Learning Outcomes based Curriculum Framework (LOCF)

For

Bachelor of Technology
Computer Science & Engineering
(Artificial Intelligence & Machine Learning)
Four-Year Graduate Programme

Curriculum for 2nd Year
For 2022-23 Batch only

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

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.

Course Code	**Definition/ Category**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities, Social Sciences and Management Courses
MC	Mandatory Audit Courses
PC	Program Core
PE	Program Elective Courses
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project work/ Summer Training/ Industrial Training/ Practical Training/ Internship/Seminar, etc.)

SEMESTER-III

Sr. No.	Course Codes	Nomenclature of the Courses	Workload/Credit			
			L	T	P	Total
1.	BSC/7-T	Mathematic III	4/4	-	-	4/4
2.	PC/CSEAIML/1-T	Data Structures and Algorithms	4/4	-	-	4/4
3.	PC/CSEAIML/2-T	Object Oriented Programming using C++	2/2	-	-	2/2
4.	PC/CSEAIML/3-T	Database Management System	3/3	-	-	3/3
5.	PC/CSEAIML/4-T	Operating Systems	3/3	-	-	3/3
6.	*HSMC/2-T	Human Values and Personality Development	3/-	-	-	3/-
7.	PC/CSEAIML/1-P	Data Structures and Algorithms Lab. using C/C++	-	-	4/2	4/2
8.	PC/CSEAIML/2-P	Object Oriented Programming Lab. using C++	-	-	4/2	4/2
9.	PC/CSEAIML/3-P	Database Management System Lab. (PL-SQL)	-	-	4/2	4/2
		Total	19/16		12/6	31/22

***It is a non-credit qualifying course only. The assessment will be completely internal.**

SEMESTER IV

Sr. No.	Course Codes	Nomenclature of the Courses	Workload/Credits			
			L	T	P	Total
1.	PC/CSEAIML/5-T	Computer Organisation and Architecture	4/4	-	-	4/4
2.	PC/CSEAIML/6-T	Data Mining Techniques	3/3	-	-	3/3
3.	**MC/2-T	Environmental Science	3/-	-	-	3/-
4.	PC/CSEAIML/7-T	Data Analytics	4/4	-	-	4/4
5.	PC/CSEAIML/8-T	R Programming	2/2	-	-	2/2
6.	PC/CSEAIML/9-T	Discrete Mathematics	3/3	-	-	3/3
7.	PC/CSEAIML/10-T	Artificial Intelligence	3/3	-	-	3/3
8.	PC/CSEAIML/6-P	Data Mining Lab. using Weka	-	-	4/2	4/2
9.	PC/CSEAIML/8-P	Data Analytics Lab. using R	-	-	4/2	4/2
		Total	22/19	-	8/4	30/23

****It is a non-credit qualifying mandatory course only.**

1.	***EEC/CSEAIML/1	Industrial Training/Internship	-	-	-/4	-/4

***** A 4-6 weeks industrial training/internship is mandatory after the completion of the IV semester. The training/internship will be evaluated in the V semester.**

Detailed Syllabi

Mathematics-III

General Course Information

Course Code: BSC/7-T Course Credits: 4 Type: Basic Sciences Contact Hours: 4 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Mathematics I and Mathematics II

About the Course

This is an advanced mathematics course that offers the knowledge of Fourier Series, Fourier Transforms, and Functions of Complex Variables. These concepts are essential for students to solve problems in image processing, digital signal processing and other related engineering fields.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** concepts and terminology of Fourier Series and Fourier transforms, Functions of complex variables and Power Series etc. (LOTS: Level 1: Remember)

CO2. **Solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)

CO3. **Apply** principles of functions of complex variables to solve computational problems. (LOTS: Level 3: Apply)

CO4. **Compare** various concepts related to Fourier transforms and functions of complex variables. (HOTS: Level 4: Analyse)

CO5. **Select** suitable method for given computational engineering problems and related domain. (HOTS: Level 4: Evaluate)

CO6. **Integrate** the knowledge of Fourier Series and Fourier transforms, Functions of complex variables, and Power Series for solving real world problems. (HOTS: Level 6: Create)

Course Content

Unit I

Fourier Series and Fourier Transforms: Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and cosine series.

Unit II

Fourier integrals, Fourier transforms, Shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac delta function.

Unit III

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity. Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions.

Unit IV

Complex integral, Cauchy Gaursat theorem (without proof), Cauchy integral formula (without proof), Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series. Zeroes and singularities of complex functions, Residues. Evaluation of real integrals using residues (around unit and semi-circle only).

Text and Reference Books:

1. F. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley, 2015.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 1965.
3. R. K. Jain, S.R.K. Iyenger. *Advance Engineering. Mathematics*, 4th edition, Narosa Publishing House, 2012.
4. Michael D. Greenberg, *Advanced Engineering Mathematics*, 2nd edition, Pearson Education, 2002.
5. Johnson and Miller *Probability and statistics for Engineers*, 8th edition, Pearson Education India, 2015.

CO-PO Articulation Matrix: Mathematics-III (BSC/7-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Define** concepts and terminology of Fourier Series and Fourier transforms, Functions of complex variables and Power Series. (LOTS: Level 1: Remember)	1	--	-		-	-	-	-	-	-	-	-	2	2
CO2. **Solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)	2	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3. **Apply** principles of functions of complex variables to solve computational problems. (LOTS: Level 3: Apply). (LOTS: Level 3: Apply)	2	2	2	2	-	-	-	-	-	-	-	-	3	2
CO4. **Compare** various concepts related to Fourier transforms and functions of complex variables (HOTS: Level 4: Analyse).	3	3	2	3	-	-	-	-	-	-	-	-	3	2
CO5. **Select** suitable method for given computational engineering problems and related domain. (HOTS: Level 4: Evaluate)	3	3	2	3	-	-	-	-	-	-	-	-	3	2
CO6. **Integrate** the knowledge of Fourier Series and Fourier transforms, Functions of complex variables and Power Series for solving real world problems. (HOTS: Level 6: Create)	3	3	2	3	-	-	-	-	-	-	-	-	2	2
Level of Attainments BSC/7-T														

Data Structures and Algorithms

General Course Information

Course Code: PC/CSEAIML/1-T Course Credits: 4 Type: Professional Core Contact Hours: 4 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Programming in C

About the Course:

Data Structure and Algorithms is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces data structures like arrays, linked lists, trees and graphs etc. and various operations to be implemented on these data structures for solving real world problems. It includes various sorting and searching algorithms as well. Further, it incorporates complexity analysis of algorithms implemented on various data structures.

Course Outcomes: By the end of the course students will be able to:

CO1. **Describe** various types of data structures and operations that can be implemented on these data structures. (LOTS: Level 1: Remember)
CO2. **Demonstrate** the use of various data structures and their related operations. (LOTS: Level 2: Understand)
CO3. **Apply** data structure to solve computational problems. (LOTS: Level 3: Apply)
CO4. **Compare** the suitability of alternative data structures and prescribed operations for various problem situations. (HOTS: Level 4: Analyse).
CO5. **Defend** solutions with respect to effective storage of data and efficiency of the required operations for solving real world problems. (HOTS: Level 5: Evaluate)

Course Content

Unit I

Introduction to data structures and their types, Abstract data types, Linear lists: Arrays and linked lists: memory representations, implementing operations like traversing, searching, inserting and deleting etc. Applications of arrays and linked lists. Representing sets and polynomials using linked lists.

Unit II

Stack and Queue: Static and linked implementations, Operations and Applications. Circular queues, Tress, Binary trees and related terminology, Tree traversals (Recursive), Threaded Binary Trees, Binary Search Trees implementation and operations, Priority queues.

Unit III

Height Balanced or AVL trees and B trees. Graph definitions and related terminology, memory representations and related operations (traversal, insertion, deletion, search), Path Matrix, Warshall's Shortest path algorithm, Hashing, Hash tables, hash function and collision resolution.

Unit IV

Sequential and binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Count sort, Heap sort, Comparison of searching and sorting techniques based on their complexity analysis, Time and space complexity of algorithms: Asymptotic analysis, Big O, Omega, Theta notations.

Text and Reference Books:

1. Aho, A. V., Ullman, J. D., and Hopcroft, J. E., *Data Structures and Algorithms*, Addison-Wesley, 1983.
2. LangsamYedidyah, Augenstein J Moshe, Tenenbaum M Aaron, *Data Structures using C and C++*, 3rd edition, PHI, 2009.
3. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., *Introduction to Algorithms*, MIT Press, 2009.
4. Robert L. Kruse, *Data Structure and Program Design in C*, Pearson Education India, 2007.
5. Weiss, M. A., *Data Structures and Algorithm Analysis in C++*, Addison-Wesley, 2007.
6. Sahni, S., *Data Structures, Algorithms, and Applications in C++*, WCB/McGraw-Hill, 2001.

CO-PO Articulation Matrix: Data Structures and Algorithms (PC/CSEAIML/1-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Describe** various types of data structures and operations that can be implemented on these data structures. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2. **Demonstrate** the use of various data structures and their related operations. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3. **Apply** data structure to solve computational problems. (LOTS: Level 3: Apply)	2	2	-	-	2	-	-	-	-	-	-	-	3	2
CO4. **Compare** the suitability of alternative data structures and prescribed operations for solving a problem. (HOTS: Level 4: Analyse).	2	2	-	-	-	-	-		-	-	-	-	3	2
CO5. **Defend** solutions with respect to effective storage of data and efficiency of the required operations for solving computational problems. (HOTS: Level 5: - Evaluate)	3	3	-	1	-	-	-	-	-	-	-	-	3	2
Level of Attainments PC/CSEAIML/1-T														

Object Oriented Programming using C++

General Course Information

Course Code: PC/CSEAIML/2-T Course Credits: 2 Type: Professional Core Contact Hours: 2 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Knowledge of computer fundamentals and problem solving using C programming

About the Course:

Object 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: By the end of the course students will be able to:

CO1. **List** the concepts related to object oriented paradigms. (LOTS: Level 1: Remember)
CO2. **Distinguish** between structured and object oriented approaches to programming. (LOTS: Level 2: Understand)
CO3. **Apply** object oriented constructs for problem solving. (LOTS: Level 3: Apply)
CO4. **Detect** logical and run time errors and suggest appropriate modifications. (HOTS: Level 4: Analyse)
CO5. **Justify** the design of a program for a given problem. (HOTS: Level 5: Evaluate)
CO6. **Design** solutions to programming problems using multiple object oriented programming constructs together. (HOTS: Level 6: Create)

Course Content

Unit I

Introduction to object oriented programming, C++ standard library, basics of a typical C++ environment, illustrative simple C++ programs, new features of ANSI C++ standard, OOPs concepts: Information hiding, encapsulation, data abstraction, access modifiers, controlling access to a class level, method, or variable (public, protected, private, block level, scope and mutable), other modifiers. Structure of class and struct in memory, accessing members of structures, Class scope and accessing class members, separating interface from implementation, pre-processors directives, macro programs, header files and namespaces, default constructors, chained constructor, default arguments with constructors, constant object and const member functions, object as member of class, use of destructors, virtual destructors, controlling access function and utility functions, function overloading.

Unit II

Inline function, friend function and friend classes, using this pointer, dynamic memory allocation with new and delete, static class members, proxy class, polymorphism concepts, overloading, overriding methods, abstract classes, reusability, class's behaviors, inheritance, base classes and derived classes, protected members, casting base-class pointers to derived-class pointers, using member functions, overriding base-class members in a derived-class, public, protected and private inheritance, using constructors and destructors in derived classes, implicit derived-class object to base- class object conversion, composition vs. inheritance.

Unit III

Virtual functions, abstract base classes and concrete classes, new classes and dynamic binding, virtual destructors, fundamentals of operator overloading, restrictions on operators overloading, operator functions as class members vs. as friend functions, overloading, <<, >> overloading unary operators, overloading binary operators. I/O Streams,

files handling, creating a sequential access file, reading data from a sequential access file, updating sequential access files, random access files, creating a random access file, writing data randomly to a random access file, reading data sequentially from a random access file.

Unit IV

Managing Console I/O, stream input/output classes and objects, stream output, stream input, unformatted I/O (with read and write), stream manipulators, stream format states, stream error states, exception handling, basics of C++ exception handling(try, throw, catch), rethrowing an exception, specific exception, processing unexpected exceptions, stack unwinding, exception handling in constructors and destructors, inheritance with exception introduction to generic classes, function templates, overloading template functions, class template, non-type parameters, templates and inheritance, templates and friends, templates and static members, container, iterator, algorithm and functional classes.

Text and Reference Books:

1. H. M.Deitel and P. J.Deitel, *C++ How To Program*, 6th Ed., Prentice Hall, 2008.
2. Robert Lafore, *Object-Oriented Programming in C++*, 3rd Ed., Sams Publishing, 2001.
3. D. Ravichandran, *Programming with C++*, 3rd Ed., T.M.H, 2011.
4. E.Balagurusamy, *Object oriented Programming with C++*, 6th Ed., Tata McGraw-Hill,2013.
5. Horstmann, *Computing Concepts with C++ Essentials*, 3rd Ed., John Wiley,2003.
6. Herbert Schildt , *The Complete Reference in C++*, 5th Ed., TMH, 2012.

CO-PO Articulation Matrix: Object Oriented Programming Using C++ (PC/CSEAIML/2-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **List** the concepts related to object oriented paradigms. (LOTS: Level 1: Remember)	1	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2. **Distinguish** between structured and object oriented approaches to programming. (LOTS: Level 2: Understand)	1	1	-	-	-	-	-	-	-	-	-	-	3	-
CO3. **Apply** object oriented constructs for problem solving. (LOTS: Level 3: Apply)	2	1	-	-	2	-	-	-	-	-	-	-	3	-
CO4. **Detect** logical and run time errors and suggest appropriate modifications. (HOTS: Level 4: Analyse)	2	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5. **Justify** the design of a program for a given problem. (HOTS: Level 5: Evaluate)	2	3	-	-	-	-	-	-	1	-	-	-	3	-
CO6. **Design** solutions to programming problems using multiple object oriented programming constructs together. (HOTS: Level 6: Create)	3	3	1	-	2	-	-	-	1	-	-	-	3	-
Level of Attainments PC/CSEAIML/2-T														

Database Management System

General Course Information

Course Code: PC/CSEAIML/3-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Prerequisite: None

About the Course:

This course includes a detailed coverage of principles of database design and models. Students learn querying a database using SQL, normalization techniques, transaction processing etc.

Course Outcomes: By the end of the course students will be able to:

CO1. **Describe** fundamental elements of Database Management System. (LOTS: Level 1: Remember)
CO2. **Discuss** principles of relational Database modelling. (LOTS: Level 2: Understanding)
CO3. **Apply** SQL for designing queries for Relational Databases. (LOTS: Level 3: Apply)
CO4. **Contrast** various concurrency control and recovery techniques with concurrent transactions in DBMS. (HOTS: Level 5: Evaluate)
CO5. **Design** models of databases using ER modelling and normalization for real life applications.(HOTS: Level 6: Create)

Course Content

Unit I

Overview: Overview of File Systems and Database Systems, Characteristics of the Data Base Approach, Database users, Advantages and Disadvantages of a DBMS, Responsibility of Database Administrator.

Data Base Systems Concepts and Architecture: DBMS architecture and various views of Data, Data Independence, Database languages, Data Models: Relational Database Model, Hierarchical Data Model, Network Data Model, Schemas and Instances.

Unit II

E-R Model: Entity Types, Attributes & Keys, Relationships, Roles and Structural Constraints, E-R Diagrams, Reduction of an E-R Diagram to Tables. Relational Model and Query Language: Overview of Relational Database, Key Integrity Constraints, Relational Algebra, Relational Calculus, SQL fundamentals, Basic Operators, Missing information and NULL values, Advanced SQL features

Unit III

Relational Database Design: Overview of normalization, Database Anomalies, Candidate and Super Key, Functional Dependencies, Integrity Constraints, Decomposition, Normal forms: First, Second, Third Normal, Boyce Codd, Normal Form, Multi-valued Functional Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Denormalization.

Unit IV

Concurrency Control Techniques: Overview of database Transactions, Transaction states, ACID properties of a Transaction, Transaction Recovery, Concurrency Control, Locking Techniques, Time-stamp ordering, Multi-version Techniques, Deadlock, Recovery Techniques in centralized DBMS.

DDBMS Design: Replication and Fragmentation Techniques.

Text and Reference Books:

1. Elmasri, R., and Navathe,S. B., *Fundamentals of Database Systems,* 3rd Edition, Addison Wesley, 2002.
2. Silberschatz, A., Korth, H. F., and Sudarshan, S., Database *System Concepts,* McGraw Hill, 2011.
3. Pannerselvam R., *Database Management Systems*, 2ndEdition, PHI Learning, 2011.
4. Desai, B. C., *An Introduction to Database System*,Galgotia Publication, 2010.
5. Leon, A., and Leon, M.,*Database Management Systems*,Ist Edition,Vikas Publishing, 2009.
6. Mata-Toledo, R., Cushman, P., Sahoo, D., *Database Management Systems*, Schaums'Outline series, TMH, 2007.

CO-PO Articulation Matrix:Database Management System (PC/CSEAIML/3-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Describe** fundamental elements of Database Management System. (LOTS: Level 1: Remember)	1	--	--	--	--	--	--	--	--	--	--	--	3	--
CO2. **Discuss** principles of relational Database modeling. (LOTS: Level 2: Understanding)	1	--	--	--	--	--	--	--	--	--	--	--	3	--
CO3. **Apply** SQL for designing queries for Relational Databases. (LOTS: Level 3: Apply)	1	--	--	_	2	--	--	--	--	--	--	--	3	--
CO4. **Contrast** various concurrency control and recovery techniques with concurrent transactions in DBMS. (HOTS: Level 5: Evaluate)	1	2	--	--	--	--	--	--	--	--	--	--	3	--
CO5. **Design** models of databases using ER modelling and normalization for real life applications.(HOTS: Level 6: Create)	3	2	3	1	2	--	--	--	--	--	--	--	3	--
Level of Attainments PC/CSEAIML/3-T														

Operating Systems

General Course Information

Course Code: PC/CSEAIML/4-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Programming in C and knowledge of computer fundamentals.

About the Course:

The objective of this course is to help students become familiar with the fundamental concepts of operating systems and provide them with enough understanding of operating system design.

Course Outcomes: By the end of the course students will be able to:

CO1. **List** various functions and design characteristics of operating systems (LOTS: Level 1: Remember)
CO2. **Explain** fundamental concepts of operating systems. (LOTS: Level 2: Understand)
CO3. **Apply** operating system design concepts for solving problems regarding scheduling, memory management, disk management and deadlocks etc.(LOTS: Level 3: Apply)
CO4. **Analyze** the issues related to various operating systems. (HOTS: Level 4: Analyse)
CO5. **Design** solutions for the memory and process management problems. (HOTS: Level 6: Create)

Course Content

Unit I

Introductory Concepts: Operating systems functions and characteristics, operating system services and systems calls, system programs, operating system structure. operating systems generation, operating system services and systems calls. Types of Operating systems: Batch operating system, Time-sharing OS, Distributed operating system, Real time systems.

File Systems: Types of Files and their access methods, File allocation methods, Directory Systems: Structured Organizations, directory and file protection mechanisms, disk scheduling and its associated algorithms.

Unit II

Processes: Process concept, Process Control Block, Operations on processes, cooperating processes. CPU scheduling: Levels of Scheduling, scheduling criteria, Comparative study of scheduling algorithms, Algorithm evaluation, multiple processor scheduling. Critical-section problem, Semaphores.

Unit III

Storage Management: Storage allocation methods: Single contiguous allocation, non-contiguous memory allocation, Paging and Segmentation techniques, segmentation with paging, Virtual memory concepts, Demand Paging, Page replacement Algorithms, Thrashing.

Unit IV

Deadlock: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock

Case Studies: Comparative study of WINDOW, UNIX & LINUX system.

Text and Reference Books:

1. Silberschatz, Peter B. Galvin and Greg Gagne, *Operating System Concepts*, 8th Edition, Wiley Indian Edition, 2010.
2. Andrew S Tanenbaum, *Modern Operating Systems*, Third Edition, Prentice Hall India, 2008.
3. Naresh Chauhan, *Principles of Operating Systems*, Oxford Press, 2014.
4. D.M. Dhamdhere, *Operating Systems*, 2nd edition, Tata McGraw Hill, 2010.
5. William Stallings, *Operating Systems– Internals and Design Principles*, 5th Edition, Prentice Hall India, 2000.

CO-PO Articulation Matrix: Operating System (PC/CSEAIML/4-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. List various functions and design characteristics of operating systems (LOTS: Level 1: Remember)	-		-	-	-	-	-	2	-	-	-	3	_	_
CO2. Explain fundamental concepts of operating systems. (LOTS: Level 2: Understand)	-	-	-	-	-	2	3	2	1	-	-	2	_	_
CO3. Apply operating system design concepts for solving problems regarding scheduling, memory management, disk management and deadlocks etc. (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	2	2	2	-	2	_	_
CO4. Analyze the issues related to various operating systems. (HOTS: Level 4: Analyse)	-	-	-	-	-	-	-	-	3	2	-	1	_	_
CO5. Design solutions for the memory and process management problems. (HOTS: Level 6: Create)	-	-	-	-	-	-	_	-	3	-		-	_	_
Level of Attainments PC/CSEAIML/4-T														

Human Values and Personality Development

General Course Information

Course Code: HSMC/2-T Course Credit: Non- Credit Type: Humanities and Social Sciences Contact Hours: 03 hours/week Mode: Lectures (L), Group Discussions, Workshops	**Course Assessment Methods:** **Max. Marks: 100 (Internal)** 30 marks' internal evaluation shall comprise the components as specified in relevant University ordinance. 70 marks' internal assessment will be made 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.

Pre-requisites: None

About the Course: This course is designed to develop a holistic perspective based on self-exploration and co-existence in society and nature. The focus is on to understand harmony and being in harmony with the society and the environment around us. The students will nurture a habit of self-reflection and courage to act. This course includes practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

Course Outcomes: By the end of the course students will be able to:

CO1: **exhibit** awareness about oneself, one's surroundings and goals in one's life.
CO2: **stay** in harmony with society and nature.
CO3: **develop** healthy and harmonious relationships.
CO4: **work in** groups and develop team spirit.
CO5: **exhibit** leadership qualities.
CO6: **excel** in personal and professional life.

Course Content

Unit I

Understanding the concept of self. Exploration of self with JOHARI-Window. Self-Esteem, Characteristics of individuals with low and high self-esteem. Self Confidence, strategies of building self-confidence.

Personality: Definition &Types & Traits; Relevance and Importance of nature and nurture in the development of personality.

Unit II

Nature of Socialization; Socialization Process, Contributions to Society and Nation. Importance of discipline and hard work. Ecologically responsibility of Engineers.
Professional Ethics: Competencies in professional values and ethics
Personal and Professional Excellence: Identifying long term choice and goals.

Unit III

Importance of Interpersonal relationships: Role and relationships, Maintaining healthy relationships. Importance and Steps to improve Interpersonal Communication.
Meaning and nature of teams, Internal and external factors affecting team building.
Leadership Meaning, Nature and functions. leadership styles in organization.
Meaning and nature of stress, causes, effect and management.

Unit IV

Meaning and importance of human rights, Human right awareness.

Harmony in nature, understanding coexistence, harmony at all levels of coexistence, Human being as cause of imbalance in nature, Understanding the concept of happiness and well-being. Role and importance of positive emotions, Gratitude, hope and optimism.

Text and Reference Books:

1. Bates, A. P. and Julian, J.: Sociology - Understanding Social Behaviour.
2. Dressler, David and Cans, Donald: The Study of Human Interaction.
3. Pestonjee, D.M, Pareek, Udai, Agarwal Rita; Studies in Stress And its Management
4. Organizational Behaviour, Davis, K.
5. Hoover, Judhith D. Effective Small Group and Team Communication, 2002, Harcourt College Publishers
6. Dick, McCann &Margerison, Charles: Team Management, 1992 Edition, viva books
7. Pestonjee, D.M.; Stress and Coping: The Indian Experience
8. Clegg, Brian; Instant Stress Management – Bring calm to your life now.

CO-PO Articulation Matrix:Human Values and Personality Development(HSMC/2-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **exhibit** awareness about oneself, one's surroundings and goals in one's life	-		-	-	-	-	-	2	-	-	-	3	_	_
CO2. **stay** in harmony with society and nature. (LOTS: Level 2: Understand)	-	-	-	-	-	2	3	2	1	-	-	2	_	_
CO3. **developing** healthy and harmonious relationships. (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	2	2	2	-	2	_	_
CO4. **understand** groups and develop team spirit. (HOTS: Level 4: analyze)	-	-	-	-	-	-	-	-	3	2	-	1	_	_
CO5. **exhibit** leadership qualities. (HOTS: Level 6: design)	-	-	-	-	-	-	_	-	3	-		-	_	_
CO6. **excel** in personal and professional life	-	-	-	-	-	-	-	-	-	2	-	-	_	_
Level of Attainments HSMC/2-T														

Data Structures and Algorithms Lab. using C/C++

General Course Information

Course Code: PC/CSEAIML/1-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 50 (External: 50)** A panel of two examiners (one internal and one external) shall evaluate the students in this course. Internal examiner shall be appointed by the Chairperson of the department and shall preferably be the teacher who has taught the class.

Pre-requisites: Programming in C language.

About the Course:

This lab course involves implementation of basic and advance data structures and various operations on these data structures. The objective of the lab course is to train the students to solve the problems related to data structures and choose the appropriate data structure for solving computational problem efficiently.

Course Outcomes: By the end of the lab course a student would be able to:

CO1. **Implement** various data structures and the related operations. (LOTS: Levels 3: Apply)
CO2. **Analyse** space and time complexity of algorithms. (HOTS: Level 4: Analyse)
CO3. **Compare** solutions on the basis of the appropriateness of data structure used and the efficiency of the operations implemented. (HOTS: Level 5: Evaluate)
CO4. **Integrate** knowledge of data structures to solve real world problems related to data structure and algorithms. (HOTS: Level 6: Create)
CO5. **Create** written records for the given assignments with problem definition, design of solution and conclusions. (HOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices while solving problems individually or in groups (LOTS: Level 3: Apply).

List of experiments/assignments

1. Two assignments related to creating and manipulating matrices and linear lists.
2. Two assignments associated with linked list, operations on linked lists and their applications.
3. Two assignments on array and linked implementation of stacks and queues.
4. Two assignments on trees and their applications.
5. Two assignments on graphs and their applications.
6. Two assignments on different searching and sorting methods along with their complexity analysis.
7. One assignment on challenging problems on data structures to be given in groups.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Data Structures and Algorithms Lab. using C/C++ (PC/CSEAIML/1-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Implement** various data structures and the related operations. (LOTS: Levels 3: Apply)	2	-	-	-	2	-	-	-	2	-	-	-	3	-
CO2. **Analyse** space and time complexity of algorithms. (HOTS: Level 4: Analyse)	2	2	-	-	2	-	-	-	1	-	-	-	3	-
CO3. **Compare** solutions on the basis of the appropriateness of data structure used and the efficiency of the operations implemented. (HOTS: Level 5: Evaluate)	2	2	-	-	3	-	-	-	1	-	-	-	3	-
CO4. **Integrate** knowledge of data structures to solve real world problems related to data structure and algorithms. (HOTS: Level 6: Create)	3	2	3	-	3	-	-	-	3	-	-	-	3	-
CO5. **Create** written records for the given assignments with problem definition, design of solution and conclusions. (HOTS: Level 6: Create)	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO6. **Demonstrate** ethical practices while solving problems individually or in groups (LOTS: Level 3: Apply).	-	-	-	-	-	-	-	3	-	-	-	3	-	-
Level of Attainments: PC/CSEAIML/1-P														

Object Oriented Programming Lab. using C++

General Course Information

Course Code: PC/CSEAIML/2-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 50 (External: 50)** A panel of two examiners (one internal and one external) shall evaluate the students in this course. Internal examiner shall be appointed by the Chairperson of the department and shall preferably be the teacher who has taught the class.

Pre-requisites: Problem solving using C Lab.

About the course:

The lab course provides the opportunity to students to solve problems using Object Oriented Framework in C++ language. This includes implementing the concepts of data abstraction, data hiding, and encapsulation, reuse of code and, compile and runtime polymorphism.

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** problems with object oriented framework. (LOTS: Level 3: Apply)
CO2. **Analyse** the structure of programs for modular design. (HOTS: Level 4: Analyse)
CO3. **Evaluate** robustness of a program by testing it on test/use cases. (HOTS: Level 5: Evaluate)
CO4. **Design** class hierarchies for implementing inheritance/polymorphism. (HOTS: Level 6: Create)
CO5. **Create** a lab record of assignments including problem definitions, design of solutions and conclusions. (HOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices and solve problems individually or in a group. (LOTS: Level 3: Apply)

List of assignments

1. Create two classes **DM** and **DB** which store the value of distances. **DM** stores distances in meters and centimeters and **DB** in feet and inches. Write a program that can read values for the class objects and add one object of **DM** with another object of **DB**. Use a friend function to carry out the addition operation. The object that stores the results maybe a **DM** object or **DB** objects, depending on the units in which the result is required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.
2. Create a class rational which represents a numerical value by two double values- NUMERATOR & DENOMINATOR. Include the following public member Functions:
    - constructor with no arguments (default).
    - constructor with two arguments.
    - void reduce () that reduces the rational number by eliminating the highest common factor between
    - the numerator and denominator.
    - Overload + operator to add two rational number.
    - Overload >> operator to enable input through cin.
    - Overload << operator to enable output through cout.

    Write the main () function to test all the functions in the class.

3. A hospital wants to create a database regarding its indoor patients. The information to be stored includes
   a) Name of the patient b) Date of admission c) Disease d) Date of discharge
   Create a structure to store the date (year, month and day as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about all the pediatric patients (less than twelve years in age).
4. Make a class **Employee** with a name and salary. Make a class **Manager** inherited from **Employee**. Add an instance variable named department of type string. Supply a method to **to String** that prints the manager's name, department and salary. Make a class **Executive** inherited from **Manager**. Supply a method **to String** that prints the string **"Executive"** followed by the information stored in the **Manager** superclass object. Supply a test program that tests these classes and methods.
5. Imagine a tollbooth with a class called 'tollBooth'. The two data items are of type unsigned int to hold the total number of cars, and a type double to hold the total amount of money collected. A constructor initializes both to 0. A member function called 'payingCar()' increments the car total and adds 0.50 to the cash total. Another function, called 'nopayCar ()', increments the car total but adds nothing to the cash total. Finally, a member function called displays the two totals. Include a program to test this class. This program should allow the user to push one key to count a paying car, and another to count a nonpaying car. Pushing the ESC kay should cause the program to print out the total cars and total cash and then exit.
6. Write a function called 'revers_it()' that reverses a string (an array of char). Use a for loop that swaps the first and last characters, then the second and next to last characters and so on. The string should be passed to 'revers_it ()' as an argument. Write a program to exercise 'revers_it ()'. The program should get a string from the user call of 'revers_it () function and print out the result. Use an input method that allows embedded blanks. Test the program with phrase, "Chaudhary Devi Lal University, Sirsa".
7. Write a program related to file handling with all the exception handling provisions.
8. C++ program to write and read time in/from binary file using fstream. Use exception handling wherever possible.
9. Write a program to implement string class using STL.
10. Write a program to implement run time polymorphism.

Note:

The experiments/assignments may vary from session to session and will be designed by the course coordinator. The assignments must meet the objective of the course and the levels of the given course outcomes. The course coordinator will provide the schedule for submission of the assignment.

CO-PO Articulation Matrix:Object Oriented Programming Lab. using C++ (PC/CSEAIML/2-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Implement** problems with object oriented framework. (LOTS: Level 3: Apply)	2	2	-	-	1	-	-		2	-	-	2	3	-
CO2. **Analyse** the structure of programs for modular design. (HOTS: Level 4: Analyse)	2	2	-	-	2	-	-	-	-	-	-	-	3	-
CO3. **Evaluate** robustness of a program by testing it on test/use cases. (HOTS: Level 5: Evaluate)	2	2	-	-	2	-	-	-	-	-	-	-	3	-
CO4. **Design** class hierarchies for implementing inheritance/polymorphism. (HOTS: Level 6: Create)	3	-	1	-	2	-	-	-	-	-	-	2	3	-
CO5. **Create** a lab record of assignments including problem definitions, design of solutions and conclusions. (HOTS: Level 6: Create)	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO6. **Demonstrate** ethical practices and solve problems individually or in a group. (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	3	3	-	-	3	-	-
Level of Attainments: PC/CSEAIML/2-P														

Database Management System Lab (PL-SQL)

General Course Information

Course Code: PC/CSEAIML/3-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments.	**Course Assessment Methods:** **Total Marks: 50 (External: 50)** A panel of two examiners (one internal and one external) shall evaluate the students in this course. Internal examiner shall be appointed by the Chairperson of the department and shall preferably be the teacher who has taught the class.

Pre-requisites: Exposure to programming language, MS Access.

About the Course:

This lab. course on DBMS involves a rigorous training on Oracle programming. It provides a strong formal foundation in database concepts, technology and practice to the students to groom them into well-informed database application developers. The objective of the lab course is to develop proficiency in the execution of commands of the database design and query using Oracle.

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** database problems using Oracle DML/DDL commands. (LOTS: Level 3: Apply)
CO2. **Enforce** integrity constraints on a database using a state-of-the-art RDBMS. (LOTS: Level 3: Apply)
CO3. **Analyse** the design of a relational database. (HOTS: Level 4: Analyse)
CO4. **Design** a relational database for a given schema. (HOTS: Level 6: Create)
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices, self-learning and team spirit.

List of experiments/assignments:

1. Use oracle software and login with valid user id and password. Explore its GUI and practice some basic commands of it.
2. Three assignments related to creation of database with tables having different fields and data types.
3. Two assignments on the creation of table with different types of constraints.
4. Two assignments on insert, delete and modify records from the tables.
5. Two assignments on modifying the table using the alter command.
6. Two assignments on exploring select statement using various clauses like where, order by, group by, having and aggregate functions.
7. Two assignments on the use of set operations to query the tables.
8. Two assignments on creating joins and views on the tables.
9. One assignment on generating sub-queries.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation: Matrix Database Management System Lab. (PC/CSEAIML/3-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Implement** database problems using Oracle DML/DDL commands. (LOTS: Level 3: Apply)	2	1		_	2	_	_	_	_	_	_	_	3	_
CO2. **enforce** integrity constraints on a database using a state-of-the-art RDBMS. (LOTS: Level 3: Apply)	2	2	_	_	2	_	_	_	_	_	_	_	3	_
CO3. **Analyse** the design of a relational database. (HOTS: Level 4: Analyse)	3	3	1	_	2	_	_	_	_	_	_	_	3	_
CO4. **Design** a relational database for a given schema. (HOTS: Level 6: Create)	3	3	2	3	3	_	_	_	_	_	_	_	3	_
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	_
CO6. **Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	_	_	_	_	_	_	_	3	3	_	_	3	_	_
Level of Attainments PC/CSEAIML/3-P														

Computer Organisation and Architecture

General Course Information

Course Code: PC/CSEAIML/5-T Course Credits: 4 Type: Professional Core Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Fundamentals of Computer Systems.

About the Course:

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: By the end of the course students will be able to:

CO1. **Outline** the general concepts of digital electronics and computer organisation and architecture. (LOTS: Level 1: Remember)
CO2. **Discuss** the basic components and their interfacing.(LOTS: Level 2: Understand)
CO3. **Apply** instructions for performing different operations. (LOTS: Level 3: Apply)
CO4. **Analyse** the effect of addressing modes on the execution time of a program.(HOTS: Level 4: Analyse)
CO5. **Contrast** different types of memory, their architecture and access methods. (HOTS: Level 5: Evaluate)
CO6. **Design** of simple computer with different instruction sets. (HOTS: Level 6: Create)

Course Content

Unit I

Basic Principles: Boolean algebra and Logic gates, Combinational logic blocks (Adders, Subtractors, Multiplexers, Encoders, decoders, demultiplexers, KMaps), Sequential logic blocks (Flip-Flops, Registers, Counters); Flynn's classification of computers (SISD, MISD, MIMD); Performance metrics: MIPS, MFLOPS; CPU Architecture types: computer register, (accumulator, register, stack, memory/ register) detailed data path of a typical register based CPU.

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; Micro Programmed 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; Introduction to Parallelism: Goals of parallelism (Exploitation of concurrency, throughput enhancement); Amdahl's law; Instruction level parallelism (pipelining, super scaling –basic features); Processor level parallelism (Multiprocessor systems overview).

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 and 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*, JohnWiley& 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.

CO-PO Articulation Matrix:Computer Organisation and Architecture (PC/CSEAIML/5-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Outline** the general concepts of digital electronics and computer organisation and architecture. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2. **Discuss** the basic components and their interfacing. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3. **Apply** instructions for performing different operations. (LOTS: Level 3: Apply)	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4. **Analyse** the effect of addressing modes on the execution time of a program. (HOTS: Level 4: Analyse)	2	2	-	1	-	-	-	-	-	-	-	1	3	-
CO5. **Contrast** different types of memory, their architecture and access methods. (HOTS: Level 5: Evaluate)	2	2	-	1	-	-	-	-	-	-	-	1	3	-
CO6. **Design** of simple computer with different instruction sets. (HOTS: Level 6: Create)	3	2	-	-	2	-	-	-	-	-	-	-	3	-
Level of Attainments PC/CSEAIML/5-T														

Data Mining Techniques

General Course Information

Course Code: PC/CSEAIML/6-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Knowledge of database systems, elementary knowledge of statistics and probability.

About the Course:

Today's era is the era of information. Data is growing exponentially day by day. There is a need to process and analyse the data to extract knowledge from it, so that one can use that knowledge for decision making. This course provides introductory concepts of data mining and data warehousing. The course will be taught with a database as well as machine learning perspectives. The objective of the course is to provide a comprehensive understanding of data mining tasks and evaluation of results obtained out of data mining processes.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** various types of data mining and data warehouse concepts and techniques. (LOTS: Level 1: Remember)
CO2. **Explain** association of patterns, data mining functionalities, tasks of data mining,. (LOTS: Level 2: Understand)
CO3. **Apply** various classification, clustering correlation and association mining for extracting valuable information from data. (LOTS: Level 3: Apply)
CO4. **Evaluate** the descriptive and predictive data mining models. (HOTS: Level 5: Evaluate)
CO5. **Plan** a data mining process for discovering knowledge from real-world databases. (HOTS: Level 6: Create)

Course Content

Unit I

Introduction to Data Mining: Kind of data to be mined, Data Mining Functionalities, Technologies used in Data Mining, Applications of data Mining, Major Issues in Data Mining.
Data Warehouse: Introduction, Data Warehouse and Database Systems, Data Warehouse Architecture, Data Warehouse Models, Data Cube and OLAP, Multidimensional data Model, Concept Hierarchies, OLAP operations
Pattern Mining:Mining Frequent Patterns, Associations and Correlations, Frequent Itemset Mining using Apriori Algorithm, Generating Association Rules from Frequent Itemsets. Pattern Growth Approach for Mining Frequent Itemsets, Pattern evaluation Methods

Unit II

Classification: Introduction, Classification using Decision Tree Induction, Bayesian Classification Methods, Rule Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy.
Introduction to advanced classifiers: k-Nearest Neighbor, Support Vector Machine, Artificial Neural Network.

Unit III

Cluster Analysis: Introduction, overview of Basic Clustering Methods,
Partitioning Methods: k-mean, k-medoids,
Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, Balanced Iterative Reducing and Clustering using Hierarchies (BIRCH), Chameleon: Multiphase Hierarchical ClusteringUsing Dynamic Modeling, Probabilistic Hierarchical Clustering,
Density-based methods: DBSCAN, OPTICS, DENCLUE,

Grid-based Methods: STING, CLIQUE, **Evaluation of Clustering.**

Unit IV

Outlier Detection: Introduction, types of outliers, challenges of outlier detection.
Outlier detection methods: statistical approaches, proximity-based approaches, clustering based approaches, classification-based approaches, Outlier detection in high dimensional data.

Text and Reference Books:

1. Jiawei Han, Micheline Kamber and Jian Pei, *Data Mining Concepts and Techniques*, Morgan Kaufmann Publishers,Third Edition, July 2011.
2. Alex Berson, Stephen J. Smith, *Data Warehousing, Data Mining & OLAP*, Tata McGraw Hill, 2004.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, *Introduction to Data Mining*, Pearson Education, 2014.
4. K. P. Soman, Shyam Diwakar and V. Ajay, *Insight into Data Mining Theory and Practice*, Easter Economy Edition, Prentice Hall of India, 2009.
5. G. K. Gupta, *Introduction to Data Mining with Case Studies*, Prentice Hall of India, 2006.
6. Daniel T. Larose, *Data Mining Methods and Models*, Wiley, 2006.
7. W. H. Inman, *Building the Data Warehouse*, Wiley India, 2005

CO-PO Articulation Matrix:Data Mining Techniques (PC/CSEAIML/6-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Outline** various types of data mining and data warehouse concepts and techniques. (LOTS: Level 1: Remember)	1	–	–	–	2	–	–	–	–	–	–	–	–	1
CO2. **Explain** characteristics, architecture of a data warehouse, OLAP operations and data mining tasks. (LOTS: Level 2: Understand)	1	–	–	–	3	–	–	–	–	–	–	–	–	2
CO3. **Apply** various pre-processing and data mining techniques for extracting valuable information from data. (LOTS: Level 3: Apply)	2	1	–	–	3	–	–	–	–	–	–	–	–	3
CO4. **Evaluate** the descriptive and predictive data mining models. (HOTS: Level 5: Evaluate)	3	2	2	3	3	–	–	–	–	–	–	–	–	3
CO5. **Plan** a data mining process for discovering knowledge from real-world databases. (HOTS: Level 6: Create)	3	3	3	3	3	–	–	–	–	–	–	–	–	3
Level of Attainments PC/CSEAIML/6-T														

Environmental Science

General Course Information

Course Code: MC/2-T Course Credits: Non-credit Type: Mandatory Course Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: None

About the Course:

This is a mandatory course to enhance the knowledge, skills and attitude of the graduating engineers to the environment. By studying this course students will understand our natural environment and its relationship with human activities.

Course outcomes: By the end of the course a student will be able to:

CO1. state the environment related issues and challenges in sustainable development
CO2. demonstrate the understanding of various environment hazards and means of protection against these hazards. (LOTS: Level 2: Understand)
CO3. apply irreplaceable tool to provide first-hand knowledge on various environmental aspects in the entire learning process. (LOTS: Level 3: Apply)
CO4. analyze impacts of human business and developmental activities on the environment. (HOTS: Level 4: analyze)
CO5. design and evaluate strategies for sustainable management of environmental eco-systems.(HOTS: Level 6: design)

Course content

Unit I

Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness; Concept, Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem ,Ecological succession ,Food chains, Food webs and ecological pyramids; Introduction, types, 27 characteristics features, structure and function of Forest ecosystem, Grassland ecosystem ,Desert ecosystem, Aquatic ecosystem (Ponds, Stream, lakes, rivers, oceans, estuaries); Biodiversity: Introduction, Definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values; Biodiversity at global, national and local level, India as a megadiversity nation, Hot-spot of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit II

Renewable and non-renewable resources, Natural resources and associated problems ,Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people; Water resources: Use and over utilization of surface and ground water, floods, droughts conflicts over water, dams benefits and problems; Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources; Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: Land as a resource, land degradation, main induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources, Equitable use of resources for suitable lifestyle.

Unit III

Definition of Environment Pollution; Causes, effects and control measures of: Air Pollution, Water Pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes effects and control measures of urban and industrial wastes; Role of and individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies; different laws related to environment: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and

Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.; Issues involved in enforcement of environmental legislation, Public awareness

Unit IV

Social issues and the Environment: From unsustainable to Sustainable development, Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problem and concern, case studies; Environment ethics: Issues and possible solutions; Wasteland reclamation; Consumerism and waste products; Human Population growth, variation among nation, Population explosion- Family Welfare Programme, Environment and human health , Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Text and Reference Books

1. Erach Bharucha, Environmental Studies for Undergraduate Courses, University press pvt. Ltd. (India), 2005.
2. Dr. D. D. Mishra, Fundamental concepts in Environmental studies, S. Chand publications, 2008.
3. Dr. S .V .S. Rana, Essentials of Ecology and Environmental Science, PHI Learning Pvt. Ltd Delhi, 2013.
4. Anil Kumar De, Environmental Chemistry, Wiley Eastern Limited, 1994.
5. T. G. Miller, Environmental Science, Wadsworth Publishing Co, 13th4edition, 2013.
6. P. D. Sharma, Ecology and Environment, Rastogi publications, 13th edition, 2003.

CO-PO Articulation Matrix: Environmental Science (MC/2-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **state** the environment issues and challenges for sustainable development	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2. **demonstrate** the understanding of various environment hazards and means of protection against these hazards. (LOTS: Level 2: Understand)	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO3. **apply** irreplaceable tool to provide a first-hand knowledge on various environmental aspects in the entire learning process. (LOTS: Level 3: Apply)	-	-	-	-	3	-	-	-	-	-	-	2	-	-
CO4. **analyze** impacts of human business and developmental activities on the environment. (HOTS: Level 4: analyze)	1	2	-	-	-	2	-	3	-	3	-	-	-	-
CO5. **design** and evaluate strategic methods for sustainable management of environmental eco-systems. (HOTS: Level 6: design)	1	2	2	-	-	-	3	-	3	-	2	-	-	3
Level of Attainments MC/2-T														

Data Analytics

General Course Information

Course Code: PC/CSEAIML/7-T Course Credits: 4 Type: Professional Core Contact Hours: 4 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Basic programming skills, Probability and Statistics

About the Course:

In this course, the learners will be able to develop expertise in R programming for manipulating, exploring, visualizing, applying descriptive and inferential statistics. In addition, they will learn to implement predictive modeling.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** the basic terms related to data analytics. (LOTS: Level 1: Remember)
CO2. **Describe** data with statistical summaries and plots. (LOTS: Level 2: Understanding)
CO3. **Build** predictive models. (LOTS: Level 3: Apply)
CO4. **Analyse** the quality of a statistical and machine learning models. (HOTS: Level 4: Analyse)
CO5. **Interpret** and evaluate statistical and predictive models. (HOTS: Level 5: Evaluate)
CO6. **Conclude** the findings of predictive modeling. (HOTS: Level 5: Evaluate)

Course Content

Unit I

Data analytics preliminaries: Introduction to data analytics, scales of measurements (Data types) and their implementation in R. Working with vectors, matrices and tabular data (data frames), reading and writing tabular data from and to files (text and CSV). Describing data with statistical summaries (mean, median, mode, variance and standard deviation). Discriminating between sample and population, Quantile-Quantile plot. writing user-defined functions in R.

Unit II

Manipulating tabular data: Sorting, filtering cases, selecting variables, deriving new variables, grouping and summarizing data. working with packages (tidyverse) for data manipulations and transformations.

Exploratory data analysis: random and normally distributed variables, skewed normal distribution, z-score, detecting outliers in data, handling missing values.

Visualizing data through various plots and charts: bar charts, histogram, frequency polygon, density plots, scatter plots, box & whisker plots, heat and contour plots, plotting the above graphs in R, plotting with package ggplot2.

Unit III

Predictive modeling: what is predictive modeling, estimating a function, the trade-off between model accuracy and prediction accuracy and model interpretability, regression versus classification, measuring the quality of fit, The bias and variance trade- off.

Simple and multiple linear regression modeling: estimating the coefficients, assessing the accuracy of the coefficient estimates, assessing the accuracy of the model. Building regression models in R.

Unit IV

Classification Modeling: The process of classification, decision tree, Bayesian, k-nearest neighbor, support vector machine classification models and their implementation in R. evaluating a classification model: confusion matrix, accuracy, sensitivity, specificity, f-measure, kappa statistics, ROC and area under curve. accuracy and interpretability of classification models.

Evaluating the accuracy of a classifier: holdout or random sampling methods, cross-validation, bootstrap methods.

Text and Reference Books:

1. W. N. Venables, D. M. Smith and the R core Team, *An introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics*, version 3.3.2, 2016.
2. Saroj Dahiya Ratnoo and Himmat Singh Ratnoo, *Essentials of R for Data Analytics*, Wiley, 2021.
3. Hadley Wickham and Garrett Grolemund, *R for Data Science Import, Tidy, Transform and model Data*, O'Reilly, 2017.
4. Paul Teeter, *R Cookbook*, O'Reilly, 2011.
5. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, *An Introduction to Statistical Learning with Applications in R*, Springer, 2013.
6. Han, J., Kamber, M, Pei, J., *Data Mining Concepts and Techniques*, Third edition, Morgan Kaufmann, 2012.

CO-PO Articulation Matrix: Data Analytics (PC/CSEAIML/7-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Define** the basic terms related to data analytics. (LOTS: Level 1: Remember)	1	-	-	-	1	-	-	-	-	-	-	-	-	2
CO2. **Describe** data with statistical summaries and plots. (LOTS: Level 2: Understanding)	2	2	-	-	2	-	-	-	-	-	-	-	1	3
CO3. **Build** predictive models (LOTS: Level 3: Apply).	2	2	-	-	3	-	-	-	-	-	-	-	1	3
CO4. **Analyse** the quality of a statistical and machine learning models (HOTS: Level 4: Analyse).	2	2	-	-	3	-	-		-	-	-	-	1	3
CO5.**Interpret** and evaluate statistical and predictive models. (HOTS: Level 5: Evaluate).	2	3	-	2	3	-	-	-	-	-	-	-	-	3
CO6. **Conclude** the findings of predictive modelling. (HOTS: Level 5: Evaluate).	2	3	-	2	3	-	-	-	-	-	-	-	-	3
Level of Attainments PC/CSEAIML/7-T														

R Programming

General Course Information

Course Code: PC/CSEAIML/8-T Course Credits: 2 Type: Professional Core Contact Hours: 2 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Basic knowledge of programming.

About the Course:

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: By the end of the course a student would be able to:

CO1. **list** data types, functions in R programming, visualization. (LOTS: Level 1: Remember)
CO2. **describe** the syntax of decision making statements, loops, user defined functions, used define packages, the process of import and export of data in text file, excel file and MYSQL . (LOTS: Level 2: Understand)
CO3. **use** various in built, user defined function and packages .
apply R programming constructs to solve real world problems..(LOTS: Level 3: Apply)
CO4. **categorize** data types, conditional & control statements, in built and user defined functions and packages.
CO5. **compare** data types, conditional & control statements, functions, packages in R programming.
CO6. **design** basic and advanced applications in R programming.

Course Content

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 and Reference 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.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Use R - A Beginner's Guide to R, Springer 2009.

CO-PO Articulation Matrix: R Programming (PC/CSEAIML/8-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **list** data types, functions in R programming, visualization. (LOTS: Level 1: Remember)	1	3	1	1	1	-	-	-	-	-	1	3	-	-
CO2. **describe** the syntax of decision making statements, loops, user defined functions, used define packages, the process of import and export of data in text file, excel file and MYSQL . (LOTS: Level 2: Understand)	2	1	1	3	1	-	-	-	-	-	2	3	-	-
CO3. **use** various in built, user defined function and packages. **apply** R programming constructs to solve real world problems.(LOTS: Level 3: Apply)	3	1	1	3	3	-	-	-	-	-	3	3	-	-
CO4. **categorize** data types, conditional & control statements, in built and user defined functions and packages.(LOTS: Level 4: categorize)	3	3	1	3	1	-	-	-	-	-	3	3	-	-
CO5. **compare** data types, conditional & control statements, functions, packages in R programming. (LOTS: Level 5: compare)	3	1	1	3	3	-	-	-	-	-	3	3	-	-
CO6. **design** basic and advanced applications in R programming.	3	3	3	3	3	-	-	-	-	-	3	3	-	-
Level of Attainments PC/CSEAIML/8-T														

Discrete Mathematics

General Course Information

Course Code: PC/CSEAIML/9-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Basic knowledge of Number Theory, Calculus and Algebra

About the Course:

Discrete Mathematics is a core and an essential course for every graduate in Computer Science and Engineering. This branch of mathematics mainly deals with discrete objects (as computer runs on discrete steps). It provides a mathematical language for computer science to resolve many real world problems by incorporating different methods applicable to various discrete structures. This course introduces set theory, propositional calculus, algebraic structures, recurrence relations and graph theory.

Course Outcomes: By the end of the course a student would be able to:

CO1. **Outline** various discrete structures and the related operations. (LOTS: Level 1: Remember)
CO2. **Illustrate** different discrete structures with the help of examples. (LOTS: Level 2: Understand)
CO3. **Apply** appropriate techniques to solve problems related to discrete structures.(LOTS: Level 3: Apply)
CO4. **Justify** the solutions with the help of proofs. (HOTS: Level 5: Evaluate)
CO5. **Combine** techniques related to discrete structures for solving real world problems. (HOTS: Level 6: Create)

Course Content

Unit I

Set Theory: Introduction to Set Theory, Venn Diagrams, Set Operations, Algebra of Sets, Duality, Finite, Infinite Sets and Counting Principle, Classes of Sets, Power Sets, Partitions, Multi Sets.

Relations: Cartesian Product, Representation of Relations, Types of Relation, Equivalence Relations and Partitions, Partial Ordering Relations.

Functions: Definition, Types of Functions, Composition of Functions, Inverse Function.

Unit II

Logic and Propositional Calculus: Introduction, Propositions and Compound Propositions, Basic Logical Operations, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional and Bi-conditional Statements.

Algebraic Structures: Group Axioms, Monoid, Semi-Groups, Subgroups, Abelian Group, Cosets, Normal Subgroup, Cyclic Group, Permutation Group, Lagrange's Theorem, Homomorphism, Isomorphism, Automorphism, Rings, Integral Domains and Fields, Splitting field.

Unit III

Logic and propositional Calculus: 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.

Lattice and Boolean algebra : Relational to Partial ording, Lattices and Hasse diagram, bounded lattices, distributive lattices, complemented lattices.

Unit IV

Graphs Theory: Introduction to Graphs, Multi Graph, Directed and Undirected Graphs, Subgraphs, Bipartite Graphs, Regular Graphs, Connected Graphs, Homomorphic and Isomorphic Graphs, Cut points and Bridges, Paths and Circuits, Euler Graph, Hamiltonian Graph, Planar Graph, Euler Formula, Weighted Graphs, Dijkstra's Shortest Path Algorithm for Weighted Graphs, Trees, Spanning Trees, Minimum Spanning Tree (Prim's and Kruskal's Algorithm).

Text and Reference Books:

1. J.P. Trembley and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science*, Tata McGraw Hill – 13th reprint, 2012.
2. Kenneth H. Rosen, *Discrete Mathematics and its applications*, 6th Edition, Tata McGraw Hill, 2011.
3. Richard Johnsonbaugh, *Discrete Mathematics*, 6th Edition, Pearson Education Asia, 2011.
4. S. Lipschutz and M. Lipson, *Discrete Mathematics*, Tata McGraw Hill, 3rd Edition, 2010.
5. B. Kolman, R. C. Busby and S. C. Ross, *Discrete Mathematical structures*, 6th Edition, PHI, 2010.
6. C. L. Liu, *Elements of Discrete Mathematics*, Tata McGraw Hill, 3rd Edition, 2008.

CO-PO Articulation Matrix:Discrete Mathematics (PC/CSEAIML/9-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Outline** various discrete structures and the related operations. (LOTS: Level 1: Remember)	1	--	--	--	--	--	--	--	--	--	--	--	1	--
CO2. **Illustrate** different discrete structures with the help of examples. (LOTS: Level 2: Understand)	1	--	--	--	--	--	--	--	--	--	--	--	2	--
CO3. **Apply** appropriate techniques to solve problems related to discrete structures. (LOTS: Level 3: Apply)	2	--	--	--	1	--	--	--	--	--	--	--	3	2
CO4. **Justify** the solutions with the help of proofs. (HOTS: Level 5: Evaluate)	3	1	--	--	2	--	--	--	--	--	--	--	3	--
CO5. **Combine** techniques related to discrete structures for solving real world problems. (HOTS: Level 6: Create)	3	2	--	--	2	--	--	--	1	--	--	1	3	2
Level of Attainments: PC/CSEAIML/9-T														

Artificial Intelligence

General Course Information

Course Code: PC/CSEAIML/10-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Internal evaluation shall comprise the components as specified in relevant University ordinance.

Pre-requisites: Basic Knowledge of Algorithms and Probability.

About the Course:

Artificial Intelligence is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces the concepts of Artificial Intelligence and challenges inherent in building intelligent systems. It includes the role of knowledge representation in problem solving and how these are used in making intelligent machine. Further it incorporates the concepts of expert system and its applications.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** various Artificial Intelligence techniques. (LOTS: Level 1: Remember)
CO2. **Illustrate** reasoning under uncertainty. (LOTS: Level 2: Understand)
CO3. **Apply** search and knowledge representation techniques to solve AI problems.(LOTS: Level 3: Apply)
CO4. **Compare** strengths and weaknesses of AI algorithms (HOTS: Level 4: Analyse).
CO5. **Combine** various AI techniques to solve intelligent systems' problems. (HOTS: Level 6: Create)

Course Content

Unit I

Introduction to AI: Introduction, Turing Test, AI problems, AI agent, production system

Problem Solving Using Search: Blind search techniques - Breadth first search, Depth first search. Heuristic search techniques - Hill Climbing, Best first search, A* Algorithm, AO* Algorithm, The Min-max Search Procedure, Alpha-Beta Cut-offs.

Unit II

Knowledge Representation: Introduction, Knowledge Representation- Representation and Mappings, Symbolic Logic - Propositional logic, Predicate logic- Representing simple facts in logic, Representing Instances and ISA Relationship, Computable functions and Predicates, Unification, Resolution.

Representing Knowledge Using Rules: Procedural versus Declarative Knowledge, Forward versus Backward Reasoning, Matching, Control Knowledge.

Unit III

Reasoning Under Uncertainty: Introduction to Reasoning and type of reasoning, Probability and Baye's Theorem, Certainty Factors and Rule-based Systems, Bayesian Networks.

Fuzzy logic system: Introduction, Crisp Set, Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations.

Unit IV

Planning: Introduction, Components of Planning System, type of planning, Goal Stack Planning, Nonlinear Planning , Block word planning problem.

Expert System and Applications: Introduction, Architecture, Rule based Expert Systems, Applications of Expert Systems.

Text and Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial intelligence, McGraw Hill Education. 3rd edition, 2009.
2. Stuart Russel and Peter Norvig, Artificial intelligence: A modern Approach, Pearson Education, 3rd edition, 2015.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert System, Pearson Education.1st edition, 2007.
4. Deepak Khemani, A first course in Artificial Intelligence, McGraw Hill Education. 3rd edition, 1st edition, 2013.
5. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 5th edition, 2009.

CO-PO Articulation Matrix:Artificial Intelligence (PC/CSEAIML/10-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Outline** various Artificial Intelligence techniques. (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	–	3
CO2. **Illustrate** reasoning under uncertainty. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	–	3
CO3. **Apply** search and knowledge representation techniques to solve AI problems. (LOTS: Level 3: Apply)	2	2	–	2	2	–	–	–	–	–	–	–	–	3
CO4. **Compare** strengths and weaknesses of AI algorithms (HOTS: Level 4: Analyse).	2	2	2	2	–	–	–	–	–	–	–	–	–	3
CO5. **Combine** various AI techniques to solve intelligent systems' problems. (HOTS: Level 6: Create)	3	3	3	3	2	2	–	–	–	–	–	3	–	3
Level of Attainments PC/CSEAIML/10-T														

Data Mining Lab. using Weka

General Course Information

Course Code: PC/CSEAIML/6-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 50 (External: 50)** A panel of two examiners (one internal and one external) shall evaluate the students in this course. Internal examiner shall be appointed by the Chairperson of the department and shall preferably be the teacher who has taught the class.

Pre-requisites: Basic Programming skills.

About the Course:
The objective of this lab is to enable students to use tools for applying advanced data reduction, classification and clustering techniques.

Course Outcomes: By the end of the course students will be able to:

- CO1. **Apply** advanced data mining algorithms. (LOTS: Level 3: Apply)
- CO2. **Usages** of modern data mining tools such as WEKA, R/Python packages. (LOTS: Level 3: Apply)
- CO3. **Evaluate** the performance of data mining models. (LOTS: Level 5: Evaluate)
- CO4. **Design** advanced data mining experiments. (LOTS: Level 6: Create)
- CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create).
- CO6. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments: (WEKA/R/Python packages etc.)

1. Five assignments on advanced classification algorithms (Advanced Classifiers).
2. Five assignments on clustering problems
3. Four assignments on data reduction and attribute selection
4. Two assignments on discovering association rules.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Data Mining Lab. using Weka (PC/CSEAIML/6-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Apply** advanced data mining algorithms. (LOTS: Level 3: Apply).	2	3	3	–	3	–	–	–	–	–	–	–	–	3
CO2. **Usages** of modern data mining tools such as WEKA, R/Python packages. (LOTS: Level 3: Apply)	1	-	–	–	3	–	–	–	–	–	–	–	–	3
CO3. **Evaluate** the performance of data mining models (LOTS: Level 5: Evaluate)	3	2	–	–	3	–	–	–	–	–	–	–	–	3
CO4. **Design** advanced data mining experiments. (LOTS: Level 6: Create)	3	3	–	3	3	–	–	–	–	–	–	–	–	3
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)	–	–	–	–	–	–	–	–	–	3	–	–	–	3
CO6. **Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	–	–	–	–	–	–	–	3	3	–	–	3	–	–
Level of Attainments PC/CSEAIML/6-P														

Data Analytics Lab. using R

General Course Information

Course Code: PC/CSEAIML/8-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 50 (External: 50)** A panel of two examiners (one internal and one external) shall evaluate the students in this course. Internal examiner shall be appointed by the Chairperson of the department and shall preferably be the teacher who has taught the class.

Pre-requisites: Basic programming skills.

About the Course:
The objective of this lab is to enable students to apply advanced data analytics tools for manipulating data, applying statistics, regression and classification.

Course Outcomes: By the end of the course students will be able to:

CO1. **Apply** pre-processing techniques to real world data. (LOTS: Level 3: Apply)
CO2. **Solve** problems of predictive analytics. (LOTS: Level 3: Apply)
CO3. **Evaluate** the performance of predictive models. (LOTS: Level 5: Evaluate)
CO4. **Design** complete data analytics experiments. (LOTS: Level 6: Create)
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create).
CO6. **Demonstrate** ethical practices, self-learning and team spirit.

List of experiments/assignments using R:

1. Four Assignments on descriptive statistics
2. Four Assignment on visualizing data
3. Four Assignments on Pre-processing Data
4. Two assignments to solve linear and non-linear regression problems.
5. Two assignments on classification problems.
6. Two assignments on different sampling techniques.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix:Data Analytics using R Lab. (PC/CSEAIML/8-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Apply** pre-processing techniques to real world data. (LOTS: Level 3: Apply)	2	1	_	_	2	_	_	_	_	_	_	_	_	3
CO2. **Solve** problems of predictive analytics. (LOTS: Level 3: Apply)	3	2	_	_	3	_	_	_	_	_	_	_	_	3
CO3. **Evaluate** the performance of predictive models. (LOTS: Level 5: Evaluate)	3	2	1	_	3	_	_	_	_	_	_	_	_	3
CO4. **Design** complete data analytics experiments. (HOTS: Level 6: Create)	3	2	2	3	3	_	_	_	_	_	_	_	_	3
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	3
CO6. **Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	_	_	_	_	_	_	_	3	3	_	_	3	_	_
Level of Attainments PC/CSEAIML/8-P														

Industrial Training/Internship

General Course Information

Course Code: EEC/CSEAIML/1 Course Credits: 4 Mode: Industrial Training/ Internship	**Course Assessment Methods (100 Marks)** An internal evaluation is done by a faculty member appointed by the Chairperson of the Department. Significance and originality of the problem addressed and the solution provided: 20 Knowledge of the problem domain and tool used (VIVA-VOCE):25 Report Writing: 20 Judgement of the skill learnt and system developed: 20 Level of ethics followed: 15

About the Industrial training:

Students do an Industrial Training of 4 to 6 weeks after fourth semester. They are expected to learn novel skills and develop some software application during the training period.

After doing training students will be able to:

CO1. **Address** novel problems in an original manner using latest skills. (HOTS: Level 6: Create)
CO2. **Select and Apply** modern engineering tools. (LOTS: Level 3: Apply)
CO3. **Prepare** training report by organising ideas in an effective manner. (HOTS: Level 6: Create)
CO4. **Engage** in lifelong learning. (HOTS: Level 6: Create)
CO5. **Apply** ethical practices while doing the training and writing report. (LOTS: Level 3: Apply)

CO-PO Articulation Matrix: Industrial Training (EEC/CSEAIML/1)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Address** novel problems in an original manner using latest skills (HOTS: Level 6: Create)	_	3	3	2		1	_	_	2	_	1	_	3	3
CO2. **Select and apply** modern engineering tools. (LOTS: Level 3: Apply)	2	_	_	_	3	_	_	_	3	_	_	_	3	2
CO3. **Prepare** training report by organising ideas in an effective manner. (HOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO4. **Engage** in lifelong learning. (HOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO5. **Apply** ethical practices while doing the training and writing report. (LOTS: Level 3: Apply	_	_	_	_	_	_	_	3	_	3	_	_	_	_
Level of Attainments EEC/CSEAIML/1														

Guidelines for Preparing Industrial Training (EEC/CSEAIML/1) Report

All the students are required to follow these guidelines for preparing their industrial training report.

General Guidelines

1. The industrial training report must include a declaration by the student that he/she has followed ethical practices while doing the industrial training work. Any violation of ethical practices will lead to rejection of the industrial training report. For instance, a plagiarized report or a readymade report purchased from market will be rejected straight away.
2. Industrial training work carried out in groups of two students must include the individual contribution of the students.
3. The industrial training report must be submitted to the internal guide in soft binding at least 7 days before the final submission so that he/she can suggest changes.

Formatting Instructions

The formatting instructions are given in Table below.

Formatting Instructions		
Sr. No.	**Item**	**Formatting**
1.	No. of pages	Minimum 20 and maximum 40
2.	Paper size	A4
3.	Font type	Times New Roman
4.	Normal text size	12
5.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers
6.	Margins	Left margin: 3.75 cm (1.5 inch) Right, bottom, top= 2.5 cm (1 inch)
7.	References/Bibliography	IEEE format
8.	Binding	soft binding of good quality

Contents of the Industrial Training Report

The contents of the industrial training report should be organised as described below.

1. Declaration that the students has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the industrial training report through references and citations.
2. Acknowledgement
3. List of figures
4. List of Tables
5. List of Abbreviations
6. Contents

Contents in the Body of the industrial training report

The report must be written in English. The ideas must be organised in a clear and concise fashion.

S. No	Content	Tentative No. of pages
1.	Profile of the Company	At most 2 pages
2.	Introduction	2-4 pages
3.	Description of skills learned	4-6 pages
4.	Application developed (if any) based on skills learnt	10-18 pages
5.	Scope of the training/ Application developed	1 paragraph

The industrial training report should not no way exceed 40 pages and should be submitted in soft binding of good quality.

Format of the title page

The format of the title page is given is given on next page.

TITLE OF THE INDUSTRIAL TRAINING REPORT

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Training report submitted to

Chaudhary Devi Lal University, Sirsa-125055 for the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 4 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 1 lines gap with 12 font size from the text above in three lines)

Bachelor of Technology
Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

(Write in Times New Roman, 14-point size, Bold, Centred style after "***of***" after 1 line gap with 12 font size)

By

(Write in Times New Roman 12-point size, Bold, Italics, and Centred style after the name of the degree with 1 line gap with 12 font size)

Your Name

(Enrolment Number)

(Write in Times New Roman, 14-point size font, Bold, Centred style after1 line gap with 12 font from "***By***")

Department of Computer Science and Engineering

Chaudhary Devi Lal University, Sirsa-125055

Month, Year

(Write in Times New Roman, 14-point size font, Bold, Centred style, after 2 lines gap from logo)

Declaration to be submitted for training report

DECLARATION

I, *Your Name*, *Your Roll No*., certify that the work contained in this industrial training report is original and has been carried by me in the ---------- company name. This work has not been submitted to any other institute for the award of any degree and I have followed the ethical practices and other guidelines provided by the Department of Computer Science and Engineering in preparing the industrial training report.

Signature

Name of Student

Registration Number

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

Signature

Supervisor/Mentor

Designation

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

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

Name of the Programme:_____ Semester:_____ Session:_____	Credits: Total Marks: 100

Evaluation of Industrial Training/Internship Report(EEC/CSEAIML/1)

SR. No.	Roll. No.	Significance of the problem addressed CO1 (15)	Knowledge of the problem domain CO2 (15)	Knowledge of the techniques and tools used CO3 (15)	Quality of the solution provided CO4 (20)	Quality of the Report Writing CO5 (20)	Level of engagement with ethical practices and self-learning CO6 (15)	Total (100)
1								
2								
3								
.								
.								

Name of the examiner(s): Signature of the Examiner(s): Date: Signature of Chairperson	Total Candidates: No. of Candidates Present: No. of Candidates Absent: