

The Curriculum Book

Bachelor of Technology

in

Computer Science & Engineering

(Artificial Intelligence & Machine Learning)

4 YEAR-PROGRAMME

Choice Based Credit System

w. e. f. July 2021-2022



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY
HISAR-125001, HARYANA

Preface

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

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

Contents

Preface

Chapter 1: General Information

Chapter 2: Scheme of B. Tech. CSE(AI&ML) Syllabus

Chapter 3: Detailed Syllabus

Chapter 4: Guidelines for Internal assessment of Theory Courses.

4.1 Tools of assessment

4.2 Preparing sessional

4.3 Assignments

4.4 Computing Attainment Levels of COs

4.5 Submitting Internal Assessment Record

Chapter 5: Guidelines for Internal and External Assessment of Lab.

Courses

Chapter 6: Guidelines for evaluating Industrial Training and Projects

Chapter 7: Computing PO attainment levels

Chapter 1: General Information

1.1. Vision and Mission of the Department of Computer Science and Engineering

1.1.1 Vision

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

1.1.2 Mission

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

1.2 B. Tech. CSE(AI&ML): Programme Educational Objectives (PEOs)

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

- PEO1. To prepare responsible and ethical professionals to be successfully employed in Computer Science and Information Technology industry, who will be able to apply the principles of mathematics, science, and engineering to develop and deploy Artificial Intelligence (AI) and Machine Learning (ML) based solutions for real world problems after assessing their environmental, cultural and societal implications.
- PEO2. To train students for analysing, evaluating and designing complex engineering AI and ML solutions individually or in teams by doing a systematic and in-depth research in the related problem domains, by using modern tools and by communicating effectively among the various stake holders.
- PEO3. To groom the professionals and entrepreneurs of tomorrow with leadership qualities and deep societal concerns who can move up in their professional career or start their own ventures.
- PEO4. To guide the graduates to develop a positive attitude towards learning and motivate them to take up higher studies and research.

1.3 B. Tech. CSE(AI&ML): Programme Outcomes (POs)

- PO1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

- PSO1 **Developing Computational Systems:** Use principles of various programming languages, data structures, database management systems, computer algorithms, theory of computation, networking and software engineering for designing and implementing computational systems.
- PSO2 **Designing Intelligent Machine Learning Systems:** Utilize the principles and tools of artificial intelligence, soft computing, data mining and machine learning, data analytics, robotics, IoT, augmented reality etc. for designing and working with intelligent systems that learn from their environment.

Chapter 2: Scheme of syllabus B.Tech. CSE(AI&ML)

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

2.1.1 Definition of a Credit

Type of Teaching Learning Activity	No. of Credit
1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
2 Hours Practical (Lab) per week	1 Credit

2.2. B.Tech. CSE (Artificial Intelligence & Machine Learning): Semester-wise Scheme

Induction Programme

It is mandatory to conduct an induction programme for newly admitted students right at the beginning of the first semester. The objective of the induction programme is to create a bond between the institution and the newly admitted students.

The new students enter an institution with diverse backgrounds and expectations. It is important to help them adjust to the new environment. To meet this purpose, there will be three week-long induction programme before the normal classes start. The induction program shall provide students the opportunity to settle down and be comfortable in the new environment. The new students will come to know their seniors, faculty members, department and university. The student would be engaged in the following activities.

1. Familiarization with the Department and the University
2. Physical activities like morning walks, cycling or playing one or the other games.
3. Creative arts like painting, music and dancing etc.
4. Talks and lectures by eminent people, and group discussion on universal Human values
5. Literary activities like reading writing or debating

The schedule for organizing the induction programme shall be prepared every year at university level.

Students will be engaged in diverse activities at the level of Department. Depending on the interest, every student must opt for one of the activities during all the semesters. For this purpose, the following clubs shall be established in the Department.

1. Sports Club
2. Green Club
3. Culture, Literature and Film Club
4. Social Service Club
5. Technology Innovation Club

Each student will spend 3 to 5 hours for these activities per week.

SEMESTER-III

Sr. No.	Course Codes	Nomenclature of the Courses	Hours per week			Credits	Internal	External
			L	T	P			
1.	PCC-CSEAI201-T / PCC-CSE201-T/ PCC-IT201-T	Data Structures and Algorithms	3	0	0	3	30	70
2.	PCC-CSEAI202-T	Object Oriented Programming using JAVA	3	0	0	3	30	70
3.	PCC-CSEAI203-T/ PCC-CSE203-T/ PCC-IT203-T	Discrete Mathematics	3	0	0	3	30	70
4.	PCC-CSEAI204-T	Data Analytics using R	3	0	0	3	30	70
5.	MC102-T	*Environmental Science	3	0	0	0	30	70
6.	HSMC201-P	**Human Values and Personality Development	0	0	3	0	100	-
7.	PCC-CSEAI201-P	Data Structures and Algorithms using C Lab.	0	0	4	2	50	50
8.	PCC-CSEAI202-P	Object Oriented Programming using JAVA Lab.	0	0	4	2	50	50
9.	PCC-CSEAI204-P	Data Analytics using R Lab.	0	0	4	2	50	50
		Total	15		15	18	400	500

* It is a non-credit qualifying course only.

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

SEMESTER IV

Sr. No.	Course Codes	Nomenclature of the Courses	Hours per week			Credits	Internal	External
			L	T	P			
1.	PCC-CSEAI205-T	Data Mining Techniques	3	0	0	3	30	70
2.	PCC-CSEAI206-T / PCC-CSE305-T/ PCC-IT206-T	Operating Systems	3	0	0	3	30	70
3.	PCC-CSEAI207-T/ PCC-CSE207-T/ PCC-IT207-T	Database Management System	3	0	0	3	30	70
4.	PCC-CSEAI208-T / PCC-CSE402-T/ PCC-IT304-T	Artificial Intelligence	3	0	0	3	30	70
5.	PCC-CSEAI209-T / PCC-CSE209-T/ PCC-IT209-T/	Software Engineering	3	0	0	3	30	70
6	PCC-CSEAI210-T	Digital Logic and Computer Design	3	0	0	3	30	70
7.	PCC-CSEAI205-P	Data Processing and Mining Tools Lab. (EXCEL/WEKA/Kaggle/R/Python etc.)	0	0	4	2	50	50
8.	PCC-CSEAI207-P/ PCC-CSE207-P/ PCC-IT207-P	Database Management System Lab.	0	0	2	1	50	50
9.	PCC-CSEAI211-P	Python Programming Lab.	0	0	4	2	50	50
		Total	18		10	23	330	570
*4-6 weeks Industrial Training/internship after completion of IV semester								

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

Chapter 3: Detailed Syllabi

Data Structures and Algorithms

General Course Information

<p>Course Code: PCC-CSEAI201-T/ PCC-CSE201-T/ PCC-IT201-T</p> <p>Course Credits: 3</p> <p>Type: Professional Core</p> <p>Contact Hours: 3hours/week</p> <p>Mode: Lectures (L)</p> <p>Examination Duration: 3 hours</p>	<p>Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70)</p> <p>Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).</p> <p>The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.</p>
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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 (PCC-CSEAI201-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI201-T														

Object Oriented Programming using JAVA

General Course Information

Course Code: PCC-CSEAI202-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) Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.
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Pre-requisites: A student should be aware about basic knowledge of computer and any programming language like C/ C++.

About the Course:

The objectives of this course are to understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc. and to understand concepts of programming such as conditional and iterative execution, methods, abstraction, encapsulation, polymorphism, inheritance along with exception handling. It aims at enabling the students to use the Java SDK environment to create, debug Java based applications.

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

- CO1. **outline** the purpose and usage of the concepts in OOPs. (LOTS: Level 1: Remember)
- CO2. **interpret** the objects, members of a class and the relationships among them which are needed for a specific problem. (LOTS: Level 2: Understand)
- CO3. **apply** OOPs concepts for to given programming problems. (LOTS: Level 3: Apply)
- CO4. **analyse** the working of JAVA programmes to identify errors or any pitfalls. ((HOTS: Level 4: Analyse)
- CO5. **design** applications to solve real life problems using console as-well-as Graphical User Interface. (HOTS: Level 6: Create)

Course Content

Unit I

Overview, Control and Looping Structure: Objective Oriented Technology, Introduction to Java Programming, History of Java, Abstraction, Encapsulation, Polymorphism, Inheritance, Data Types and Operators, Java Run-Time

Environment, Running Java Application, Java Programming Editors, Control Statements- if, if-else, if-else-if ladder, switch-case statement, Looping Statements: for, while and do while.

Unit II

Inheritance, Polymorphism and Multithreading: Visibility controls, class and methods, constructors, Final keyword, Array- Single and Multidimensional, String, Vector, Inheritance and its types, Abstract Class, Interfaces and their implementation, Interface Inheritance, Polymorphism: Overloading and Overriding, Multiple inheritance in Java, Packages, Creating user-defined packages, Multithreading in Java.

Unit III

Exceptions and File Handling: Exception in Java, try, catch, multiple catch and finally block, Handling user-defined errors, Study of various Exception Classes, Input and Output Streams: Streams Concept, Byte Stream Classes – FileInputStream, FileOutputStream, Character Streams Classes – FileReader, FileWriter, String Tokenizer Class, Handling Primitive Data Types.

Unit IV

GUI Programming: AWT and SWING packages and their controls – Creating a Frame, using Labels, using TextFiled, Buttons, ComboBox, CheckBox, Radio Button, JOptionPane, Events and Its Types in Java, Mouse Events, Key Events, Other Events with Frame and Controls, Listeners, Creating Menus and Submenus, Database connectivity.

Text and Reference Books:

1. E. Balagurusamy, *Programming with Java A Primer*, 5th Edition, McGraw Hill Education Pvt. Limited, 2014.
2. Herbert Schildt, *The Complete Reference Java*, 7th Edition, Tata McGraw Hill Education India, 2006.
3. Mughal K. A., Rasmussen R. W., *A Programmer's Guide to Java Certification*, Addison – Wesley, 2008.
4. Paul Deitel and Harvey Deital, *Java – How to Program*, 11th Edition, Pearson Education, 2017.

CO-PO Articulation Matrix: Object Oriented Programming Using JAVA (PCC-CSEAI202-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. outline the purpose and usage of the concepts in OOPs. (LOTS: Level 1: Remember)	1	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2. interpret the objects, members of a class and the relationships among them which are needed for a specific problem. (LOTS: Level 2: Understand)	1	1	-	-	-	-	-	-	-	-	-	-	3	-
CO3. apply OOPs concepts for to given programming problems. (LOTS: Level 3: Apply)	2	1	2	-	-	-	-	-	-	-	-	-	3	-
CO4. analyse the working of JAVA programmes to identify errors or any pitfalls. ((HOTS: Level 4: Analyse)	2	2	2	2	-	-	-	-	-	-	-	-	3	-
CO5. design applications to solve real life problems using console as-well-as Graphical User Interface. (HOTS: Level 6: Create)	3	3	3	2	-	2	-	-	2	-	-	-	3	-
Level of Attainments PCC-CSEAI202-T														

Discrete Mathematics

General Course Information

Course Code: PCC-CSEAI203-T/ PCC-CSE203-T/ PCC-IT203-T	Course Assessment Methods:
Course Credits: 3	Max. Marks: 100 (Internal: 30; External: 70)
Type: Professional Core	Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).
Contact Hours: 3 hours/week	The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.
Mode: Lectures (L)	
Examination Duration: 3 hours	

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, Recursively Defined Functions.

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 (Also, some basic and standard results related to Groups, Rings, ID and Fields).

Unit III

Recursion and Recurrence Relation: Polynomials and their evaluation, Sequences, Introduction to AP, GP and AG Series, Partial Fractions, Recurrence Relation, Linear Recurrence Relations with Constant Coefficients, Linear Homogeneous Recurrence Relations with Constant Coefficients, Particular Solution- Homogeneous Linear Difference Equations, Non-Homogeneous Linear Difference Equations, Total Solution, Generating Functions.

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 (PCC-CSEAI203-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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: PCC-CSEAI203-T														

Data Analytics using R

General Course Information

<p>Course Code: PCC-CSEAI204-T</p> <p>Course Credits: 3</p> <p>Type: Professional Core</p> <p>Contact Hours: 3 hours/week</p> <p>Mode: Lectures (L)</p> <p>Examination Duration: 3 hours</p>	<p>Course Assessment Methods:</p> <p>Max. Marks: 100 (Internal: 30; External: 70)</p> <p>Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).</p> <p>The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.</p>
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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 modelling.

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 modelling. (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 modelling: what is predictive modelling, 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 modelling: 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 using R (PCC-CSEAI204-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI204-T														

Environmental Science

General Course Information

Course Code: MC102-T Course Credits: Non- Credit Type: Mandatory Course Contact Hours: 2 hours/week Mode: Lectures (L) Examination Duration: 3 hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.
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Pre-requisites: None

About the Course and its Outcomes:

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,

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 mega-diversity 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 an 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.

Field Work: Visit to a local area to document environmental assets- river/forest/grassland/hill/mountain; Study of simple ecosystems – ponds, river, hill slopes etc; Study of common plants, insects, birds; Visit to a local polluted site- Urban/Rural/Industrial/Agricultural.

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, 13th edition, 2013.
6. P. D. Sharma, *Ecology and Environment*, Rastogi publications, 13th edition, 2003.

CO-PO Articulation Matrix: Environmental Science (MC102-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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	-	-	-
Level of Attainments MC102-T														

Human Values and Personality Development

General Course Information

<p>Course Code: HSMC201-P Course Credit: Non- Credit Type: Humanities and Social Sciences Contact Hours: 3 hours/week Mode: Group Discussions, Workshops</p>	<p>Course Assessment Methods: Total Marks: 100 (Internal evaluation only)</p> <p>Internal Examinations + Class Performance: 50 Interview/VIVA-VOCE=50</p> <p>It is a non-credit qualifying course only. The assessment will be completely internal divided into two components (50+50).</p> <p>The assessment is based on the level of participation in personality development-based activities, the learning of core human values, timely submission of assignments and the performance in interview/ VIVA-VOCE.</p> <p>There will be a continuous process for personality development and learning of human values. Two internal examinations (each of 50 marks) will be conducted by the course coordinator in the week before or after the internal examinations for the theory courses. The marks for the first component will be calculated as the average of these two internal examinations.</p> <p>The assessment for 50 marks (second component) will be made through Interview/VIVA-VOCE mode by a committee of two faculty members including the course coordinator and a faculty member appointed by the Chairperson of the concern Department.</p>
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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. (LOTS: Level 2: Understand)
- CO2: **stay** in harmony with society and nature. (LOTS: Level 2: Understand)
- CO3: **develop** healthy and harmonious relationships. (LOTS: Level 3: Apply).
- CO4: **work in** groups and develop team spirit. (HOTS: Level 4: analyze)
- CO5: **exhibit** leadership qualities. (HOTS: Level 3: Apply)
- CO6: **excel** in personal and professional life. (HOTS: Level 3: Apply)

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, 1975.
2. Dressler, David and Cans, Donald: The Study of Human Interaction, 1976.
3. Hoover, Judith D. Effective Small Group and Team Communication, Harcourt College Publishers, 2002.
4. Dick, McCann & Margerison, Charles: Team Management, viva books, 1992.
5. Pestonjee, D.M.; Stress and Coping: The Indian Experience, 1998.
6. J Krishnamurti, The way of Intelligence, KFI, 1985.
7. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010.

CO-PO Articulation Matrix: Human Values and Personality Development (HSMC201-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. exhibit awareness about oneself, one’s surroundings and goals in one’s life (LOTS: Level 2: Understand)	-		-	-	-	-	-	2	-	-	-	3	–	–
CO2. stay in harmony with society and nature. (LOTS: Level 2: Understand)	-	-	-	-	-	2	3	2	1	-	-	2	–	–
CO3. develop healthy and harmonious relationships. (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	2	2	2	-	2	–	–
CO4. work in groups and develop team spirit. (HOTS: Level 4: analyze)	-	-	-	-	-	-	-	-	3	2	-	1	–	–
CO5. exhibit leadership qualities. (HOTS: Level 3: Apply)	-	-	-	-	-	-	–	-	3	-		-	–	–
CO6. excel in personal and professional life (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	-	-	2	-	-	–	–
Level of Attainments HSMC201-P														

Data Structures and Algorithms using C Lab.

General Course Information

<p>Course Code: PCC-CSEAI201-P</p> <p>Course Credits: 2</p> <p>Type: Professional Core Lab. Course</p> <p>Contact Hours: 4 hours/week</p> <p>Mode: Lab practice and assignments</p>	<p>Course Assessment Methods :</p> <p>Total Marks: 100 (internal: 50; external:50)</p> <p>The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed.</p> <p>There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations.</p> <p>The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students.</p> <p>For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file.</p> <p>The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.</p>
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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 using C Lab. (PCC-CSEAI201-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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: PCC-CSEAI201-P														

Object Oriented Programming using JAVA Lab.

General Course Information

<p>Course Code: PCC-CSEAI202-P</p> <p>Course Credits: 2</p> <p>Type: Professional Core Lab. Course</p> <p>Contact Hours: 4 hours/week</p> <p>Mode: Lab practice and assignments</p>	<p>Course Assessment Methods : Total Marks: 100 (internal: 50; external:50)</p> <p>The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed.</p> <p>There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations.</p> <p>The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students.</p> <p>For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file.</p> <p>The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.</p>
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Pre-requisites: The course assumes knowledge of Object-Oriented Concepts and programming.

About the Course:

This Java course will provide a strong understanding of basic Java programming elements and data abstraction using problem representation and the object-oriented framework. The objective of the lab course is to inculcate proficiency in students to design and develop market-based software applications.

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

- CO1. **implement** Java programs using object oriented concepts for problem solving. (LOTS: Level 3: Apply)
- CO2. **detect** syntax and logical errors in java programs (HOTS: Level 4: Analyse)
- CO3. **apply** exception handling for making robust JAVA code. (HOTS: Level 3: Apply)
- CO4. **design** java applications using File I/O and GUI. (HOTS: Level 6: Create)
- CO5. **create** lab record of the solutions of assignments that includes problem definitions, solutions and conclusions. (HOTS: Level 6: Create)
- CO6. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments:

1. Use eclipse or NetBeans platform and acquaint with the various menus, create a test project, add a test class and run it to see how you can use auto suggestions and auto fill functionalities. Try code formatter and code refactoring like renaming variables, methods and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
2. Two assignments illustrating class, objects, methods, arrays and various data types in java.
3. Two assignments on the use of control, looping statements and user defined functions.
4. One assignment illustrating the implementation of various forms of inheritance.
5. One assignment on method overloading.
6. One assignment on polymorphism and method overriding.
7. One assignment on implementing exception handling.
8. One assignment to illustrate interfaces in java.
9. One assignment to create package in java.
10. One assignment to design of multithreaded programs in java.
11. One new assignment on event handling.
12. Two assignments related to java applets.
13. One assignment to design a GUI application.
14. One assignment to access and update data from a database using JDBC.

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: Object Oriented Programming using JAVA Lab. (PCC-CSEAI202-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. implement Java programs using object oriented concepts for problem solving. (LOTS: Level 3: Apply)	2	2	2	1	2	-	-	-	-	-	-	-	3	-	-
CO2. detect syntax and logical errors in java programs (HOTS: Level 4: Analyse)	-	-	2	1	2	-	-	-	-	-	-	-	3	-	-
CO3. apply exception handling for making robust JAVA code. (HOTS: Level 3: Apply)	2	2	1	1	-	-	-	-	-	-	-	-	3	-	-
CO4. design java applications using File I/O and GUI. (HOTS: Level 6: Create)	3	3	3	1	3	-	-	-	-	3	-	-	3	-	-
CO5. create lab record of the solutions of assignments that includes problem definitions, solutions and conclusions. (HOTS: Level 6: Create)	-	-	-	-	-	-	-	3	3	-	-	3	-	-	-
CO6. demonstrate ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Level of Attainments PCC-CSEAI202-P															

Data Analytics using R Lab.

General Course Information

<p>Course Code: PCC-CSEAI204-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments</p>	<p>Course Assessment Methods: Total Marks: 100 (internal: 50; external:50)</p> <p>The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed.</p> <p>There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations.</p> <p>The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students.</p> <p>For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file.</p> <p>The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.</p>
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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 assignment 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. (PCC-CSEAI204-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI204-P														

Data Mining Techniques

General Course Information

<p>Course Code: PCC-CSEAI205-T</p> <p>Course Credits: 3</p> <p>Type: Professional Core</p> <p>Contact Hours: 3hours/week</p> <p>Mode: Lectures (L)</p> <p>Examination Duration: 3 hours</p>	<p>Course Assessment Methods:</p> <p>Max. Marks: 100 (Internal: 30; External: 70)</p> <p>Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).</p> <p>The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.</p>
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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 Clustering Using 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 (PCC-CSEAI205-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI205-T														

Operating Systems

General Course Information

<p>Course Code: PCC-CSEAI206-T/ PCC-CSE305-T/ PCC-IT206-T</p> <p>Course Credits: 3</p> <p>Type: Professional Core</p> <p>Contact Hours: 3 hours/week</p> <p>Mode: Lectures (L)</p> <p>Examination Duration: 3 hours</p>	<p>Course Assessment Methods:</p> <p>Max. Marks: 100 (Internal: 30; External: 70)</p> <p>Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).</p> <p>The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.</p>
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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, Realtime 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 Systems (PCC-CSEAI206-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. List various functions and design characteristics of operating systems (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	3	–
CO2. Explain fundamental concepts of operating systems. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	3	–
CO3. Apply operating system design concepts for solving problems regarding scheduling, memory management, disk management and deadlocks etc. (LOTS: Level 3: Apply)	3	1	–	–	2	–	–	–	–	–	–	1	3	–
CO4. Analyze the issues related to various operating systems. (HOTS: Level 4: Analyse)	3	2	3	–	2	–	–	–	–	–	–	1	3	–
CO5. Design solutions for the memory and process management problems. (HOTS: Level 6: Create)	3	2	3	2	2	–	–	–	–	–	–	–	3	–
Level of Attainments PCC-CSEAI206-T														

Database Management System

General Course Information

<p>Course Code: PCC-CSEAI207-T/ PCC- CSE207-T/ PCC-IT207-T</p> <p>Course Credits: 3</p> <p>Type: Professional Core</p> <p>Contact Hours: 3 hours/week</p> <p>Mode: Lectures (L)</p> <p>Exam Duration: 3 hours</p>	<p>Course Assessment Methods:</p> <p>Max. Marks: 100 (Internal: 30; External: 70)</p> <p>Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).</p> <p>The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.</p>
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Prerequisite: Knowledge of UNIX/ Windows, programming language and data structures

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*, 2nd Edition, PHI Learning, 2011.
4. Desai, B. C., *An Introduction to Database System*, Galgotia Publication, 2010.
5. Leon, A., and Leon, M., *Database Management Systems*, 1st 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 (PCC-CSEAI207-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI207-T														

Artificial Intelligence

General Course Information

Course Code: PCC-CSEAI208-T / PCC-CSE402-T/ PCC-IT304-T	Course Assessment Methods:
Course Credits: 3	Max. Marks: 100 (Internal: 30; External: 70)
Type: Professional Core	Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).
Contact Hours: 3 hours/week	The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.
Mode: Lectures (L)	
Examination Duration: 3 hours	

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, State Space Search, production system

Problem Solving Using Search: Blind search techniques - Breadth first search, Depth first search. Heuristic search techniques - Generate and test, Hill Climbing, Best first search, A* Algorithm, AO* Algorithm, The Minimax Search Procedure, Adding 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, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge.

Unit III

Reasoning Under Uncertainty: Introduction to Nonmonotonic 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, Goal Stack Planning, Nonlinear Planning using Constraint Posting, Hierarchical Planning.

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 (PCC-CSEAI208-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI208-T														

Software Engineering

General Course Information

<p>Course Code: PCC-CSEAI209-T / PCC-CSE209-T/ PCC-IT209-T/</p> <p>Course Credits: 3</p> <p>Type: Professional Core</p> <p>Contact Hours: 3 hours/week</p> <p>Mode: Lectures</p> <p>Examination Duration: 3 hours</p>	<p>Course Assessment Methods:</p> <p>Max. Marks: 100 (Internal: 30; External: 70)</p> <p>Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).</p> <p>The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.</p>
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Pre-requisites: Knowledge of algorithms, flow charts and a programming language.

About the Course:

Software Development is generally a quite complex and time-consuming process. Moreover, depending on the nature and complexity of the software requirements, Software Engineering plays an important role. This course will help the students to understand the systematic approach to requirement analysis, design, development, operations and maintenance of software systems. Besides this, it also guides students in developing the optimal software systems.

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

- CO1. **define** the various concepts related to software engineering. (LOTS: Level 1: Remember)
- CO2. **demonstrate** the use of stages of various Software Life Cycle Models. (LOTS: Level 2: Understanding)
- CO3. **apply** the Software Requirement Analysis and Software Design Process. (LOTS: Level 3: Apply)
- CO4. **analyse** the size, cost, complexity, reliability, quality and maintenance of a software system. (HOTS: Level 4: Analyse)
- CO5. **construct** software model according to the requirements of a customer. (HOTS: Level 6: Create)

Course Content

Unit I

Introduction: Software Crisis, Software Process, Evolution of Software Engineering, Software Characteristics, Software Metrics and SDLC. Software Life Cycle Models: Water Fall Model, Increment Process Model, Evolutionary Process Models, Unified Process. Selection of Life Cycle Model.

Software Requirements, Analysis and Specifications: Requirement Engineering, Requirements Elicitation, Requirements Analysis: Data Flow Diagram, Data Dictionary, Entity-Relationship Diagrams, Decision Table, Decision Tree and Structured Charts. Requirements Documentation and Requirements validation.

Unit II

Software Project Management: Size Estimation, Cost Estimation, Constructive Cost Model (COCOMO), Putnam Resource Allocation Model. Software Risk Management: Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, RMMM Plan.

Unit III

Software Design: Software Design Fundamentals, Modularity, Design Principles, Strategy of Design, Function Oriented Design, and Object Oriented Design, IEEE Recommended Practice for Software Design Descriptions.

Software Quality: Basic Concepts, ISO 9126, McCall's Quality Factors, Software Quality Assurance, SQA Activities, Software Review Process, Formal Technical Review, ISO 9000 Quality Standards, and CMM.

Unit IV

Software Testing: Testing fundamentals, Verification and Validation, Test Plan, Test Case, Levels of Software Testing: Unit Testing, Integration Testing, Top Down and Bottom up Testing Integration Testing, Alpha and Beta Testing, System Testing, White Box Testing and Black Box Testing, Debugging and Software Testing Tools.

Maintenance and Reengineering: Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering and The Economics of Reengineering.

Text and Reference Books:

1. K. K. Aggarwal and Yogesh Singh, *Software Engineering*, 3rd Edition, New Age International PublishersLtd., Reprint 2014.
2. Roger S. Pressman, *Software Engineering: A Practitioners Approach* 7th Edition, Mc Graw Hill Education,2014.
3. Rajib Mall, *Fundamental of Software Engineering*, Prentice Hall India, 2004.
4. Pankaj Jalote, *An integrated Approach to Software Engineering*, 3rd Edition, Narosa Publications, 2014.
5. Ian Sommerville, *Software Engineering*, 10th Edition, Addison-Wesley, 2015.
6. Carlo Ghezzi, Mehdi Jazayeri and Dino Mandrioli, *Fundamentals of Software Engineering*, 2nd Edition,Pearson, 2007.
7. Waman S Jawadekar, *Software Engineering-Principles and Practice*, Tata McGraw-Hill, 2004.

CO-PO Articulation Matrix Software Engineering (PCC-CSEAI209-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. Define the various concepts related to software engineering. (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO2. Demonstrate the use of stages of various Software Life Cycle Models. (LOTS: Level 2: Understanding)	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3. Apply the Software Requirement Analysis and Software Design Process. (LOTS: Level 3: Apply)	2	1	1	–	2	–	–	–	–	–	2	–	3	–	–
CO4. Analyse the size, cost, complexity, reliability, quality and maintenance of a software system. (HOTS: Level 4: Analyse)	2	3	2	–	2	–	–	–	–	2	2	–	3	–	–
CO5. Construct software model according to the requirements of a customer. (HOTS: Level 6: Create)	3	3	2	–	3	–	–	–	2	2	3	–	3	–	–
Level of Attainments PCC-CSEAI209-T															

Digital Logic and Computer Design

General Course Information

<p>Course Code: PCC-CSEAI210-T</p> <p>Course Credits: 3</p> <p>Type: Professional Core</p> <p>Contact Hours: 3 hours/week</p> <p>Mode: Lectures (L)</p> <p>Examination Duration: 3 hours</p>	<p>Course Assessment Methods:</p> <p>Max. Marks: 100 (Internal: 30; External: 70)</p> <p>Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).</p> <p>The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.</p>
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Pre-requisites:-Fundamental of Computer Systems.

About the Course:

This course helps to understand the basic concepts, principles and techniques for the design of digital circuits. It illustrates the different stages of execution 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, Number representations and Computer arithmetic (fixed and floating point); Combinational logic blocks: Adders, Subtractors, Multiplexers, Demultiplexers, Encoders,

Decoders; Min term, Max term, POS, SOP, KMap, Simplification by boolean theorems, don't care condition, Sequential logic blocks: Latches and Flip-Flops, Shift Registers, Counters.

Unit II

Flynn's classification of computers (SISD, MISD, SIMD, MIMD); Performance metrics: MIPS, MFLOPS; CPU Architecture types: computer register, (accumulator, register, stack, memory/ register);

Computer Organization: Store program control concept- Von Neumann architecture, Instruction codes, timing and control, instruction cycle; type of instructions: memory reference, register reference, I/O reference; Basics of Logic Design, accumulator logic.

Unit III

Control memory; Micro Programmed Control: address sequencing, micro-instruction formats, micro-program sequencer, Implementation of control unit;

Instruction Set Architecture: Instruction set based classification of processors (RISC, CISC, and their comparison); Stack Organization, Instruction Formats; Addressing modes and types of addressing modes; Operations in the instruction set: Arithmetic and Logical, Data Transfer, Control Flow; Interrupt and Types of interrupts.

Unit IV

Introduction to Parallelism: Goals of parallelism, Amdahl's law; Instruction level parallelism (Pipelining and Pipelining hazards); Processor level parallelism (Multiprocessor systems overview);

Memory Hierarchy & I/O Techniques: The need for a memory hierarchy (Locality of reference principle, Memory hierarchy in practice), Memory parameters: access / cycle time, cost per bit/byte); Main memory, Auxiliary Memory, Associative Memory; 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: Digital Logic and Computer Design (PCC-CSEAI210-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI210-T														

Data Processing and Mining Tools Lab.
(EXCEL/WEKA/Kaggle/R/Python etc.)

General Course Information

<p>Course Code: PCC-CSEAI205-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments</p>	<p>Course Assessment Methods: Total Marks: 100 (internal: 50; external:50)</p> <p>The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed.</p> <p>There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations.</p> <p>The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students.</p> <p>For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file.</p> <p>The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.</p>
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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 assignment on clustering problems
3. Four assignment on data reduction and attribute selection
4. Two assignment 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 Processing and Mining Tools Lab. (EXCEL/WEKA/Kaggle/R/Python etc.). (PCC-CSEAI205-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 PCC-CSEAI205-P														

Database Management System Lab.

General Course Information

<p>Course Code: PCC-CSEAI207-P/ PCC-CSE207-P/ PCC-IT207-P</p> <p>Course Credits: 1</p> <p>Type: Professional Core Lab. Course</p> <p>Contact Hours: 2 hours/week</p> <p>Mode: Lab practice and assignments.</p>	<p>Course Assessment Methods: Total Marks: 100 (internal: 50; external:50)</p> <p>The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed.</p> <p>There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations.</p> <p>The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students.</p> <p>For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file.</p> <p>The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.</p>
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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/DDDL 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 datatypes.
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. (PCC-CSEAI207-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. Implement database problems using Oracle DML/DDDL 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 PCC-CSEAI207-P														

Python Programming Lab.

General Course Information

<p>Course Code: PCC-CSEAI211-P</p> <p>Course Credits: 2</p> <p>Type: Professional Core Lab. Course</p> <p>Contact Hours: 4 hours/week</p> <p>Mode: Lab practice and assignments</p>	<p>Course Assessment Methods: Total Marks: 100 (internal: 50; external:50)</p> <p>The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed.</p> <p>There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations.</p> <p>The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students.</p> <p>For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file.</p> <p>The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.</p>
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Pre-requisites: Basic programming skills

About the Course:

Python is a scripting programming language known for both its simplicity and wide breadth of applications. For this reason it is considered one of the best languages for beginners. Used for everything from web development to scientific computing Python is referred to as a general purpose language by the greater programming community. The major objective of Python language is to make the students solve real word problem efficiently using python library.

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

- CO1. **implement** solutions to the given assignments in Python. (LOTS: Level 3: Apply)
- CO2. **use** various Python packages for solving different programming problems. (LOTS: Level 3: Apply)
- CO3. **devise** solutions for complex problems of data analysis and machine learning. (HOTS: Level 6: Create)
- CO4. **Evaluate** the output of data analysis and machine learning models. (HOTS: Level 5: Evaluate)
- CO5. **create** lab records of the solutions for the given assignments. (HOTS: Level 6: Create)
- CO6. **demonstrate** use of ethical practices, self-learning and team spirit.. (LOTS: Level 3: Apply)

List of experiments/assignments

1. Running instructions in Interactive interpreter and a Python Script.
2. Write a program to purposefully raise Indentation Error and correct it.
3. Three to Four programs on scientific problem solving using decision making and looping.
4. Two to Three programs on simple programming for one dimensional and two-dimensional arrays.
5. Two to Three programs on python Programming to explore string functions.
6. Two to three programs to implement various data structures like Lists, Dictionaries, tuple, dictionaries, Sets, Frozen sets.
7. Three to Four programs to understand the utilization of Functions and modules in Python.
8. Two to three programs for Building a Classical Data Structure using Python Programming.
9. Programs to implement Searching and sorting Operations: Linear & Binary Search, Selection Sort & Merge sort.
10. Two to Three Programs on file handling.
11. Two to Three Programs to Demonstrate Exceptions in Python.
12. Two to three Programs implementing basic concepts of object oriented programming.
13. Programs to illustrate basic concept behind Python Database connectivity, Python regular expressions.
14. Two to three programs on Numpy.
15. Two to three programs on Python Imaging Library.
16. Two to three programs on Pandas
17. Two to three programs on Matplotlib.
18. Two to three programs on Scrapy.
19. Two to three programs on any Library of python.

Reference Books:

1. Allen B. Downey , *Think Python: How to Think Like a Computer Scientist*, Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Shroff , *Learning Python: Powerful Object-Oriented Programming*, Fifth edition, 2013.
3. David M.Baezly, *Python Essential Reference*, Addison-Wesley Professional; Fourth edition, 2009.
4. David M. Baezly , *Python Cookbook*, O'Reilly Media; Third edition (June 1, 2013).
5. <http://www.edx.org>

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: Python Programming Lab. (PCC-CSEAI211-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. Implement solutions to the given assignments in Python. (LOTS: Level 3: Apply)	2	1	–	–	3	–	–	–	–	–	–	–	–	3
CO2. Use various Python packages for solving different programming problems. (LOTS: Level 3: Apply)	2	3	–	3	3	–	–	–	–	–	–	–	–	3
CO3. Devise solutions for complex problems of data analysis and machine learning. (HOTS: Level 6: Create)	3	3	1	3	3	–	–	–	–	–	–	–	–	3
CO4. Evaluate the output of data analysis and machine learning models. (HOTS: Level 5: Evaluate)	3	3		3	3	–	–	–	–	–	–	–	–	3
CO5. Create lab records of the solutions for the given assignments. (HOTS: Level 6: Create)	–	–	–	–	–	–	–	–	–	3	–	–	–	–
CO6. Demonstrate use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	–	–	–	–	–	–	–	3	3	–	–	3	–	–
Level of Attainments PCC-CSEAI211-P														

Industrial Training/Internship

General Course Information

Course Code: INT-CSEAI301 Course Credits: 2 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
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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 (INT-CSEAI301)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
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 INT-CSEAI301														

Chapter 5: Guidelines for Assessment of Theory Courses

5.1 Assessment tools for theory courses

The overall direct and indirect tools of assessment for theory courses are given below.

Assessment Tools for Theory Courses		
Direct Tools		
Sr No.	Description of the tool	COs Covered
1	Minor Examination I	Questions must cover at least first three Levels of COs. (Remember, Understand, Apply)
2	Minor Examination II	Questions must cover at least four Levels of COs including the first three levels (Remember, Understand, Apply).
3	Minor Examination III (Open Book Mode)	Last four levels of COs (Apply, Analyse, Evaluate, Create)
4	Assignment I	Last Three Levels of COs (Analyse, Evaluate, Create)
6	Assignment II	Last Two Levels of COs (Evaluate and Create)
7.	Attendance/Level of Participation in Class	Learning Curve and Communication
	Final Examination	Possibly Covering all levels of COs
Indirect Tools		
1.	End-Semester Survey	Covering all levels of COs
2.	Exit Survey	Covering all POs

5.2 Guidelines for internal evaluation

1. All the teachers are required to set questions sessional/minor exams according to the COs and the level of CO needs to be mentioned against each question.
2. The three minor examinations together must cover all the levels of COs.
3. It is compulsory to give two assignments during the semester pertaining to the last three levels of COs.
4. The sessional/minor examination answer sheet must be evaluated as per the COs.
5. All the teachers are required to maintain the internal evaluation record according the COs
6. All the teachers are required to submit the internal evaluation record along with the computation of attainment levels of COs.
7. The respective proformas for making sessional/ minor question papers, maintaining CO-wise evaluation record of the course and submitting the CO attainment levels are given next in this chapter.
8. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).

Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar-125001

Sample Detailed Direct Tools for Internal Assessment

Minor 1	The sessional exams must contain four questions.				
	Question No.	Question No. 1	Question No. 2	Question No. 3	Question No. 4
	Levels of Bloom's Taxonomy	First level: Remember	Second level: Understand	Third Level: Apply	Any of these levels (3, 4, 5) Apply, Analyse, Evaluate
Marks Distribution	4	4	6	6	
Minor 2	No. of Questions	Question No. 1	Question No. 2	Question No. 3	Question No. 4
	Levels of Bloom's Taxonomy	First level: Remember	Second level: Understand	Third Level: Apply	Any of these levels: (4, 5, 6) Analyse, Evaluate, Create
	Marks Distribution	4	4	6	6
Minor 3	No. of Questions	Question No. 1	Question No. 2	Question No. 3	Question No. 4
	Levels of Bloom's Taxonomy	Third level: Apply	Any one out of fourth and fifth levels: Analyse, Evaluate	Any one out of fifth and sixth levels: Evaluate	Last level: Create
	Marks Distribution	4	4	6	6
Assignment 1	Must be based on the last three levels For purpose of computing CO attainment level only (10 Marks)				
Assignment 2	Must be based on the last two levels For purpose of computing CO attainment level only (10 Marks)				
Industrial Training	Based on the last four levels				
Industrial Training/Mini Project	Based on the last four levels				
Major Project	Based on the last four levels				

Note: The course coordinator may make slight modification in the style of minor examinations as per the requirement the course. The due weightage to higher level COs must be maintained in all respects.

Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar-125001

Record of CO-wise Internal Assessment

Name of the Programme:																	Semester:						
Nomenclature of the Course:																	Course Code:						
Details of Students		Minor I					Minor II					Minor 3				AI (CO5)	AII (CO6)	Overall Attainment					
Roll. No.	Name	Q1 CO1 4	Q2 CO2 4	Q3 CO3 6	Q4 CO4 6	- CO5	Q1 CO1 4	Q2 CO2 4	Q3 CO3 6	Q4 CO4 6	- CO5 6	- CO6	Q1 CO3 4	Q2 CO4 4	Q3 CO5 6	Q4 CO6 6	10	10	CO1	CO2	CO3	CO4	CO5
101	-	3	3	4	4	-	4	3	5		4		3	2	4	3	5	4	7/8 0.85	6/8 0.80	12/16 0.75	6/110 0.73	4/6 0.77
102	-																		-	-	-	-	-
103	-																		-	-	-	-	-
104	-																		-	-	-	-	-
% student getting more than 55 % marks																			0.82	0.78	0.72	0.65	0.60
Attainment Levels																			3	3	3	2	1
Name of the Course Coordinator																	Signature of the Course Coordinator						

Max marks for COs: CO1:8; CO: 8; CO3=16; CO4=10; CO5=22, CO6=16.

Criteria for Computing Attainment Level

Attainment Level - (None): Below 60% of students score more than 55% marks out of the maximum relevant marks.

Attainment Level 1 (low): 60% of students score more than 55% marks out of the maximum relevant marks.

Attainment Level 2 (Medium): 70% of students score more than 55% marks out of the maximum relevant marks.

Attainment Level 3 (high): 80% of students score more than 55% marks out of the maximum relevant.

Sample Overall Attainment Level of COs for Data Structures and Algorithms Course	
List of Course Outcomes	Level of attainment
CO1. list or describe types of data structures and operations that can be implemented on these data structures.	3
CO2. Demonstrate the use of various data structure and their related operations	3
CO3. Apply appropriate data structures with respect to effective storage of data and efficiency of the required operations on data for solving real world problems.	3
CO4. Analyse the time complexity of searching and algorithms.	2
CO5. formulate data structures and prescribe operations for given real world situations.	1

Note: The class coordinators needs to submit the course outcome attainment levels as given in the table above.

Chapter 6: Guidelines Internal and external Assessment of Lab. Courses

6.1 Assessment Tools for Lab. Courses

The assessment tools for evaluating lab. courses are given below. The total lab evaluation marks: 100 (Internal: 50; External 50)

Assessment Tools for Lab. Courses		
Direct Tools		
Sr No.	Description of the tool	COs Covered
1	Assignments	10 to 15 assignments based on the last four levels of COs (Apply, Analyse, Evaluate, Create)
2.	Group Assignment (s)	Last three levels of COs (Analyse, Evaluate, Create)
3.	Minor Laboratory Evaluations (MLE) I and II (Each of 50 marks) (implementing a problem, lab. record, VIVA-VOCE, use of ethical practices, self-learning and group spirit)	Last four levels of COs (Apply, Analyse, Evaluate, Create)
4.	External Examination (50 Marks) (implementing a problem, lab. record, VIVA-VOCE, use of ethical practices)	Last four levels of COs (Apply, Analyse, Evaluate, Create)
Indirect Tools		
1.	End-Semester Survey	Covering all levels of COs
2.	Exit Survey	Covering all POs

6.2. Guidelines for internal and external evaluation of lab. courses:

1. The internal evaluation MEA I and MEA II will be conducted in the week before or after the internal minor examinations for the theory courses by the course coordinator.
2. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable.
3. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations.
4. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations.
5. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations.
6. The internal lab practical examination is to be conducted strictly on the pattern of external practical examination.
7. The evaluation must be conducted to measure the attainment level of COs
8. The proforma for break-up of marks for internal and external lab. course evaluations are given next in this chapter.
9. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.
10. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file.
11. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch.
12. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Chapter 6: Evaluating Training and Project Reports

6.1 Evaluation of Industrial Training/Internship

It is mandatory for all the students to go for industrial training or internship after fourth semester and sixth semester. The students internship work is evaluated as per the criteria given in the evaluation proforma given below.

Department of Computer Science and Engineering Guru Jambheshwar University of Science and Technology, Hisar-125001							
Name of Programme: _____		of		the Credits:			
Semester: _____				Total Marks:		100	
Session: _____							
Evaluation of Industrial Training (INT-CSE301)							
SR. No.	Roll. No.	Significance and originality of the problem addressed and the solution provided CO1+CO2 (20)	Knowledge of the problem domain and the tool used (VIVA-VOCE) CO3 (25)	Judgement of the skill learnt and system developed CO4 (20)	Quality of Report Writing CO5 (20)	Level of ethics followed CO6 (15)	Total 100
1							
2							
3							
.							
.							
Name (s) and Signature of the Internal/External Examiner(s): Date: Name and Signature of the Chairperson				Total Candidates: No. of Candidates Present: No. of Candidates Absent:			

6.2. Guidelines for Preparing Industrial Training (INT-CSE301) Report

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

6.2.1. 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.

6.2.2 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 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
7.	References/Bibliography	IEEE format
8.	Binding	soft binding of good quality

6.2.3. 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.

6.2.4. 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
Guru Jambheshwar University of Science and Technology, Hisar
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
in Computer Science and 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 after 1 line gap with 12 font from “*By*”)



**Department of Computer Science & Engineering
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND
TECHNOLOGY, HISAR**

Month, Year

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

6.2.5. 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

Guru Jambheshwar University of Science and Technology, Hisar

Signature

Supervisor/Mentor

Designation

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar

6.3. Evaluation of mini-project

The proforma for evaluating the mini-project using open source tools is given on the next page.

Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar-125001

Name of the Programme: _____

Credits:

Semester: _____

Total Marks: 100

Session: _____

Evaluation of Industrial Training/Internship Report (INT-CSEAI301)

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

Name of the examiner(s):

Total Candidates:

Signature of the Examiner(s):

No. of Candidates Present:

Date:

No. of Candidates Absent:

Signature of Chairperson

