrast: android versions with their functions, types of android applications, development platforms, layout of android applications, activities associated with android and user interfaces.
CO6	create: android applications using different types of resources and development platforms.

CO-PEO Mapping Matrix for Course MCA/CSE/3/SEC/501(i)

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
CO6	3	3	1	3	3
Average	2.5	3	1	3	3

CO-PO Mapping Matrix for Course MCA/CSE/3/SEC/501(i)

COs	PO1	PO2	PO3	PO4	PO5	PO	PO7	PO8	PO9	PO1	PO1	PO12
CO1	1	1	1	1	1	-	3	1	-	-	-	-
CO2	2	2	1	3	1	-	3	2	-	-	-	-
CO3	3	3	1	3	3	-	3	3	-	-	-	-
CO4	2	3	1	3	3	-	3	3	-	-	-	-
CO5	2	3	3	1	3	-	3	3	-	-	-	-
CO6	2	3	3	1	3	-	3	3	-	-	-	-
Average	2	2.5	1.66	2	2.33	-	3	2.5	-	-	-	-

CO-PSO Mapping Matrix for Course MCA/CSE/3/SEC/501(i)

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	-
CO6	3	3	3	3	-
Average	3	3	3	2.5	-

Course Content
MCA/CSE/3/SEC/501(i):Android Development

Unit – I	Introduction: Android, Android versions and its feature, The Android market application store. Android Development Environment: system requirements, Android SDK, installing Java, and ADT bundle, eclipse integrated development environment (IDE), creating Android Virtual Devices (AVDs).
Unit – II	Android Architecture Overview, creating a new Android project, defining the project name and SDK settings, project configuration settings, configuring the launcher icon, creating an activity, running the application in the AVD, stopping a running application, modifying the example application, reviewing the layout and resource files.
Unit – III	Android software development platform, understanding Java SE and the Dalvik Virtual Machine, The directory structure of an Android project, common default resources folders, screen sizes, launching your application.
Unit – IV	Android Framework overview, Android application components, Android activities: defining the UI, Android services: processing in the background, Android Manifest XML: declaring your components, understanding Android views, view groups and layouts, Graphical User Interface screen with views, displaying pictures, files, content providers, and databases.

Text/Reference Books	
Text Books	1. Burton Michael, Android App Development for Dummies, Wiley, 2015. 2. Wei-Meng Lee, Beginning Android 4 Application Development, Wiley India (Wrox), 2013. 3. John Horton, Android Programming for Beginners, Packet Publishing, 2015.
Reference Books	1. Ian F. Darwin, Android CookbookProblems and Solutions for Android Developers**,** 2e, O′Reilly,2017.

MCA/CSE/3/SEC/501(ii): Linux and Shell Scripts

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
SEC Theory + Practical	04	06 (2T+4P)	Lecture/ Practical	30 Theory	20 (10 + 5 + 5)	3 Hours	TEE/MTE/ Assignment/ Attendance
				50 Practical	-	3 Hours	TEE (Experiment, Practical file, 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 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 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 objectives of this course are to provide the in-depth coverage of various concepts of Linux. Linux administration is an essential course for the students

Course Outcomes	At the end of this course, the student will be able to:	At the end of
CO1	define and outline: basic requirements, features, essential commands of Linux, vi editors, processes scheduling, communication commands, simple (grep, sed) and advanced filters (awk, perl).	define: andro development
CO2	explain: the organization, file system, Shells, file permissions, priorities, processes, communication commands in Linux and operations performed by the simple as well as advanced filters.	explain: vers JAVA SE, th
CO3	perform: operations in Linux, modes of operations in vi, mailing communication, regular expressions along with the simple and advanced filters.	demonstrate: directory stru
CO4	categorize: the Linux commands, processes, priorities, communication commands, simple and advanced filters using regular expressions.	illustrate: ar directory str android fram
CO5	compare: shells, file permissions, processes, command with different options, simple filters like grep, sed and advanced filters like awk, perl.	compare and android ap applications,
CO6	create: Linux shell scripts showing the use of commands, regular expressions and filters.	create: andr development

CO-PEO Mapping Matrix for Course MCA/CSE/3/SEC/501(ii)

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
CO6	3	3	1	3	3
Average	3	3	1	3	3

CO-PO Mapping Matrix for Course MCA/CSE/3/SEC/501(ii)

COs	PO1	PO2	PO3	PO4	PO5	PO	PO7	PO8	PO9	PO1	PO1	PO12
CO1	1	1	1	1	1	-	3	1	-	-	-	-
CO2	2	2	1	3	1	-	3	2	-	-	-	-
CO3	3	3	1	3	3	-	3	3	-	-	-	-
CO4	2	3	1	3	3	-	3	3	-	-	-	-
CO5	2	3	3	1	3	-	3	3	-	-	-	-
CO6	2	3	3	1	3	-	3	3	-	-	-	-
Average	2	2.5	1.66	2	2.33	-	3	2.5	-	-	-	-

CO-PSO Mapping Matrix for Course MCA/CSE/3/SEC/501(ii)

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	-
CO6	3	3	3	3	-
Average	3	3	3	2.5	-

Course Content
MCA/CSE/3/SEC/501(ii)Linux and Shell Scripts

Unit – I	Introduction, hardware requirements for Unix/Linux, salient features of Unix-multiuser capability, multitasking, communication, security, portability. Unix system organization, types of shells, Unix commands, the Unix file system, listing of files and directories, file permissions with chmod, disk related commands. Essential Unix/ Linux commands: cal, touch, file, file related commands, viewing files, taking printouts, file compression, the on-line Unix manual.
Unit – II	I/O redirection and piping, the vi editor, modes of operations in vi. processes in Unix/Linux: background processes, nohup command, killing a process, changing process priorities, scheduling of processes- the at command, the batch command, the crontab command. Communication: the write command, the wall command, motd command, mail-sending, handling incoming mail, customizing mail.
Unit - III	Simple Filters: the sample database, pr- paginating files, head, tail, cut, paste, sort, uniq, tr, displaying a word-count list. Filters using regular expressions: grep – searching for a pattern, basic regular expression, extended regular expression. Sed: the stream editor, line addressing, using multiple instruction (-E and –F),

	context addressing, text editing, substitution(s), basic regular expression revisited.
Unit – IV	Awk: an advanced filter, simple awk filtering, splitting into fields, variables and expressions, the comparison operators, number processing, variables, the –f option, the begin and end sections, built-in-variables, arrays, functions. Perl: the master manipulator- perl preliminaries, chop function, string handling functions, split, join, for each, lists and arrays, file handling, file tests, subroutines.
Text/Reference Books	
Text Books	1. Sumitabha Das, Your Unix – The Ultimate Guide, Tata McGraw Hill, 2008. 2. YaswantKanetkar, "Unix Shell Programming", BPB Publication, (2009).
Reference Books	1. Matthew Neil, Stones Richard, Beginning Linux Programming, Wiley India Pvt. Ltd. 2. Christopher Negus, Linux Bible, Wiley India Pvt. Ltd. 3. Richard Peterson, Linux – The Complete Reference, Tata McGraw Hill

MCA 2-Year Program
Semester IV
Option 1

MCA/CSE/4/DSC/551:
MSc/CSE/4/DSC/554: **Deep Learning**

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks				Exam Duration	Assessment Methods
				External	Internal				
DSC Theory	04	04	Lecture/ Tutorial	70	30			3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5	5		

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 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 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, neurons, CNN and RNN
CO2	explain: architecture of ANN and deep learning, variants of the basic convolution function, Long short –term memory.
CO3	Appy: classification, regression, clustering techniques, Feed forward multilayer neural network, CNN, RNN according to their problems.
CO4	Classify: regression, classification, Convolutional neural network, RNN
CO5	compare: single layer and multi layer perceptron, CNN and RNN

CO-PEO Mapping Matrix for Course MCA/CSE/4/DSC/551 & MSc/CSE/4/DSC/554

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 for Course MCA/CSE/4/DSC/551& MSc/CSE/4/DSC/554

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 for Course MCA/CSE/4/DSC/551 & MSc/CSE/4/DSC/554					
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

MCA/CSE/4/DSC/551:
MSc/CSE/4/DSC/554: **Deep Learning**

Unit – I	**Introduction:** Introduction to machine learning, deep learning and AI, historical trendsin deeplearning, architectureofdeeplearning, significance of deep learning, application of deep learning, challenges of deep learning. **Neuralnetwork**:Introduction,architecture,differencebetweenBiological Neuron Network and Artificial Neuron Network.
Unit – II	**Foundation of deep learning:**Vector, scalars, matrix, statistics, probability.Regression,classification,underfitting, over fitting,gradientdescent, logistic regression, confusion matrix. activation functionsof Neural Network (liner, sigmoid, tanh, softmax).
Unit – III	**Fundamental of deep learning:**Common architectural principles of deep learning,single-layerand multi-layer perceptron, cross-entropylossfunctions for neural networks, matrix representation of neural nets. **Buildingblockofdeepnetwork**:Feedforwardmultilayerneuralnetwork, RBMs, autoencoders.
Unit – IV	**Convolutional neural networks:** Deep learning and neural networks perceptrons,convolutional networks,variantsof the basicconvolutionfunction, efficient convolution algorithms. **Recurrent neural networks:** Bidirectional RNNs, deep recurrent networks,recursiveneuralnetworks,the long short–termmemoryandothergatedRNNs.
Text/Reference Books	
Text Books	1.David Foster, GenerativeDeepLearning, O'Reilly, 2019. 2.Goodfellow,Y.Bengio,A.Courville,Deep Learning,MITPress,2016. 3.Patterson,JoshandAdamGibson.Deeplearning:Apractitioner's approach. " O'Reilly Media, Inc.", 2017. 4.Charu,C.Aggarwal.Neuralnetworksanddeeplearning:atextbook. 2018.
Reference Books	1. Buduma,Nithin,NikhilBudumaandJoePapa.Fundamentalsofdeep learning. " O'Reilly Media, Inc.", 2022. 2. Weidman,Seth.Deep learning fromscratch:buildingwithpythonfrom first principles. O'Reilly Media, 2019 3. IanGoodfellow,YoshuaBengioandAaronCourville.Deeplearning,The MIT

	Press, 2016.

MCA/CSE/4/DSC/552: IoT and Cloud Computing								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSC Theory	04	04	Lecture/ tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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 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/defineIoT: 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 for Course MCA/CSE/4/DSC/552

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 for Course MCA/CSE/4/DSC/552

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 for Course MCA/CSE/4/DSC/552

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
MCA/CSE/4/DSC/552: IoT and 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 its 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 Practical 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

MCA/CSE/4/DSC/553(i): Data Science

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSE Theory	04	04	Lecture/Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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: 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, sampling, data analysis techniques-correlation, regression, mean, mode, kurtosis, Bayesian network, and visualization.
CO2	understand and describe: exploratory data analysis, evolution of analytic scalability, data analysis techniques, Bayesian network, parametric and non-parametric tests, data analysis framework and visualization.
CO3	use: data science process, modern data analytic tools, statistical concepts, data analysis techniques, different statistical tests, and visualization.
CO4	categorize: analytic processes and tools, analysis, reporting, data analysis techniques, linear and non-linear time series.
CO5	choose: data science process, data analytic tools and processes, different tests, data analysis technique, time series, visual data analysis framework and technique suitable in given situation.

CO-PEO Mapping Matrix for Course MCA/CSE/4/DSC/553(i)

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 for Course MCA/CSE/4/DSC/553(i)

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	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	1	-	-

CO-PSO Mapping Matrix for Course MCA/CSE/4/DSC/553(i)

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	2.4	-

Course Content
MCA/CSE/4/DSC/553(i):Data Science

Unit I	**Introduction unstructured to Data Science**: Introduction, types of data- structured versus steps data, quantitative versus qualitative data, the four levels of data, five data, of graphical data science, data science process, exploratory data analysis, collection of science, presentation of data, classification of data, components of data reporting. evolution of analytic scalability, analytic processes and tools, analysis vs reporting.
Unit – II	**Statistical Concepts:** 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 Analytics**: Analytics for Data Science, Data Analytics examples, Life Cycle of Data Analytics, Data Discovery, Data preparation, Model Planning, Model Building Operationalization. Parametric & Non-Parametric tests: Z-test, t-test, F-test, sign test, Wilcoxon sign rank test, Mann-Whitney U test.
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.

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.

MCA/CSE/4/DSC/553(ii): Big Data Analytics							
Course Type	Course Credits	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
DSE Theory	04	04	Lecture/ Tutorial	70	30 (20 / 5 / 5)	3 Hours	TEE/MTE/ Assignment/ Attendance

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 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 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: 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 Content
MCA/CSE/4/DSC/553(ii): 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, analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Big Data applications.
Unit – II	Hadoop Distributed File System (HDFS):The design of HDFS, HDFS concepts, command line interface, Hadoop file system interfaces, data flow, data ingest with flume and Scoop 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: 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, Hbaseversus RDBMS. Big SQL: Introduction

Text/Reference Books

Text Books	1. Tom White “Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012. 2. SeemaAcharya, SubhasiniChellappan, "Big Data Analytics", Wiley 2015. 3. ArvindSathi, “BigDataAnalytics: 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” AuerbachPublications, CRC press (2013) 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.

MCA/CSE/4/DSC/554(i): Soft Computing								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSE Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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 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 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: The objective of this course is to cover fundamental soft computing concepts with an exposure to ANN, fuzzy Logic, optimization techniques using Genetic Algorithm (GA).

Course Outcomes	By the end of this course, the student will be able to:
CO1	recognize the concept of: soft computing and hard computing, simple genetic a fuzzy set, neuron, neural network and activation function.
CO2	understand and describe: the role of genetic algorithm operators, representatior set and its operation, types of neural network and activation function including and cons.
CO3	use: genetic algorithm, fuzzy logic , ANN and their constituents for solving optimization problem.
CO4	differentiate: soft computing and hard computing, operators of genetic algor activation functions of ANN. Analyze: fuzzification and defuzzification.
CO5	compare: soft computing and hard computing, operators of genetic algor different activation functions of ANN.

CO-PEO Mapping Matrix for Course MCA/CSE/4/DSC/554(i)

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 for Course MCA/CSE/4/DSC/554(i)

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 for Course MCA/CSE/4/DSC/554(i)

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
MCA/CSE/4/DSC/554(i): Soft Computing

Unit – I	Introduction to Soft Computing: Overview of Soft Computing, difference between soft and hard computing, brief descriptions of different components of soft computing including artificial neural networks, fuzzy logic, genetic algorithms.
Unit – II	Genetic Algorithm- Introduction to genetic algorithm, simple genetic algorithm, its representation. Selection: Roulette wheel selection, random, rank, tournament, Boltzmann selection. Crossover and its types: Single point crossover, two point crossover, multipoint crossover, ordered crossover, uniform crossover, crossover for real-valued representation. Mutation and its types: Flipping, Interchanging, reversing, replacement, mutation for real-valued representation, crossover rate, mutation rate and convergence criteria.
Unit – III	Fuzzy Logic: Introduction to fuzzy logic, representation of a classical set, representation of fuzzy set, basic properties of fuzzy sets. Fuzzy set operation: Intersection of fuzzy sets, union of fuzzy sets, complement of fuzzy sets, important terminologies in fuzzy set operations, properties of fuzzy sets, fuzzy arithmetic. Fuzzy Composition: Max-Min composition, max-star composition, max-product composition, max-average composition. fuzzification and de-fuzzification.
Unit - IV	Artificial Neural Network: Basic of neural network: neuron, artificial neuron, neural network, artificial neural network , perceptron, feed forward, multilayer perceptron neural network, advantage and disadvantage of ANNs. activation function and types of activation function. perceptron network, XOR problem.
Text/Reference Books	
Text Books	1. David E. Goldberg, Genetic Algorithms in Search, Optimization and machine learning, Addison Wesley. 2. ZbigniewMichalewicz, Genetic algorithms +Data Structures = Evolution Programs, SpringerVerlag.
Reference Books	1. M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall. 2. S. Rajasekaran& G. A. VijayalakshmiPai, Neural Networks, Fuzzy Logic and

	Genetic Algorithms: Synthesis & Applications, PHI. 3. S. N. Sivanandam& S. N. Deepa, Principles of Soft Computing, Wiley - India. 4. Simon O. Haykin, Neural Networks, A Comprehensive Foundation, PHI.

MCA/CSE/4/DSC/554(ii): Bioinspired Computing								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
DSE Theory	04	04	Lecture/ Tutorial	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to 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 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 Nature Computing ,neural network, Computing inspired by nature, Immuno computing.
CO2	explain: Genetic Algorithms, Complexity,Ant Colony Optimization, SACO and scope of ACO algorithms.
CO3	Appy: Simulated Annealing, Evolutionary Computing, Genetics Principles, Ant Colony Algorithm (ACA), Swarm Robotics, Forest's Algorithm, Artificial Immune Networks, DNA Computing
CO4	Classify: Forest's Algorithm, DNA Computing, DNA Molecule, Genetic Algorithms, Adaptation Feedback , Nature Computing
CO5	compare: GA operations, DNA Molecule, Artificial Immune Networks. Evaluation Interaction Immune Algorithms

CO-PEO Mapping Matrix for Course MCA/CSE/4/DSC/554(ii)

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 for Course MCA/CSE/4/DSC/554(ii)

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 for Course MCA/CSE/4/DSC/554(ii)

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
MCA/CSE/4/DSC/554(ii): Bioinspired Computing

Unit – I	**Introduction**- Nature to Nature Computing, Philosophy, Three Branches of Computing: A Brief Overview, Individuals, Entities and agents. **Artificial Neural Network:** Basic of neural network: neuron, artificial neuron, neural network, artificial neural network. Adaptation Feedback : Self-Organization-Complexity, Emergence and Bottom-up Vs Top-Down- Determination, Chaos and Fractals.
Unit – II	**Computing inspired by nature**: Evolutionary Computing, Hill Climbing and Simulated Annealing, Darwin's Dangerous Idea, Genetics Principles, Standard Evolutionary Algorithm -Genetic Algorithms, Reproduction-Crossover, Mutation.
Unit – III	**Swarm intelligence**: Introduction - Ant Colonies, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Swarm Robotics, Foraging for food, Social Adaptation of Knowledge, Particle Swarm Optimization (PSO)
Unit – IV	**Immuno computing:** Introduction- Immune System, Physiology and main components, Pattern Recognition and Binding, Immune Network Theory-Danger Theory, Evaluation Interaction Immune Algorithms, Introduction – Genetic algorithms, Bone Marrow Models, Forest's Algorithm, Artificial Immune Networks. **Computing with new natural materials** : DNA Computing: Motivation, DNA Molecule.

Text/Reference Books

Text Books	1. Floreano D. and Mattiussi C. (2008). Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies. MIT Press, Cambridge, MA. 2. Leandro Nunes de Castro. (2007). Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications. Chapman & Hall/ CRC, Taylor and Francis Group. 3. Marco Dorrigo, Thomas Stutzle, Ant Colony Optimization, PHI,2005
Reference Books	4. Sam Jones. (2015). Bio-Inspired Computing, Recent Innovations and Applications. Publisher: CLANRYE INTERNATIONAL 5. Tao Song, Pan Zheng, Mou Ling Dennis, Wong and Xun Wang. (2019). Bio-Inspired, Computing Models and Algorithms.

MCA/CSE/4/DSC/555: R Programming							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
DSC Theory + Practical	04	06 (2T+4P)	Lecture/ Practical	30 Theory	20 (10 / 5 / 5)	3 Hours	TEE/MTE/ Assignment/ Attendance
				50 Practical	-	3 Hours	TEE (Experiment, Practical file, 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 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 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: 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, visualization.
CO2	describe: the syntax ofdecision making statements, loops, user defined functions,used define 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-PEO Mapping Matrix for Course MCA/CSE/4/DSC/555

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 for Course MCA/CSE/4/DSC/555

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 for Course MCA/CSE/4/DSC/555

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
MCA/CSE/4/DSC/555: 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.

MCA/CSE/4/PRW/551: Project Work						
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks	Exam Duration	Assessment Methods
SEC/ Project Work	04	-	Project work	100	-	Training Report/ Presentation/ Viva Voce

Instructions for evaluation: The evaluation of project work will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of the Internship/Training Report and a presentation-based viva voce exam.

Course Objectives: The objective of this course is to enable students to undertake independent project-based work or practical investigation in their area of study. Through systematic exploration, students will apply theoretical knowledge and technical or analytical tools to address real-world problems or academic questions. The course aims to foster critical thinking, creativity, problem-solving skills, and effective communication, culminating in a well-documented project report or thesis that demonstrates scholarly depth and professional competence.

Course Outcomes	At the end of this course, the student would be able to:
CO1	identify and formulate a project problem or objective based on a critical understanding of existing knowledge, technological needs, or real-world challenges.
CO2	develop a structured project plan including methodology, tools, timelines, and resource requirements, aligned with academic or industry standards.
CO3	implement the project using appropriate techniques and tools**,** demonstrating technical proficiency, problem-solving abilities, and innovative thinking.
CO4	analyze and interpret project outcomes**,** drawing meaningful conclusions and relating them to theoretical or practical frameworks.
CO5	communicate project findings effectivelythrough a detailed project report and oral presentation, adhering to academic or professional documentation standards.

CO-PEO Mapping Matrix for Course MCA/CSE/4/PRW/551

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 for Course MCA/CSE/4/PRW/551

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 for Course MCA/CSE/4/PRW/551

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

MCA 2-Year Program
Semester IV
Option 2

MCA/CSE/4/SEC/551:Research Methodology							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
SEC Theory + Practical	04	05 (3T+2P)	Lecture/ Practical	50 Theory	25 15 5 5	3 Hours	TEE/MTE/ Assignment/ Attendance
				25Practical	-	3 Hours	TEE (Experiment, Practical file, 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 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: objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis
CO2	describe: objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis
CO3	illustrate: measurement, data collection, processing, sampling, analysis and its strategies, reports.
CO4	categorize:research,samplingmethods,datacollectiontechniques, reportsand data processing strategies. perform: data analysis..
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 for Course MCA/CSE/4/SEC/551

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 for Course MCA/CSE/4/SEC/551

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
Average	3	3	3	3	3	-	-	3	-	3	3	3

CO-PSO Mapping Matrix for Course MCA/CSE/4/SEC/551)

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
Average	3	3	3	3	3

Course Content
MCA/CSE/4/SEC/551: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 (frequencytables, 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: structureand componentsof scientificreports, types of report-technicalreportsandthesis,writing-synopsis,abstract,illustrationsand tables,

	results, summary, reference citing and listing.
Text/Reference Books	
Text Books	1. J.Garg,B.L,Karadia,R,AggarwalF,AnIntroductiontoResearchMethodology,RBSA Publishers, 2002. 2. Kothari, Chakravanti Rajagopalachari. Research methodology: Methods and techniques. New Age International, 2004. 3. SantoshGupta,ResearchMethodologyandStatisticalTechniques,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.

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

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

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

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

CO-PEO Mapping Matrix for Course MCA/CSE/4/RPR/552

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 for Course MCA/CSE/4/RPR/552

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 for Course MCA/CSE/4/RPR/552					
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

MCA 2-Year Program

Semester III

Option 3

MCA/CSE/3/SEC/501:Research Methodology							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
SEC Theory + Practical	04	05 (3T+2P)	Lecture/ Practical	50 Theory	25 (15 / 5 / 5)	3 Hours	TEE/MTE/ Assignment/ Attendance
				25 Practical	-	3 Hours	TEE (Experiment, Practical file, 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 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: objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis
CO2	describe: objectives, hypothesis, interpretation, data analysis, data collection, research design and method, interpretation, data analysis
CO3	Illustrate: measurement, data collection, processing, sampling,analysis And its strategies, reports.
CO4	categorize:research,samplingmethods,datacollectiontechniques, reports,and data processing strategies. perform: data analysis..
CO5	compare: sampling methods, data collection techniques, reports and dataprocessing strategies.
CO6	create: thesis, reports. design: research tool. Interpret(derive)results.

CO-PEO Mapping Matrix for Course MCA/CSE/3/SEC/501

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 for Course MCA/CSE/3/SEC/501

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
Average	3	3	3	3	3	-	-	3	-	3	3	3

CO-PSO Mapping Matrix for Course MCA/CSE/3/SEC/501)

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
Average	3	3	3	3	3

Course Content
MCA/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 report-technicalreportsandthesis,writing-synopsis,abstract, Illustrationsand tables,

	results, summary, reference citing and listing.
Text/Reference Books	
Text Books	4. J. Garg, B.L, Karadia, R, Aggarwal F, An Introduction to Research Methodology, RBSA Publishers, 2002. 5. Kothari,ChakravantiRajagopalachari. Researchmethodology: Methods and techniques. New Age International, 2004. 6. Santosh Gupta, Research Methodology and Statistical Techniques, Deep & Deep Publications Pvt. Ltd., 2008
Reference Books	2. N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers. Montgomery, Douglas C, Design and Analysis of Experiments, Wiley India Pvt. Ltd.

MCA/CSE/3/RPR/502: Research Project (Synopsis)						
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks	Exam Duration	Assessment Methods
Research	20	-	-	500	-	-

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

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

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

CO-PEO Mapping Matrix for Course MCA/CSE/3/RPR/502					
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 for Course MCA/CSE/3/RPR/502												
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 for Course MCA/CSE/3/RPR/502					
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

MCA 2-Year Program
Semester IV
Option 3

MCA/CSE/4/SEC/551: LLM &Generative AI and Research& Publication Ethics							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
SEC Theory + Practical	04	05 (3T+2P)	Lecture/ Practical	50 Theory	25 (15 / 5 / 5)	3 Hours	TEE/MTE/ Assignment/ Attendance
				25 Practical	-	3 Hours	TEE (Experiment, Practical file, 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 paper setter for term-end theory examination: The term-end examination of the theory part will have a total of NINE questions. Question number one will be compulsory and will consist of FIVEshort/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 make the students capable of understanding and using LLM and generative AIs and to instill ethical awareness and integrity in academic research and scholarly publication. It introduces students to key concepts such as plagiarism, authorship criteria, data falsification, peer review ethics, and responsible conduct of research. The course aims to prepare students to uphold ethical standards in designing, conducting, reporting, and publishing research across disciplines.

Course Outcomes	By the end of this course, the student will be able to:
CO1	understand the foundational concepts and applications of Large Language Mod (LLMs) and Generative AI in research.
CO2	analyze the capabilities, limitations, and ethical concerns of LLMs and other ge technologies.
CO3	apply knowledge of LLMs to enhance academic research, writing, and publicat practices responsibly.
CO4	understand key ethical principles, standards, and practices in academic publishi scientific research.
CO5	identify, evaluate, and prevent unethical research practices such as plagiarism, fabrication, and authorship misconduct.

CO-PEO Mapping Matrix for Course MCA/CSE/4/SEC/551					
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 for Course MCA/CSE/4/SEC/551

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 for Course MCA/CSE/4/SEC/551)

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
MCA/CSE/4/SEC/551: LLM & Generative AI and Research & Publication Ethics

Unit – I	Introductionto LLMs and Generative AI: Basics of Artificial Intelligence and Machine Learning; Evolution of Large Language Models (LLMs); architecture of transformer-based models; key concepts: tokens, embeddings, attention mechanisms, pre-training and fine-tuning; comparison of popular LLMs (GPT, BERT, PaLM, LLaMA). Introduction to Generative AI across modalities – text, image, audio, code. Applications of LLMs in academic research: summarization, language translation, idea generation, citation support, and literature review automation. Prompt engineering basics. Overview of model limitations, bias, and hallucinations.
Unit – II	Applications, Opportunities and Ethical Challenges of AI in Research: Use of generative AI tools in research design and dissemination; authorship issues in AI-generated content; ethical concerns: originality, bias, hallucinated data, overreliance, misuse. Review of guidelines from COPE, IEEE, Elsevier, and UGC on AI usage. Role of disclosure and transparency in AI-assisted research. Case studies of AI's role in knowledge production and missteps. Discussion on accountability and responsible innovation. Understanding alignment and safety in generative AI.
Unit – III	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. 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 - IV	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. 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	4. N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers. Montgomery, Douglas C, Design and Analysis of Experiments, Wiley India Pvt. Ltd. 5. Brian Christian, *The Alignment Problem: Machine Learning and Human Values*, W. W. Norton & Company, 2020.

MCA/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 Option 3 shall continue their research work in the fourth semester based on the project work/synopsis submitted at the end of the third semester. The final Research Thesis 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 for Course MCA/CSE/4/RPR/552

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 for Course MCA/CSE/4/RPR/552

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 for Course MCA/CSE/4/RPR/552

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