The Curriculum Book

Bachelor of Technology

Computer Science & Engineering

(Artificial Intelligence & Machine Learning)

4-YEAR PROGRAMME

Choice Based Credit System with
Learning Outcomes based Curricular Framework
w. e. f. 2023-24

Department of Computer Science & Engineering

Faculty of Engineering and Technology
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Preface

The overall well-being of a nation depends on the eminence of its human resource. Providing quality education plays a vital role in transforming people into valuable human resource. Well educated students of today will become innovators and leaders of tomorrow who are going to ensure a constructively competitive but sustainable and peaceful world for everyone. Keeping in the view the demand of the skills based on Artificial Intelligence (AI) and Machine Learning (ML), the university has introduced a Bachelor of Technology Programme in CSE with specialisation in Artificial Intelligence & Machine Learning in the Department of Computer Science & Engineering. The curriculum has been designed around the Choice-based Credit System and Outcome-Based Education in which students are at the centre of teaching learning process. The salient features of the curriculum design are as follows:

1. To start with, four Programme Educational Outcomes are defined.
2. The twelve Programme Outcomes (POs) are taken from the Self Appraisal Report format of National Board of Accreditation (NBA) for undergraduate engineering programmes and two Programme Specific Outcomes (PSOs) are outlined to capture the specialisations of the B. Tech. (AI & ML) programme.
3. An induction programme of three weeks duration has been introduced to make the admitted students comfortable in their new environment. The induction programme continues in the form of participation in Sports club or Green club or Cultural, Literature and Film Club etc. for the remaining period of the programme. It is mandatory for every student to join in one of these clubs.
4. In addition to the professional core and elective courses, there is a provision for many courses from Basic Sciences, Engineering Sciences, Mathematics and Humanities. The non-credit mandatory courses are included to make students aware about constitution of India, issues related to environmental and sustainable development, and Indian traditional wisdom.
5. For every course, 4 to 6 Course Outcomes (COs) are defined which are concrete and measurable.
6. Guidelines for preparing sessional examination question papers and assignments have been framed for measuring the attainment levels of COs.
7. The internal and external evaluation criteria for various courses have been succinctly described.
8. The Course Outcomes (COs) are mapped to Programme Outcomes (POs) by defining a CO: PO articulation matrix for every course.
9. The methodology for computing the attainment levels for the Course Outcomes and Programme Outcomes is laid out.
10. The new curriculum has a focus on the problem solving and learning capabilities of the students. There are many laboratory courses which give students a hands-on experience in problem solving. Further, provisions for industry internship/training and project works make students ready to accept challenges and do research to solve difficult engineering problems.
11. Overall, the curriculum is made keeping in the view the continuous cycle of improvement in teaching learning process.

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Chapter 1: General Information

1.1 Vision and Mission of the Department

1.1.1 Vision

The vision of the Department is to become a centre of excellence for education in Computer Science and Engineering, Information Technology and Computer Applications. We visualize ourselves as an agency to nurture young minds to be the future leaders in the field of higher education, research and development, and information technology industry. Our aim is to bring out creators and innovators who will work towards the overall well-being of the society.

1.1.2 Mission

1. Imparting state-of-the-art knowledge in Computer Science and Engineering, Information Technology and Computer Applications.
2. Ensuring that our students graduate with a sound theoretical basis and wide-ranging practical experience.
3. Fostering linkages between the Department and, public and private sectors, traversing research establishments as well as Information Technology industry.
4. Promoting ethical research of high quality.
5. Adopting the best pedagogical methods in order to maximize knowledge transfer.
6. Inculcating a culture of free and open discussions in the Department.
7. Engaging students in evolving original ideas and applying them to solve complex engineering problems.
8. Inspiring a zest into students for lifelong learning.
9. Infusing scientific temper, enthusiasm, professionalism, team spirit and leadership qualities in students.
10. Sensitizing students to look for environmentally sustainable engineering solutions.
11. Upholding democratic values and an environment of equal opportunity for everyone.

1.2 Programme Educational Objectives (PEOs)

The Programme Educational Objectives of the B. Tech. (Artificial Intelligence &Machine Learning) Programme are:

PEO1. To prepare responsible and ethical professionals to be successfully employed in Computer Science and Information Technology industry, who will be able to apply the principles of mathematics, science, and engineering to develop and deploy Artificial Intelligence (AI) and Machine Learning(ML) based solutions for real world problems after assessing their environmental, cultural and societal implications.

PEO2. To train students for analysing, evaluating and designing complex engineering AI and ML solutions individually or in teams by doing a systematic and in-depth research in the related problem domains, by using modern tools and by communicating effectively among the various stake holders.

PEO3. To groom the professionals and entrepreneurs of tomorrow with leadership qualities and deep societal concerns who can move up in their professional career or start their own ventures.

PEO4. To guide the graduates to develop a positive attitude towards learning and motivate them to take up higher studies and research.

1.3 Programme Outcomes (POs)

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

1.4 Program Specific Outcomes (PSOs)

PSO1 **Developing Computational Systems**: Use principles of various programming languages, data structures, database management systems, computer algorithms, theory of computation, networking and software engineering for designing and implementing computational systems.

PSO2 **Designing Intelligent Machine Learning Systems:** Utilize the principles and tools of artificial intelligence, soft computing, data mining and machine learning, data analytics, robotics, IoT, augmented reality etc. for designing and working with intelligent systems that learn from their environment.

Chapter 2: Scheme of Examination

2.1 General course structure and credit distribution amongst various components of the curriculum

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits:

In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering has around 165 credits, the total number of credits proposed for the four-year B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) shall be kept around 165.

C. Structure of UG Program in CSE (AI & ML):

The structure of UG program in Artificial Intelligence and Machine Learning shall have essentially the following categories of courses with the breakup of credits as given:

S. No.	Category	Breakup of Credits
1.	Humanities & Social Science Courses	
2.	Basic Science Courses	
3.	Engineering Science Courses	
4.	Program Core Courses (Branch specific)	
5.	Professional Elective Courses (Branch specific)	
6.	Open Elective Courses (from Humanities, Technical Emerging or other Subjects)	
7.	Project work, Seminar and Internship in Industry or elsewhere	
8.	Mandatory -Courses [Induction Program, Environmental Sciences, Indian Constitution]	(non-credit)
	TOTAL CREDIT	**165***

**Minor variation is allowed as per need of the respective disciplines.*

D. Course code and definition:

Course code	Definitions
HSMC	Humanities & Social Science Mandatory Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PC	Program Core Courses
PE	Program Elective Courses
OE	Open Elective Courses
MC	Mandatory Courses
EEC	Employment Enhancement Courses (Project/Summer Internship/Seminar, etc.)

E. Category-wise Courses

E.1 HUMANITIES & SOCIAL SCIENCES COURSES [HSMC]

(i) Number of Humanities & Social Science Courses:
(ii) Credits:

#	Course Code	Course Title	Hours per week		Credits
			Lecture	Practical	
1	HSMC/1-T	Communication Skills	3	-	-
2	HSMC/2-T	Universal HumanValues – I	3	-	-
3					
4					
				Total Credits	

E.2 BASIC SCIENCE COURSES [BSC]

(i) Number of Basic Sciences Courses:
(ii) Credits:

#	Course Code	Course Title	Hours per week		Credit
			Lecture	Practical	
1	BSC/1-T	Mathematics-I	4	-	4
2	BSC/2-T	Mathematics-II	4	-	4
3					
4					
				Total Credits	

E.3 ENGINEERING SCIENCE COURSES [ESC]

(i) Number of Engineering Sciences Courses:
(ii) Credits:

#	Course Code	Course Title	Hours per week		Credits
			Lecture	Practical	
1	ESC/1-T	Computer Fundamentals	3	-	3
2	ESC/2-T	Problem Solving and Programming	4	-	4
3	ESC/2-P	C Programming Lab	-	4	2
4	ESC/3-T	Mathematical Concepts for Artificial Intelligence	3	-	3
5					
6					
Total Credits					

E.4 PROGRAM CORE COURSES [PC]

(i) Number of Program Core Courses:
(ii) Credits:

#	CourseCode	Course Title	Hours per week		Credits
			Lecture	Practical	
1	PC/CSEAIML/1-T	Database Concepts	3	-	3
2	PC/CSEAIML/1-P	Database Concepts Lab (SQL)	-	4	2
3	PC/CSEAIML/2-T	Object Oriented Programming	3	-	3
4	PC/CSEAIML/2-P	Object Oriented Programming Lab	-	4	2
5	PC/CSEAIML/3-T	Data Structures	4	-	4
6	PC/CSEAIML/3-P	Data Structures Lab	-	4	2
7	PC/CSEAIML/4-T	Computer Organization and Architecture	4	-	4
Total Credit					

E.5 PROGRAM ELECTIVE COURSES [PE]

(i) Number of Program Elective Courses:
(ii) Credits:

#	Course Code	Course Title	Hours per week		Total Credits
			Lecture	Practical	
1					
2					

E.6 OPEN ELECTIVE COURSES [OE]

(i) Number of Open Elective Courses:
(ii) Credits:

#	Course Code	Course Title	Hours per week		Total Credits
			Lecture	Practical	
1					
2					
				Total Credits	

E.7 EMPLOYABILITY ENHANCEMENT COURSES (EEC) PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

#	Course Code	Course Title	Hours per week		Total Credits
			Lecture	Practical	
1					
2					
				Total Credits	

E.8 MANDATORY COURSES [MC]

#	Course Code	Course Title	Hours per week		Total Credits
			Lecture	Practical	
1	*MC/1	Induction Program	-	-	-
2					
				Total Credits	

Note: These are mandatory non-credit courses.

*The Essence and Details of Induction program can also be understood from the 'Detailed Guide on Student Induction program', as available on AICTE Portal, (Link:https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf).

Induction program (mandatory)	Three-week duration
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

F. Mandatory Visits/ Workshop/Expert Lectures:

a. It is mandatory to arrange one industrial visit every semester for the students of each branch.

b. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.

c. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

G. Evaluation Scheme (Suggestive only):

a. **For Theory Courses:**
(The weightage of internal assessment is 30% and for End Semester Exam is 70%)

b. **For Practical Courses:**
(The weightage of End Semester External Exam is 100%).

c. **For Summer Internship / Projects / Seminar etc.**
Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

H. Mapping of Marks to Grades

Absolute marks will be mapped to grades as per University ordinances.

Semester I					
#	**Course Code**	**Course Title**	**L**	**P**	**Credits**
1.	MC/1	3-Week Induction Programme	-	-	-
2.	*HSMC/1-T	Communication Skills	3	-	-
3.	BSC/1-T	Mathematics-I	4	-	4
4.	ESC/1-T	Computer Fundamentals	3	-	3
5.	PC/CSEAIML/1-T	Database Concepts	3	-	3
6.	ESC/2-T	Problem Solving and Programming	4	-	4
7.	PC/CSEAIML/1-P	Database Concepts Lab (SQL)	-	4	2
8.	ESC/2-P	Problem Solving and Programming Lab (C language)	-	4	2
				Total Credit	**18**

Semester II					
#	**Course Code**	**Course Title**	**L**	**P**	**Credits**
1.	BSC/2-T	Mathematics-II	4	-	4
2.	PC/CSEAIML/2-T	Object Oriented Programming	3	-	3
3.	PC/CSEAIML/3-T	Data Structures	4	-	4
4.	ESC/3-T	Mathematical Concepts for Artificial Intelligence	3	-	3
5.	PC/CSEAIML/4-T	Computer Organization and Architecture	4	-	4
6.	**HSMC/2-T	Universal Human Values-I	3	-	-
7.	PC/CSEAIML/2-P	Object Oriented Programming Lab	-	4	2
8.	PC/CSEAIML/3-P	Data Structures Lab	-	4	2
				Total Credit	**22**

*Non-credit mandatory course.
**Non-credit mandatory course. Internal evaluation only.

Chapter 3. Detailed Syllabus

SEMESTER – I

HSMC/1-T **: Communication Skills**

Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks				Exam Duration	Assessment Methods
				External	Internal				
Humanities & Social Sciences	0	03	Lecture	70	30			3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5	5		

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

Course Objective: The main aim of the course is to build competence in English grammar and vocabulary and to enhance effective communication by developing Reading, Writing, Listening and Speaking skills ofstudents.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define various technical writing skills.
CO2	understand and explain the technical writing and communication skills in their academic and professional life.
CO3	gain self-confidence with improved command over English language.
CO4	classify the technical aspects of communication for better performance in extra-curricular activities, recruitment process and prospective jobs.
CO5	compare the various technical and communication skills.

CO-PO Mapping Matrix for Course HSMC/1-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	-	-	-	-	-	-	-

Course Content
HSMC/1-T **: Communication Skills**

Unit I	**Fundamentals of Communication Skills** Scope and Significance of Communication Skills, Listening, Speaking, Reading and Writing, Technical Communication, Tools of Effective Communication. **Writing Skills Basics of Grammar** – Placing of Subject and Verb, Parts of Speech, Uses of Tenses, Active- Passive, and Narration.

Unit II	**Vocabulary Building and Writing** Word Formation & Synonyms, Antonyms, Words Often Confused, One-Word Substitutes, Idioms and Phrasal Verbs, Abbreviations of Scientific and Technical Words.
Unit III	**Speaking Skills** Introduction to Phonetic Sounds & Articulation, Word Accent, Rhythm and Intonation,Interpersonal Communication, Oral Presentation, Body Language and Voice Modulation (Para linguistics and Non- Verbal), Negotiation and Persuasion, Group Discussion, Interview Techniques (Telephonic and Video Conferencing).
Unit IV	**Technical Writing** Job Application, CV Writing, Business Letters, Memos, Minutes, Notices, Report Writing &Structure, E-mail Etiquette, Blog Writing.

Text/Reference Books

1. "The Essence of Effective Communication", Ludlow R. and Panton F., Pubs: Prentice Hall,1992
2. "Effective Communication Skills", Kulbhushan Kumar, Khanna Publishing House, 2019.
3. "A University Grammar of English", Quirk R. and Sidney G., 3rd Edition, Pubs: PearsonEducation, 2008
4. "High School English Grammar", Wren and Martin, Pubs: S. Chand & Company Ltd, 2007
5. "Essentials of Business Communication", Guffrey M.E., 8th Edition, Pubs: South-WesternCollege Publishing, 2009
6. "Technical Communication: Principles and Practice", Raman M. and Sharma S., 2ndEdition, Pubs: Oxford University Press, 2012
7. "Effective Business Communication", Rodrigues M.V., Pubs: Concept PublishingCompany, Delhi, 2003
8. "English Vocabulary in Use", McCarthy M. and Felicity O' Dell, 2nd Edition, Pubs:2010

BSC/1-T **: Mathematics-I**								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Basic Science	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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

Course Objective: The main aim of the course is to discuss the concepts and related terminology of calculus, various theorems and engineering domain problems.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define the concepts and related terminology of calculus, ordinary differential equation and multiple integrals, vector calculus, differential equations, Laplace transforms etc.
CO2	understand the contribution and significance of various theorems and methods such as Green's theorem, Stokes' theorem, Variation of parameters, etc.
CO3	solve the different problems of calculus, ordinary differential equation and Laplace transform with the assistance of suitable theorems and methods
CO4	Analyze and evaluate different approaches and methods of calculus, ordinary differential equation and Laplace transform in solving engineering domain problems
CO5	compile and integrate the knowledge of calculus, ordinary differential equation and Laplace transform to solve the real-world problems

CO-PO Mapping Matrix for Course BSC/1-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	3	1	1	2	-	-	-	-	-	-	1	-	-
CO3	2	3	3	3	3	1	-	-	1	1	-	2	-	-
CO4	1	3	3	3	3	1	1	-	1	-	-	1	-	-
CO5	1	3	3	3	3	3	2	1	1	1	1	3	-	-
Average	2	1.8	2.2	2.2	2.2	1	0.6	0.2	0.6	0.4	0.2	1.6	-	-

Course Content
BSC/1-T **: Mathematics I**

Unit I	**Linear Algebra** Vector spaces, Subspaces, basis and dimension, linear transformations, representation oftransformations by Matrices, linear functions, transpose of linear transformations, canonical forms. Linear functions and adjoints, Bilinear forms, symmetric bilinear forms, skew symmetric bilinear forms.

Unit II	**Calculus** Continuity and differentiability of a function of single variable, statement of Rolle's Theorem, Lagrange's mean value theorem and applications. Double and Triple Integrals: Calculations, Areas, Volumes, change of variables **Vector Calculus** Applications. Integrals of Vector Functions: Line integrals, Green's formula, path independence, Surface integral: definition, evaluation, Stoke's formula, Gauss-Ostrogradsky divergence theorem.
Unit III	**Differential Equations** Ordinary Differential Equations: First order linear equations, Bernoulli's equations, Exact equations and integrating factor, Second order and Higher order linear differential equations with constant coefficients
Unit IV	**Multivariate Calculus** Integral Calculus: Definite Integrals as a limit of sums, Applications of integration to area, volume, surface area, Improper integrals. Functions of several variables: Continuity and differentiability, mixed partial derivatives, local maxima and minima for function of two variables, Lagrange multipliers.
Text/Reference Books	
1. G. B. Thomas, R. L. Finney. Calculus and Analytic Geometry, Ninth Edition, PearsonEducation, 2010 2. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Co., Delhi. 3. B. V. Ramana. Higher Engineering Mathematics, Tata McGraw Hill, 2017 4. E. Kreyszig. Advanced Engineering Mathematics, Wiley, 2015 5. Calculus and Analytic Geometry, G. B. Thomas and R. L. Finney, Pearson Education, 2010	

ESC/1-T **: Computer Fundamentals**								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Engineering Science	03	03	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

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

Course Objective: The objective of the course is to give basic competencies for application of a computer to everyday tasks using standard packages.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define the organization and operation of a computer processor.
CO2	understand the contribution of primary and secondary memory, peripheral devices and computer specifications.
CO3	explain the representation of data and information in computer systems.
CO4	analyze the use standard word, and spreadsheets, graphics generation packages, standard use database system
CO5	compile and integrate the knowledge of organization and operation of a computer processor, representation of data, packages.

CO-PO Mapping Matrix for Course ESC/1-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	3	1	1	2	-	-	-	-	-	-	1	-	-
CO3	2	3	3	3	3	1	-	-	1	1	-	2	-	-
CO4	1	3	3	3	3	1	1	-	1	-	-	1	-	-
CO5	1	3	3	3	3	3	2	1	1	1	1	3	-	-
Average	2	1.8	2.2	2.2	2.2	1	0.6	0.2	0.6	0.4	0.2	1.6	-	-

Course Content
ESC/1-T **: Computer Fundamentals**

Unit I	Definition, characteristics of computers, application of computers, evolution of computers. Block diagram of computer, its components and their functions Types of computer based on different criteria like processing power, hardware generation and functions.

Unit II	Non positional number system, positional number system, number system conversion, fractional number. Binary Arithmetic: Addition, Subtraction, Multiplication, Division. Boolean Algebra and Logic Circuits: Boolean Algebra, Boolean Function. Logic Gates, Logic Circuits, Minimization of Boolean expressions – algebraic method and K-map. Computer Codes: BCD Code, EBCDIC code, ASCII, Collating Sequence.
Unit III	Secondary Storage Devices: Sequential and Direct Access Devices, Punched Paper Tape, Magnetic Tape, Magnetic Disk, Floppy Disk, Winchester Disk, Magnetic Drum, Mass Storage, Optical Disk, Magnetic Bubble Memory, Storage Hierarchy. Input-Output Devices: Punched Hole Devices, Magnetic media devices, printers, keyboard devices, Scanners, Other devices, Offline Data Entry Devices.
Unit IV	Computer languages and computer software: Levels/generations of computer languages and their advantages and disadvantages, types of computer languages and their application areas/domains, software and its types, software packages.

Text/Reference Books

1. Priti Sinha, Pradeep K., Sinha, “Computer Fundamentals: Concepts, Systems & Applications”, BPB Publications.
2. V. Rajaraman, “Fundamentals of Computers”, PHI.
3. V. Rajaraman, "Introduction to Information Technology", PHI
4. R.K. Taxali, "Introduction to Software Packages", Galgotia Publications.

PC/CSEAIML/1-T**: Database Concepts**								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Program Core	03	03	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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 PC/CSEAIML/1-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	1	1	1	-	3	-	-	2	-	-	3	
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	-	-		

Course Content
PC/CSEAIML/1-T**: Database Concepts**

Unit I	Basic Terminology, Traditional file based Systems- File Based Approach-Limitations of File Based Approach, Database Approach-Characteristics of Database Approach, Database Management System (DBMS), Components of DBMS Environment, DBMS Functions and Components, Advantages and Disadvantages of DBMS. Roles in the Database Environment - Database Administrator, Database Designers, Applications Developers and End Users.
Unit II	Database System Architecture – Three Levels of ANSI/SPARC Architecture, Schemas and Instances, Data Independence – Logical and Physical Data Independence. Classification of Database Management System, Centralized and Client Server architecture to DBMS. Introduction to Data Models, Entity-Relationship Model – Entity Types, Entity Sets,

	Attributes Relationship Types, Relationship Instances and ER Diagrams
Unit III	Relational Model, Relational Model Terminology-Relational Data Structure, Database Relations, Properties of Relations, Keys, Domains, Integrity Constraints over Relations, Base Tables and Views. Relational Algebra & various operations (with respective SQL commands), Tuple and Domain calculus
Unit IV	Functional dependencies & Normalisation: Data Redundancy and Update Anomalies. Functional Dependencies:-Full Functional Dependencies and Transitive Functional Dependencies, Decomposition and Normal Forms (1NF, 2NF, 3NF & BCNF).
Text/Reference Books	
1. Elmasri & Navathe, Fundamentals of Database System, 3e, Addison Wesley, New Delhi. 2. Korth & Silberschatz, Database System Concept, 4e, McGraw Hill International Edition. 3. C.J. Date, An Introduction to Database System, 7e, Addison Western, New Delhi. 4. Abbey Abramson & Cory, ORACLE SI-A Beginner's Guide, Tata McGraw Hill Publishing Company Ltd.	

ESC/2-T **: Problem Solving and Programming**									
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks				Exam Duration	Assessment Methods
				External	Internal				
Engineering Science	04	04	Lecture	70	30			3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5	5		

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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: Programming for problem Solving is a basic and important for every graduate in Engineering. This course introduces basic constructs of programming language like algorithms, conversion of algorithms to programs etc. By studying this course students will get to know about C programming language with its various programming paradigms like branching, looping, arrays, functions, recursion, structure, pointers, etc. to be implemented for solving real world problems. It includes various sorting and searching algorithms as well with notion of order of complexity through simple program

Course Outcomes	At the end of this course, the student will be able to:
CO1	describe the algorithms to programs (in C language) to test and execute the programs and correct syntax and logical errors.
CO2	demonstrate the use of conditional branching, iteration and recursion.
CO3	apply programming to solve matrix addition and multiplication problems and searching and sorting problem, apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.
CO4	compare the suitability of arrays, pointers and structures to formulate algorithms and programs for various problem situations
CO5	justify a problem into functions and synthesize a complete program using divide and conquer approach

CO-PO Mapping Matrix for Course ESC/2-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	2	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	1	-	-	-	-	-	-	-	-	-	-
Average	1.8	1.4	-	0.2	0.4	-	-	-	-	-	-	-	-	-

Course Content

ESC/2-T **: Problem Solving and Programming**

Unit I	**Introduction to Programming** Evolution of languages: Machine languages, Assembly languages, High-level languages. Software requirements for programming: System software like

	operating system, compiler, linker, loader; Application programs like editor. Algorithm, specification of algorithm. Flowcharts, Decision Tables, Pseudocodes.
Unit II	**Data Types and Operators, Variables, Sequences and Iteration** Different types of Data types, Expressions, Precedence Rules, Operators-Operators: arithmetic operators, relational operators, logical operations, bitwise operators, miscellaneous operators, LocalVariables, Global Variables, String.
Unit III	**Conditional Statements, Loops, Arrays and Strings, User Defined Data Types** If-else statement, For loop, While Loop, Nested Iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types
Unit IV	**Dictionaries and Dictionary Accumulation, Functions/Methods** Dictionary Basics, Operations, Methods, Advantage of modularizing program into functions, function definition and function invocation. Positional Parameter Passing, Passing arrays to functions, Recursion, Library functions. **File Handling and Memory Management** Concepts of files and basic file operations, Writing/ Reading Data to/from a .csv File, Memory Management Operations
Text/Reference Books	
1. Yashwant Kanetkar, Let us C, BPB Publications. 2. Jeri R. Hanly & Elliot P. Koffman, Problem Solving &Program Design in .C. 3rd Ed., Addison Wesley, 2000. 3. All Kelley, Ira Pohl, A Book on C, Programing in C, 4th Ed., Addison Westley, 2000. 4. Balaguruswami, C programming language : Tata McGraw 5. Programming for Problem Solving, R.S. Salaria, Khanna Book Publishing Co., Delhi. 6. Stroustrup, B., The C programming language, Addison –Wesley1993 7. A. Goyal, C programming language, year 2020, publication NA	

PC/CSEAIML/1-P**: Database Concepts Lab (SQL)**							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Program Core	02	04	Practical	50	---	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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: This lab Course involves implementation of basic constructs of SQL. The objective of the lab course is to train the students translate the simple algorithms to programs in SQL efficiently.

Course Outcomes	At the end of this course, the student will be able to:
CO1	implement simple, iterative as well as recursive programs.
CO2	analyze given algorithms to a working and correct program.
CO3	compare solutions on the basis of the appropriateness of various commands of SQL.
CO4	integrate knowledge of structured queries with identification and correcting logical errors encountered at run time.
CO5	create written records for the given assignments with problem definition, design of solution and conclusions.
CO6	demonstrate ethical practices while solving problems individually or in groups.

CO-PO Mapping Matrix for Course PC/CSEAIML/1-P

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	1	-	-	-	2	-	-	-	3	-
CO2	2	2	-	-	1	-	-	-	2	-	-	-	3	-
CO3	2	2	-	-	1	-	-	-	2	-	-	-	3	-
CO4	3	2	3	-	-	-	-	-	3	-	-	-	3	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-			3	-	-	-	3	3	-
Average	1.5	1	0.5	-	0.5	-	-	0.5	1.5	-	-	0.5	3	-

ESC/2-P**: Problem Solving and Programming Lab (C language)**							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Engineering Science	02	04	Practical	50	---	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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: This lab Course involves implementation of basic constructs of programming language. The objective of the lab course is to train the students translate the simple algorithms to programs in C language efficiently

Course Outcomes	At the end of this course, the student will be able to:
CO1	implement simple, iterative as well as recursive programs.
CO2	analyze given algorithms to a working and correct program.
CO3	compare solutions on the basis of the appropriateness of data structure used like arrays, strings and structures and manipulate through implementation.
CO4	integrate knowledge of programming with identification and correcting logical errors encountered at run time.
CO5	create written records for the given assignments with problem definition, design of solution and conclusions.
CO6	demonstrate ethical practices while solving problems individually or in groups.

CO-PO Mapping Matrix for Course ESC/2-P

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	1	-	-	-	2	-	-	-	3	-
CO2	2	2	-	-	1	-	-	-	2	-	-	-	3	-
CO3	2	2	-	-	1	-	-	-	2	-	-	-	3	-
CO4	3	2	3	-	-	-	-	-	3	-	-	-	3	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-			3	-	-	-	3	3	-
Average	1.5	1	0.5	-	0.5	-	-	0.5	1.5	-	-	0.5	3	-

SEMESTER – II

BSC/2-T**: Mathematics II**								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Basic Science	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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 main aim of the course is to discuss the concepts and related terminology of calculus, various theorems and engineering domain problems.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define the concepts and related terminology of probability, random variables, statistics.
CO2	understand the contribution and significance of Random variables, Basic probability and distribution, test of significance and curve fitting
CO3	solve the different problems of Random variables, Basic probability and distribution, test of significance and curve fitting.
CO4	analyze and evaluate different approaches and methods of calculus, ordinary differential equation and Random variables, Basic probability and distribution, test of significance and curve fitting.
CO5	compile and integrate the knowledge of Random variables, Basic probability and distribution, test of significance and curve fitting to solve the real-world problems.

CO-PO Mapping Matrix for Course BSC/2-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		-		-	-	-	-	1	-	-
CO2	3	3	1	1	2							1	-	-
CO3	2	3	3	3	3	1			1	1		2	-	-
CO4	1	3	3	3	3	1	1		1			1	-	-
CO5	1	3	3	3	3	3	2	1	1	1	1	3	-	- -
Average	2	2.8	2.2	2.2	2.2	1	0.6	0.2	0.6	0.4	0.2	1.6	-	-

Course Content

BSC/2-T**: Mathematics II**

Unit I	**Basic Probability:** Introduction, additive law of Probability, conditional probability, independent events, Bayes' theorem. **Random Variables:** Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of Discrete Random Variables.
Unit II	**Continuous Probability distribution:** Continuous random variables and their properties, probability distribution, Probability density function and distribution function, functions and densities, Expectation, Moments, Variance and standard deviation of Continuous Random Variables. **Probability distributions**: Binomial, Poisson and Normal- evaluation of statistical

	parameters for these distributions, Poisson approximation to the binomial distribution, Introduction to exponential and gamma densities.
Unit III	**Basic Statistics:** Measures of Central tendency: Mean, Median and Mode, Quartiles, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, skewness and Kurtosis. Correlation, Rank correlation, Correlation coefficient, methods of calculations, Lines of regression.
Unit IV	**Curve fitting by the method of least squares:** Introduction, fitting of straight lines, second degree parabolas and more general curves, fitting of a geometric or power curve of the form $y=ax^b$, fitting of an exponential curve of the form $y=ab^x$. **Test of significance:** Basic terminology, large sample test for single proportion, difference of proportions, single mean, difference of means and difference of standard deviations. Test for single mean, difference of means (t-test), Chi-square test for goodness of fit and independence of attributes.

Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

PC/CSEAIML/2-T**: Object Oriented Programming**									
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks				Exam Duration	Assessment Methods
				External	Internal				
Program Core	03	03	Lecture	70	30			3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5	5		

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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: Objected Oriented Programming using C++ is an essential course for every graduate in Computer Science and Engineering. This course introduces the Object Oriented concepts such as data encapsulation, data hiding, data abstraction, reusability, exception handling etc., and their implementation using C++.

Course Outcomes	At the end of this course, the student will be able to:
CO1	list the concepts related to object oriented paradigms
CO2	distinguish between structured and object oriented approaches to programming.
CO3	apply object oriented constructs for problem solving
CO4	detect logical and run time errors and suggest appropriate modifications
CO5	justify the design of a program for a given problem
CO6	design solutions to programming problems using multiple object oriented programming constructs together

CO-PO Mapping Matrix for Course PC/CSEAIML/2-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	1	-	-	2	-	-	-	-	-	-	-	3	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	2	3	-	-	-	-	-	-	1	-	-	-	3	-
CO6	3	3	1	-	2	-	-	-	1	-	-	-	3	-
Average	2	1.83	0.16	-	0.67	-	-	-	0.33	-	-	-	3	-

Course Content
PC/CSEAIML/2-T**: Object Oriented Programming**

Unit I	**Principles of Object Oriented Programming**: Software Crisis, Software Evolution , Procedure Oriented Programming , Object Oriented Programming Paradigm , Basic concepts and benefits of OOP , Object Oriented Languages, Structure of C++ Program , Tokens, Keywords, Identifiers, Constants, Basic data type, User-defined Data type, Derived Data type, Symbolic Constants, Declaration of Variables, Dynamic Initialization - Reference Variable ,Operators in C++ , Scope resolution operator, Memory management Operators , Manipulators , Type Cast operators , Expressions and their types , Conversions , Operator Precedence , Control Structures
Unit II	**Functions in C++:** Function Prototyping , Call by reference ,Return by reference , Inline functions , Default, const arguments , Function Overloading , Classes and

	Objects , Member functions , Nesting of member functions , Private member functions , Memory Allocation for Objects , Static Data Members , Static Member functions , Array of Objects , Objects as function arguments , Returning objects , friend functions , Const Member functions .
Unit III	**Constructors:** Parameterized Constructors , Multiple Constructors in a class , Constructors with default arguments , Dynamic initialization of objects , Copy and Dynamic Constructors , Destructors , Operator Overloading , Overloading unary and binary operators , Overloading Using Friend functions , manipulation of Strings using Operators.
Unit IV	**Inheritance**: Defining derived classes - Single Inheritance ,Making a private member inheritable , Multilevel, Multiple inheritance , Hierarchical inheritance , Hybrid inheritance , Virtual base classes , Abstract classes , Constructors in derived classes , Member classes , Nesting of classes. **Pointers, Virtual Functions and Polymorphism**: Pointer to objects , this pointer, Pointer to derived Class , Virtual functions , Pure Virtual Functions , C++ Streams , Unformatted I/O, Formated Console I/O , Opening and Closing File.

Text/Reference Books

1. E. Balaguruswamy, Object Oriented Programming in C++ : Tata McGraw
2. Stroustrup, B., The C++ programming language, Addison –Wesley1993.
3. Mastering Object-Oriented Programming, R.S. Salaria, Khanna Book Publishing Co., Delhi
4. Herbert Schildt, The Complete Reference to C++, 4th edition, McGraw Hill Education

PC/CSEAIML/3-T**: Data Structures**									
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks				Exam Duration	Assessment Methods
				External	Internal				
Program Core	04	04	Lecture	70	30			3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5	5		

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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 students should be able to describe and implement various data structures including lists,arrays, stacks, queues, binary search trees, graphs, hash tables, and matrices. The student will be able to analyse and apply various algorithms for shortest path calculation, sorting and searching 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-PO Mapping Matrix for Course PC/CSEAIML/3-T

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3	1	1	1	-	3	-	-	-	-	-	3	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-	3	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-	3	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-	3	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-	3	-
Average	2	1.4	1.4	2.2	1.5	-	3	-	-	-	-	-	3	-

Course Content
PC/CSEAIML/3-T**: Data Structures**

Unit I	**Introduction and Elementary Data Structures** **Introduction**: Introduction to Data Structures and data types, Efficient use of memory, Recursion, time and space complexity of algorithms, Big O Notation and theta notations. **Elementary Data Structures:** Stacks, queues, Infix, Postfix & Prefix conversions, evaluations of expressions, multiple, stacks and queues, priority queues as heaps, double ended queue, implementation of stacks and queues

Unit II	**Linked Lists** Singly linked lists, linked stacks and queues, polynomial addition, sparse matrices, doubly linked lists and dynamic storage management, circular linked list, Applications of Stacks, Queues and Linked lists, Garbage collection, Josephus Problem
Unit III	**Trees** Basic terminology, binary trees, binary tree traversal, representations of binary tree, application of trees, decision tree, game trees, Threaded Trees, Binary Search Tree, AVL tree, B-tree
Unit IV	**Graph Theory** Graph representations, Graph Traversals, Dijkstra's algorithm for shortest path, Prim's and Kruskal's Algorithm for Minimal Spanning tree **Sorting and Searching** Searching: Linear search, binary search and hash search. Sorting: Insertion sort, selection sort, bubble sort, quick sort, merge sort, heap sort, and Bucket sort

Text/Reference Books

1. Data Structures, R.S. Salaria, Khanna Book Publishing, 2019.
2. Data Structures and Program Design in C By Robert L. Kruse, C.L. Tondo, Bruce Leung,Pearson Education, 2007.
3. Expert Data Structures with C, 3rd Edition, R.B. Patel, Khanna Book Publishing, 2020.
4. Expert Data Structures with C++, 2nd Edition, R.B. Patel, Khanna Book Publishing, 2020.
5. Data Structures Using C & C++, Langsam, Augenstein, Tanenbaum, Pearson Education, 1989.
6. Fundamentals of Data Structures, Ellis Horowitz and Sartaj Sahni, Computer Science Press, 2011.
7. An introduction to data structures with applications, J.P. Trembley & P.G. Sorensen, TMH, 2004.

ESC/3-T**: Mathematical Concepts for Artificial Intelligence**								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Engineering Science	03	03	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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: This course should help the students understand the basic mathematical background of AI. Also, thestudents should be able to apply statistics and probability to analyse various datasets.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define the the mathematical background of AI.
CO2	understand the mathematical background of AI, statistical methods to analyze and collect data
CO3	solve the different problems of AI, statistical methods to analyze and collect data,
CO4	Analyze and evaluate different problems of AI, use statistical methods to analyze and collect data,
CO5	compile and integrate the knowledge of mathematical concepts of AI,.

CO-PO Mapping Matrix for Course ESC/3-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		-	-	-	-	-	-	1	3	3
CO2	3	3	1	1	2	-	-	-	-	-	-	1	3	3
CO3	2	3	3	3	3	1	-	-	1	1	-	2	3	3
CO4	1	3	3	3	3	1	1	-	1	-	-	1	3	3
CO5	1	3	3	3	3	3	2	1	1	1	1	3	3	3
Average	2	2.8	2.2	2.2	2.2	1	0.6	0.2	0.6	0.4	0.2	1.6	3	3

Course Content

ESC/3-T**: Mathematical Concepts for Artificial Intelligence**

Unit I	Equations, Functions and Graphs: Introduction to linear equations, Intercepts and slopes, System of equations, Exponentials, radicals and logarithms, Polynomials, Polynomial operations, Factorizations, Introduction to quadratic equations, Functions
Unit II	Vectors and Matrices: Introduction to vectors, Vector addition, vector multiplication, Introduction to matrices, matric multiplication, properties of matrices, types of matrices, Matrix division, solving system of equations with matrices, Matrix transformations, Eigen values and Eigen vectors, rank of matrix

Unit III	Logic: Propositional logic, syntax and semantic for propositional logic, Tautologies, Contradictions and Contingencies, CNF, DNF. The predicate calculus and FOPL: predicate, terms, Quantifiers, free and bound variable, normal form of predicate logic, inference rules, resolution and unification.
Unit IV	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.

Text/Reference Books

1. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press., 2020
2. Artificial Intelligence and Expert Systems, V S Janakiraman, Macmillan India Ltd.
3. Advanced Engineering Mathematics, Reena Garg, Khanna Book Publishing Co., Delhi.
4. Machine Learning, Rajiv Chopra, Khanna Book Publishing Co., Delhi.
5. Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares, Stephen Boyd, Lieven Vandenberghe, Cambridge University Press., 2018
6. Probability and statistics for Engineers and Scientists, Walpole, Myers, Myers and Ye, Pearson Education, 2012
7. Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill, 1995
8. https://www.udemy.com/course/mathematical-foundation-for-machine-learning-and-ai/

PC/CSEAIML/4-T**: Computer Organization and Architecture**								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Program Core	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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: Computer Architecture and organization describes the role of instruction set architecture in digital computer, main memory, and input/output devices. It illustrates the simple data path and control design for processors. It helps to understand the different operations and concept of instructions. It would enable the students to learn the basic function and architecture of modern computer systems.

Course Outcomes	At the end of this course, the student will be able to:
CO1	outline the general concepts of digital electronics and computer organisation and architecture.
CO2	discuss the basic components and their interfacing
CO3	Apply instructions for performing different operations.
CO4	analyse the effect of addressing modes on the execution time of a program.
CO5	contrast different types of memory, their architecture and access methods.

CO-PO Mapping Matrix for Course PC/CSEAIML/4-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	1	1	1	-	3	-	-	-	-	-	3	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-	3	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-	3	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-	3	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-	3	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-	3	-

Course Content
PC/CSEAIML/4-T**: Computer Organization and Architecture**

Unit I	Basic Principles: Combinational logic blocks (Adders, Subtractors, Multiplexers, Demultiplexers, Encoders, Decoders), Sequential logic blocks (Flip-Flops, Registers, Counters); Flynn's classification of computers (SISD, MISD, MIMD); Performance metrics: MIPS, MFLOPS.
Unit II	Computer Organization: Store program control concept, Instruction codes, timing and control, instruction cycle; type of instructions: memory reference, register reference, I/O reference; Basics of Logic Design, accumulator logic, Control memory; Microprogrammed Control: address sequencing, micro-instruction formats, micro-program sequencer, Implementation of control unit.

Unit III	Instruction Set Architecture & Parallelism: Instruction set based classification of processors (RISC, CISC, and their comparison); Stack Organization, Instruction Formats; addressing modes: register, immediate, direct, indirect, indexed; Operations in the instruction set: Arithmetic and Logical, Data Transfer, Control Flow; Types of interrupts.
Unit IV	Memory Hierarchy & I/O Techniques: The need for a memory hierarchy (Locality of reference principle, Memory hierarchy in practice: Cache, main memory and secondary memory, Memory parameters: access/ cycle time, cost per bit); Main memory (Semiconductor RAM & ROM organization, memory expansion, Static & dynamic memory types); Cache memory (Associative & direct mapped cache organizations; input-output interface, mode of transfer, DMA (Direct memory transfer).

Text/Reference Books

1. Mano, M. Morris, Digital Logic and Computer Design, Prentice Hall of India Pvt. Ltd., 1981.
2. M. Morris Mano, Computer System Architecture, Prentice Hall of India Pvt. Ltd., 1993.
3. Milles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization, An Integrated Approach, John Wiley & Sons Inc., 2007.
4. William Stallings, 10th edition, Computer Organization and Architecture, Prentice Hall, 2016.
5. Heuring, V.P., Jordan, H.F., Computer Systems Design and Architecture, Addison Wesley, 1997.
6. R.P Jain, Modern Digital Electronics, 3rd Edition, Tata McGraw Hill, 2003.

HSMC/2-T: **Universal Human Values-I**								
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				Internal	Internal			
Humanities & Social Sciences	0	03	Lecture	70	30		3 Hours	Internal Interview/ viva voce/ MTE/ Assignment/ Attendance
					20	5 5		

The internal assessment of 30 marks shall be carried out s per University ordinance.
The internal assessment of 70 marks will be at the end of Semester through Interview/ VIVA-VOCE only by a committee of Two Faculty Members including course coordinator and a faculty member appointed by Chairperson/Head of concerned Department.

Course Objectives: Universal Human Values course is aimed at creating awareness on Engineering Ethics and Human Values. It helps understand social responsibility of an engineer and appreciate ethical dilemma while discharging duties in professional life.

Course Outcomes	At the end of this course, the student will be able to:
CO1	define the concepts related to awareness about oneself, one's surroundings and goals in one's life
CO2	describe the significance of value inputs in a classroom and start applying them in their life and profession, **stay** in harmony with society and nature.
CO3	developing healthy and harmonious relationships
CO4	understand groups and develop team spirit.
CO5	exhibit leadership qualities.
CO6	excel in personal and professional life

CO-PO Mapping Matrix for Course HSMC/2-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO2	-	-	-	-		2	3	2	1	-	-	2	-	-
CO3	-	-	-	-	-	-	-	2	2	2	-	2	-	-
CO4	-	-	-	-	-	-	-	-	3	2	-	2	-	-
CO5	-	-	-	-	-	-	_	-	3	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Average	-	-	-	-	-	0.33	0.5	1	1.5	1	-	1.5	-	-

Course Content
HSMC/2-T: **Universal Human Values-I**

Unit I	**Introduction to Value Education** Value Education, Definition, Concept and Need for Value Education, The Content and Process of Value Education, Basic Guidelines for Value Education, Self exploration as a means of Value Education, Happiness and Prosperity as parts of Value Education.
Unit II	**Harmony in the Human Being** Human Being is more than just the Body, Harmony of the Self ('I') with the

	Body, Understanding Myself as Co-existence of the Self and the Body, Understanding Needs of the Self and the needs of the Body, Understanding the activities in the Self and the activities in the Body.
Unit III	**Harmony in the Family and Society and Harmony in the Nature** Family as a basic unit of Human Interaction and Values in Relationships, The Basics for Respect and today's Crisis: Affection, e, Guidance, Reverence, Glory, Gratitude and Love. Comprehensive Human Goal: The Five Dimensions of Human Endeavour, Harmony in Nature: The Four Orders in Nature, The Holistic Perception of Harmony in Existence.
Unit IV	**Social & Professional Ethics** The Basics for Ethical Human Conduct, Defects in Ethical Human Conduct, Holistic Alternative and Universal Order, Universal Human Order and Ethical Conduct, Human Rights violation and Social Disparities, Professional Ethics and Right Understanding, Competence in Professional Ethics, Issues in Professional Ethics

Text/Reference Books

1. A. N. Tripathy, New Age International Publishers, 2003.
2. Bajpai. B. L., New Royal Book Co, Lucknow, Reprinted, 2004
3. Bertrand Russell Human Society in Ethics & Politics
4. Corliss Lamont, Philosophy of Humanism
5. Gaur. R. R., Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books, 2009.
6. Gaur. R. R., Sangal. R , Bagaria. G.P, Teachers Manual, Excel Books, 2009.
7. I. C. Sharma, Ethical Philosophy of India, Nagin & Co. Julundhar
8. Mortimer, J. Adler, What man has made of man
9. William Lilly, Introduction to Ethic, Allied Publisher

PC/CSEAIML/2-P**: Object Oriented Programming Lab**							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	02	04	Practical	50	---	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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 hands on practice with the advanced concepts of data structure and how to implement those concepts of object oriented programming using C++.

Course Outcomes	At the end of this course, the student will be able to:
CO1	implement problems with object oriented framework
CO2	analyse the structure of programs for modular design.
CO3	evaluate robustness of a program by testing it on test/use cases.
CO4	design class hierarchies for implementing inheritance/polymorphism.
CO5	create a lab record of assignments including problem definitions, design of solutions and conclusions.
CO6	demonstrate ethical practices and solve problems individually or in a group

CO-PO Mapping Matrix for Course PC/CSEAIML/2-P

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3	1	1	1	-	-	-	-	-	1	3	3	-
CO2	2	1	1	3	1	-	-	-	-	-	2	3	3	-
CO3	3	1	1	3	3	-	-	-	-	-	3	3	3	-
CO4	3	3	1	3	1	-	-	-	-	-	3	3	3	-
CO5	3	1	1	1	3	-	-	-	-	-	3	3	3	-
CO6	3	3	3	3	3	-	-	-	-	-	3	3	3	-
Average	2.5	2	1.33	2.33	2	-	-	-	-	-	2.5	3	3	-

PC/CSEAIML/3-P**: Data Structures Lab**							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Program Core	02	04	Practical	50	---	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: Final-Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will 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 hands on practice with the concepts of data structure.

Course Outcomes	At the end of this course, the student will be able to:
CO1	identify: data type, time and space complexity, various data structure – stack, queue, linked list, trees, graph, searching, sorting and hashing.
CO2	understand and explain: abstract data types, data structure like- (stack, queue, linked list, tree, and graph), searching, sorting, and traversing algorithms and hashing function.
CO3	apply and use: various data types, algorithms, stack, queue and link list operations, tree traversal operation, graph representation and traversals algorithms, and searching sorting techniques on data.
CO4	distinguish: time and space complexity, stack and queue, single, double and circular linked list, binary, AVL, B tree and multiway search tree, depth and breadth first search, Dijkstra's and Kruskal's algorithm, various searching and sorting techniques.
CO5	select: algorithm, data representation technique , searching and sorting technique suitable in a given situation.
CO6	design: algorithm, various data structure – stack, queue, linked list, trees, graph, searching, sorting and hashing.

CO-PO Mapping Matrix for Course PC/CSEAIML/3-P

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3	1	1	1	-	-	-	-	-	1	3	3	-
CO2	2	1	1	3	1	-	-	-	-	-	2	3	3	-
CO3	3	1	1	3	3	-	-	-	-	-	3	3	3	-
CO4	3	3	1	3	1	-	-	-	-	-	3	3	3	-
CO5	3	1	1	1	3	-	-	-	-	-	3	3	3	-
CO6	3	3	3	3	3	-	-	-	-	-	3	3	3	-
Average	2.5	2	1.33	2.33	2	-	-	-	-	-	2.5	3	3	-